Act 129 Statewide Evaluator Annual Report

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This SWE Team Program Year 6 Annual Report presents the findings, conclusions, and recommendations of the 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 Technical Reference Manual, Total Resource Cost Test Order, and individual EDC Energy Efficiency and Conservation Plan revision proceedings.

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LIST OF ACRONYMS

AHU: Air handler unit

ARP: Appliance Recycling Program

ASHP: Air-source heat pump

BBNP: Better Buildings Neighborhood Partnership

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

EM&V: Evaluation, Measurement, and Verification

EMS: Energy Management System

EUL: Effective Useful Life

GNI: Government, Non-Profit, Institutional

MW: Megawatt

MWh: Megawatt-hour

MPI: Market Progress Indicators

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

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

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

SACS: Smart A/C Saver Program

SAP/SAR: Smart Appliance Recycling Program

SBR: Smart Builder Rebates Program

SBS: Smart Business Solutions Program

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

LPD: Lighting Power Density

MMMF: Mastered Metered Multi-Family Program

M&V: Measurement and Verification

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

SPEE: Student and Parent Energy-Efficiency Education

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

VG: Verified Gross Impact Savings

Please see Appendix G for Glossary of Terms.

1 EXECUTIVE SUMMARY

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 electric distribution companies (EDCs) subject to Act 129 are:[1] 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 at Docket No. M-2008-2069887. As part of the Implementation Order and Act 129, the Commission sought a Statewide Evaluator (SWE) for Phase II to evaluate the EDCs' EE&C programs. The SWE Team, led by GDS Associates, Inc. (GDS) in partnership with Nexant, Research Into Action, and Apex Analytics, was retained to fulfill requirements of the Phase II Implementation Order of Act 129. The SWE Team was contracted to monitor and verify EDC reported program MWh and MW savings, benefit/cost 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) and developing recommendations for possible revisions and additions to the TRM.

This report is the sixth annual report from the SWE Team to the Commission. This report provides detailed information on the findings of the SWE Team's Program Year Six (PY6) audit activities of the Act 129 EE&C programs implemented by seven EDCs in Pennsylvania. PY6 started June 1, 2014 and ended May 31, 2015. PY6 is the second year of the three-year period covered by Phase II.

The PY6 evaluation conducted by the SWE Team includes:

- 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 M&V of energy savings attributable to its plan, in accordance with the Commission-adopted TRM and custom measure protocols.

[1] EDCs within the Commonwealth of Pennsylvania with more than 100,000 customers are subject to the energy efficiency targets outlined in Act 129.

- An analysis of the cost-effectiveness of each EDC's portfolio of EE&C programs in accordance with the Commission-adopted TRC Test Order.
- Identification of any errors in the EDC calculations of program and portfolio savings or in cost effectiveness calculations.
- A review of a program evaluation best practices workshop, which was conducted by the SWE Team for the TUS staff, EDCs, and EDC evaluation contractors.
- A review of Pennsylvania TRM information and savings values with suggestions for possible revisions and additions during Phase III.
- A review of the TRC test calculation procedures included in the Commission's TRC Orders, with suggestions for revisions and additions.
- A review of any proposed revisions and updates to EDC EE&C plans.
- Recommendations for program, EE&C plan, and evaluation plan improvements.
- Recommendations for future improvements to the Pennsylvania TRM.
- Recommendations relating to changes proposed by some of the EDCs to their EE&C plans.

These evaluation activities address the following topics, which are discussed in detail in this PY6 Annual Report:

- The status of programs
- Discussion of the SWE Team's methodology and approach to developing its findings and recommendations relative to processes and reported values
- Key qualitative findings and recommendations related to programs and measurement and verification (M&V) processes based on observations, site visits with EDCs, and other field work
- 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 EDC, including recommendations for upgrading the TRM during Phase III of Act 129
- A summary of findings and recommendations

1.1 SUMMARY OF FINDINGS AND CONCLUSIONS

Based on the SWE Team audit activities conducted in PY6, 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 Chapters 4–10 of this report.

1) The SWE Team reviewed EDC reported and evaluated savings and generally affirm their validity. The SWE Team does however note a number of small errors in the calculations of reported MWh and MW savings. 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 PY6 verified MWh or MW savings or reported

benefit/cost calculations for an EDC should be corrected in that EDC's final Phase II annual report to the Commission.[2] See Chapters 4–10 of this report for more detailed information about SWE findings and recommendations regarding such errors.

2) The SWE Team found instances where EDCs chose not to use values or algorithms in the applicable Pennsylvania TRM. The 2013 SWE Evaluation Framework states 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 (1) also calculates the savings using TRM protocols and (2) 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 reported savings. The SWE recommends that EDCs be reminded by TUS staff that their final Phase II reports must report savings for both sets of results in the quarterly and/or annual EDC reports.

3) The SWE Team found that most of their respective TRC ratios for PY6 were calculated correctly, but that some EDCs made errors in their calculations of the Total Resource Cost (TRC) test benefit/cost (B/C) ratios. These discrepancies are discussed in Chapters 4–10 of this report. The SWE Team recommends that such TRC discrepancies be corrected in each EDC's final report for Phase II.

4) The SWE Team found that EDC evaluation consultants assumed a net-to-gross (NTG) ratio of 1.0 for most low-income programs as well as for three residential programs that were not low-income and for two non-residential programs. The SWE Evaluation Framework states that EDCs' evaluation contractors should conduct NTG research and consider conducting additional research to assess market conditions and market effects to determine net savings.[3] Looking forward, the SWE recommends that NTG research be conducted for all market segments where an EDC offers Act 129 programs, including the residential low-income sector.[4]

5) The SWE Team finds that the seven Pennsylvania EDCs subject to the Phase II electricity savings requirements of Act 129 are making steady progress toward meeting the Phase II kWh/yr savings targets listed in the Phase II Implementation Order for Act 129. On a statewide basis, the EDCs have achieved 93% of the Phase II MWh/yr savings goal for 2016, based on the numbers verified by the EDCs' evaluators. Since progress towards the Phase II MWh/yr targets is satisfactory, the SWE Team has no recommendation relating to this finding.

6) The overall TRC test B/C ratio, as reported by the EDCs and consolidated across each EDC for PY6, is about 1.6. The net present value (NPV) savings to Pennsylvania ratepayers reported by the EDCs for PY6 is approximately $257 million ($674 million in benefits compared to $417 million in costs). In those instances where calculation errors cause the net present value savings for an EDC's PY6 program portfolio to change by one percent or more, the SWE Team recommends that the EDC cost-effectiveness calculations be revised (in those instances where the SWE has identified errors in the individual EDC sections of this report). If the errors cause EDC portfolio PY6 net present value savings to change by less than one percent, the errors can be fixed in the EDC's final report for Phase II.

[2] In February 2015 the PUC's Technical Utility Services 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."

[3] See July 2015 Pennsylvania Statewide Evaluator "Evaluation Framework for Pennsylvania Act 129 Phase II Energy Efficiency and Conservation Programs", Net Impact Evaluation section, page 66.

[4] Research conducted by the SWE Team members in other jurisdictions indicates that the net-to-gross ratio for low income programs is often significantly different than 1.0. The SWE recommends that net-to-gross 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 the future planning and program design for Act 129 low income programs.

Examples of EDC errors identified by the SWE that affect cost effectiveness calculations include errors in calculations of PY6 electricity savings and other minor errors the SWE Team found in TRC calculations (such as using incorrect avoided costs of electricity).

7) There still is evidence of high free-ridership for several EDC programs. 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 government, nonprofit, and institutional segments. When high free-ridership exists, the SWE Team recommends that EDCs should continue to examine program design, requirements and practices to determine whether free-ridership can be reduced during the remainder of Phase II as well as in program designs for Phase III. All EDCs should consider actions to reduce free-ridership in Phase III. In the nonresidential sector, EDCs that allow customers to submit rebate applications after equipment purchase should consider implementing a 90-day rebate eligibility clause for such purchases, if such a clause has not already been implemented.[5] There are other ways to reduce free-ridership, and the SWE Team recommends that the EDCs determine which methods suit their programs.

8) The EDC process evaluations identified that retailers and contractors are an important source of program information. 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 to increase program participation.

9) Process evaluations of home audit programs tended 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 results 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 to develop findings, best practices and recommendations on program strategies that lead to the highest conversion rates for audit participants to program participants.

10) EDC database tracking systems should be sure 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 PY6 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 Chapters 4–10 of this report.

11) The SWE Team found that 9.3% of the verified savings in the non-residential sector in PY6 came from residential upstream lighting programs. This finding 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

[5] The SWE has made this recommendation to the EDCs during Program Evaluation Group 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 this data is 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 to participants who applied more quickly for a rebate. The SWE recommends that this research recommendation be discussed with Program Working Group participants at a future meeting during 2016. 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.

savings associated with these upstream bulb programs. For Duquesne, the amount verified in this category was actually 0%. For PECO and PPL, the percentages verified were 16% and 12% respectively, with those for the FirstEnergy Companies ranging from 2.1% for Penn Power to 6.7% for Met-Ed. 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.

12) 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 greater detail about methods and findings to support their conclusions. The SWE Team recommends that the SWE discuss these process evaluation issues with each EDC in March 2016 (after this report is filed with the Pennsylvania PUC).

13) The SWE process evaluation audit activities for the PY6 programs found that the evaluation contractors made 181 Phase II process evaluation recommendations to the EDCs. Of this total, 66 were implemented by the EDCs, 110 were still being considered for implementation, and five were rejected by the EDCs. This amounts to a 36% acceptance rate and a 3% rejection rate, which are both comparable to the PY5 rates (32% and 2%, respectively). The SWE Team concludes that the evaluation contractors are providing valuable and actionable recommendations. The fact that 61% of the recommendations were still being considered by the EDCs at the time their PY6 annual reports were submitted to the Pennsylvania PUC is not surprising, given the relatively 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 Team plans to continue to monitor the status of the evaluation contractor recommendations in PY7. Chapter 3 of this report (Table 3-13) summarizes the status of the 181 process evaluation recommendations by EDC and program. The SWE Team recommends that the EDCs establish the priority for the process evaluation recommendations so that the most important recommendations are resolved quickly.

14) For PY6, 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 in-service rate (ISR) for residential lighting measures provided in the TRM applicable for PY6, unless the EDC has conducted research in its service area to document the actual ISR achieved during PY6.

15) The SWE Team completed 69 ride-along site inspection reports (RASIRs) of randomly selected PY6 commercial and industrial (C/I) energy efficiency measure installations. Through these rigorous ride-along site inspections, the SWE Team found that it was very common to have deviations from the non-residential customers' initial project applications relating to the quantity, type, or operational characteristics of energy efficiency measure installations. Specifically, the SWE Team found significant deviations in 24 of the 69 (35%) ride-along site inspections conducted for PY6.[6] While there is an expected and allowable amount of discrepancy based on what is received from the customer, the SWE Team recommends that the EDC evaluation contractors perform additional pre-trip communication and inspection preparation with either the CSP or the program participant, as appropriate, to determine if the participant's initial project application has changed. Any changes discovered through this process should be communicated and presented to the SWE personnel in advance of their ride-along site inspection whenever possible. In addition, the SWE Team recommends that each EDC take additional steps with program participants in order to reduce such deviations in future program years.

[6] The implication of this finding is that it was common for the reported quantity and type of measures installed to deviate significantly from the equipment that was actually installed. While the measure data was corrected where on-site inspections were performed, the SWE Team notes that it is likely that similar discrepancies exist for projects that were not inspected. The SWE Team finds however that the calculation of a realization rate for such programs based on a robust random sample and then applied to the program population adequately addresses this issue.

16) 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 evaluators should investigate whether customers who had audits in a given program are more likely than customers who did not receive an energy 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.

17) The PPL process evaluation of the Company's residential lighting program found that CFL disposal behavior remains relatively unchanged from prior years, with over half of customers disposing of CFLs in the trash, in spite of more recycling bins in diverse locations. The SWE recommends that the EDCs work together during PY7 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.

18) The PECO LEEP evaluation found that 75% of homes visited during ride-along surveys had unfinished basements with no floor insulation, and up to 25% had windows that did not shut properly or were broken. The SWE recommends that PECO examine these issues and determine if any program modifications are appropriate for the Company's residential low income energy efficiency program.

19) The SWE Team found several 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.

20) The SWE Team found the discussion regarding shifts in cross-sector residential lighting and low-income sales from PY5 to PY6 to be lacking some key technical information for some of the EDCs. 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 bias between the two samples from different years to ensure that the differences in PY5 and PY6 parameters were entirely driven by changes to program rather than changes in methods and samples. Given the upstream residential lighting programs' significant contribution to each EDC's portfolio savings, the SWE Team recommends that the EDC evaluators include additional details regarding the research methods in future annual reports as well as a discussion related to differences in parameter estimates.

21) The SWE recommends that more thorough auditing of program applications for commercial and industrial measures be conducted by EDCs to ensure clarity of the project files for the subsequent SWE review.

22) 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, however, has several recommendations relating to the methodology used by EDCs to determine program net to gross ratios. Where applicable, the SWE Team recommends that EDC evaluator reports 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 results that would be achieved if the common method were utilized.

23) The EDC PY5 and PY6 reports show different participation rates across EDCs for similar types of programs. The SWE plans to examine this issue more thoroughly for the Phase II final report 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 SWE plans to use the results of this analysis for two purposes: (1) to determine if the SWE needs to clarify how program participation levels and participation rates should be calculated and reported to the PUC and (2) to develop recommendations, as appropriate, on 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. The SWE Team has a contractual responsibility to the Pennsylvania PUC to examine, consider and recommend such program efficiency and effectiveness improvements where appropriate.[7]

As of May 31, 2015 (the end of PY6), the seven EDCs collectively had saved 2,055,656 MWh/yr (i.e., on a cumulative annual basis) and 401 MW during Phase II.[8] The SWE Team and the EDCs expect that the cumulative annual savings will continue to grow as additional programs are implemented, existing programs mature, and evaluation findings and best practices are incorporated into program delivery. Table 1-1 provides a status update on each EDC's progress toward reaching its Phase II savings targets as of the end of PY6. These savings are attributable to 82 EE&C programs implemented by the seven EDCs. Three of the EDCs (Duquesne, Penn Power, and PPL) have already achieved their energy savings targets for Phase II. Table 1-1 also provides the EDCs' progress toward their Phase II low-income and government/nonprofit/institutional (GNI) carve-out goals. Six of the EDCs have achieved their low-income carve-out goals, and PPL is approaching its goal, having achieved 82% of its target. Four EDCs (Penn Power, West Penn, PECO, and PPL) have achieved their GNI carve-out goals.

Table 1-1: Summary of Progress Toward Achieving the Phase II Energy Savings Compliance Goal as of the End of PY6

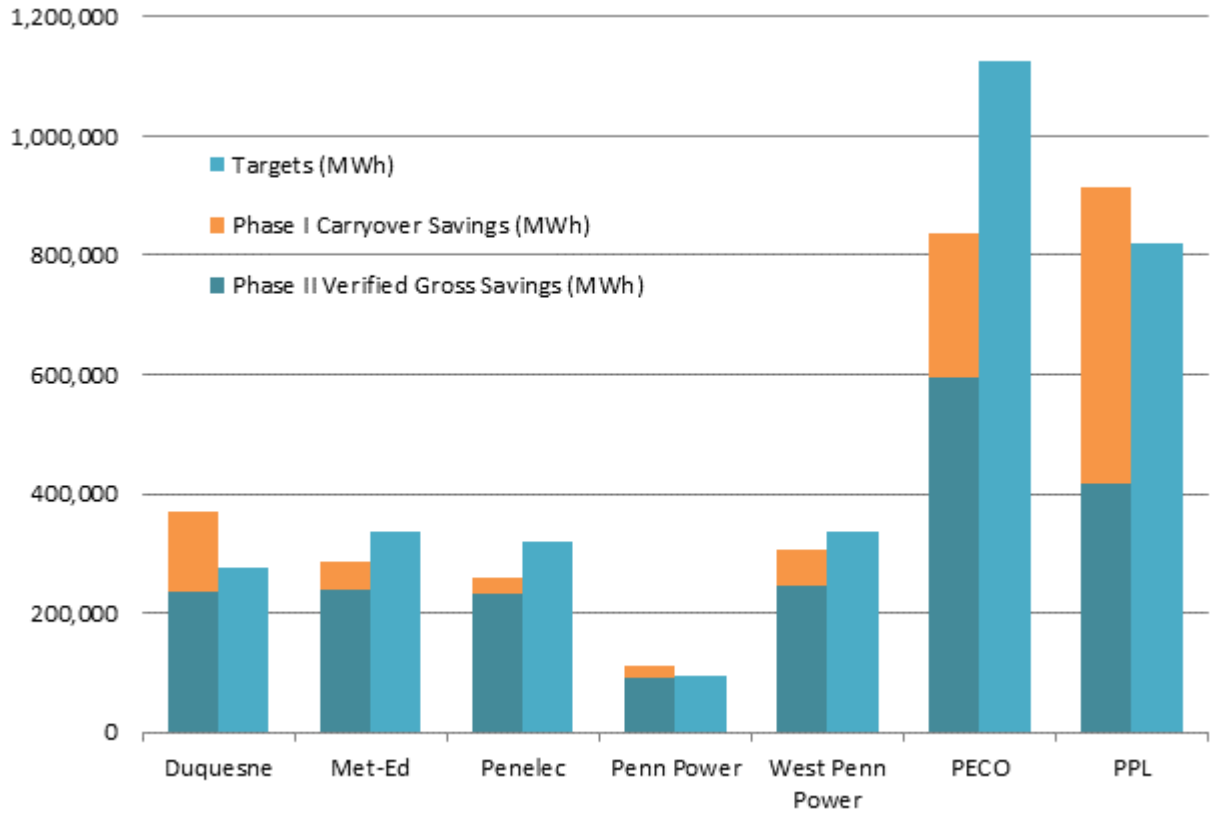
% of Target Achieved	Statewide	Duquesne	FE: Met-Ed	FE: Penelec	FE: Penn Power	FE: West Penn	PECO	PPL
% of Phase II Energy Savings Target[a]	**93%**	133%	85%	82%	119%	91%	74%	111%
% of Phase II Low-Income Carve-Out Goal	**130%**	123%	185%	222%	241%	161%	106%	82%
% of Phase II GNI Carve-Out Goal	**144%**	82%	49%	88%	103%	235%	160%	170%

NOTES
[a] Percentage of compliance target achieved was calculated using verified Phase II verified gross savings plus Phase I verified carryover savings values divided by compliance target value.

Figure 1-1 shows a comparison of Phase II cumulative annual savings and the cumulative annual savings target to be achieved by the end of PY7. The figure shows Phase II savings achieved during PY5 and PY6 plus carryover savings from Phase I.

[7] See page 26 of the 2013 SWE Team Phase II contract with the Pennsylvania PUC, page 26, first sentence.
[8] Savings represent verified gross energy and demand savings achieved.

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



During PY6, the SWE Team finalized energy efficiency and demand response potential studies. These studies are described in more detail in Section 3.8 of this report.

2 PROGRAM YEAR 6 ANNUAL REPORT SUMMARY

This chapter summarizes the EDC program impacts achieved during PY6. It presents the aggregated EDC portfolio dollar savings, the energy savings and demand reductions achieved by each EDC, and a comparison of actual PY6 EDC expenditures to the budgets in the approved EE&C plans. It also discusses the implications of laws and regulations on Act 129 programs.

2.1 SUMMARY OF AGGREGATED EDC PORTFOLIO SAVINGS

Table 2-1 presents the seven EDCs' aggregated Phase II reported gross MWh/yr and MW impacts and Phase II verified gross MWh/yr and MW impacts. The cumulative annual verified gross energy savings through PY6 exceed two million MWh per year and 400 MW per year. These savings have resulted in nearly $1.2billion in benefits to Pennsylvania customers, with a B/C ratio of more than 1.6 to 1. The table also includes estimates of the cumulative annual reduction of CO_2 emissions through the end of the fourth quarter for PY6 based on Phase II reported and verified energy savings.

Table 2-1: Summary of Seven EDC Aggregated Phase II Impacts through the End of PY6

Impact	Phase II Reported Gross Impact[f]	Phase II Verified Gross Impact[h]
Total Energy Savings (MWh/yr)	1,940,682	2,055,621
Total Demand Reduction (MW)	369.2	401.3
TRC Benefits ($1,000)[a]	N/A[g]	$1,188,629
TRC Costs ($1,000)[b]	N/A[g]	$723,669
TRC B/C Ratio[c]	N/A[g]	1.64
CO_2 Emissions Reduction (Tons)[d][e]	1,656,372	1,754,473

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 1,707 lb CO_2 per MWh according to the latest available (2014) PJM Emission Report of marginal off-peak annual CO_2 emission rate based on direction provided by Commission staff.
[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 Gross Impact is the cumulative program/portfolio Phase II inception-to-date verified gross savings.

Table 2-2 presents the statewide reported and verified gross annual savings achieved by the EDCs in PY6 and across the first two years of Phase II. The verified net annual savings and verified net lifetime savings of these are also provided for PY6 and Phase II. The overall NTG ratio in Phase II across all EDCs is 72%, and the programs have yielded more than 13 million MWh of verified net lifetime savings in Phase II.

Table 2-2: Summary of Statewide PY6 and Phase II Impacts – Gross and Net Annual Savings and Lifetime Savings

Element	Statewide Total
Phase II Reported Gross Savings (MWh/yr)	1,940,682
Phase II Verified Gross Savings (MWh/yr)	2,055,656
Phase II Net Savings (MWh/yr)	1,472,671
Phase II Gross Lifetime Savings (MWh)	17,513,692
Phase II Net Lifetime Savings (MWh)	13,302,207
PY6 Reported Gross Savings (MWh/yr)	1,053,515
PY6 Verified Gross Savings (MWh/yr)	1,111,782
PY6 Net Savings (MWh/yr)	777,083
PY6 Net Lifetime Savings (MWh)	7,161,616

2.2 SUMMARY OF ENERGY REDUCTIONS BY EDC

This section highlights the progress of the seven EDCs toward meeting their May 31, 2016 compliance targets. Table 2-3 and Figure 2-1 provide Phase II savings achieved during PY6, as well as carryover savings obtained during Phase I. The data in Table 2-3 show that, as a group, the seven Pennsylvania EDCs have achieved 93% of the May 2016 Phase II compliance target for MWh/yr savings.

Table 2-3 summarizes the verified energy reductions in Phase II for each EDC. EDC annual MWh/yr savings carried over from Phase I range from 22,580 MWh/yr (Penn Power) to 495,636 MWh/yr (PPL). The total verified energy savings in Phase II are the sum of the verified gross (VG) savings achieved in Phase II plus the carryover (CO) savings achieved by each EDC in Phase I. The EDCs have achieved between 74% and 133% of their May 31, 2016 MWh/yr compliance targets.

The cumulative portfolio annual energy savings (including Phase I carryover) for Phase II is 3,084,303 MWh/yr through PY6. This value includes 2,055,656 MWh/yr of savings attained in Phase II plus 1,028,647 MWh/yr of verified Phase I carryover savings that applies toward Phase II compliance. The Phase II programs have also achieved 401 MW of verified gross demand savings through PY6 (there is no compliance target for demand savings in Phase II).

Table 2-3: Summary of Phase II Verified Energy Reductions by EDC

EDC	Phase II VG Savings (MWh/yr)	Phase I CO Savings (MWh/yr)	Phase II VG + Phase I CO (MWh/yr)	% of Goal ([Phase II VG + Phase I CO] / Target)	May 31, 2016 Compliance Target (MWh/yr)
Duquesne	235,061	133,717	368,778	133%	276,722
FE: Met-Ed	239,896	47,187	287,083	85%	337,753
FE: Penelec	233,186	26,805	259,991	82%	318,813
FE: Penn Power	90,633	22,580	113,213	119%	95,502
FE: West Penn	245,859	59,929	305,788	91%	337,533
PECO	593,953	242,793	836,746	74%	1,125,851
PPL	417,068	495,636	912,704	111%	821,072
Total	**2,055,656**	**1,028,647**	**3,084,303**	**93%**	**3,313,246**

Figure 2-1: Phase II Verified Gross Energy Impacts Statewide

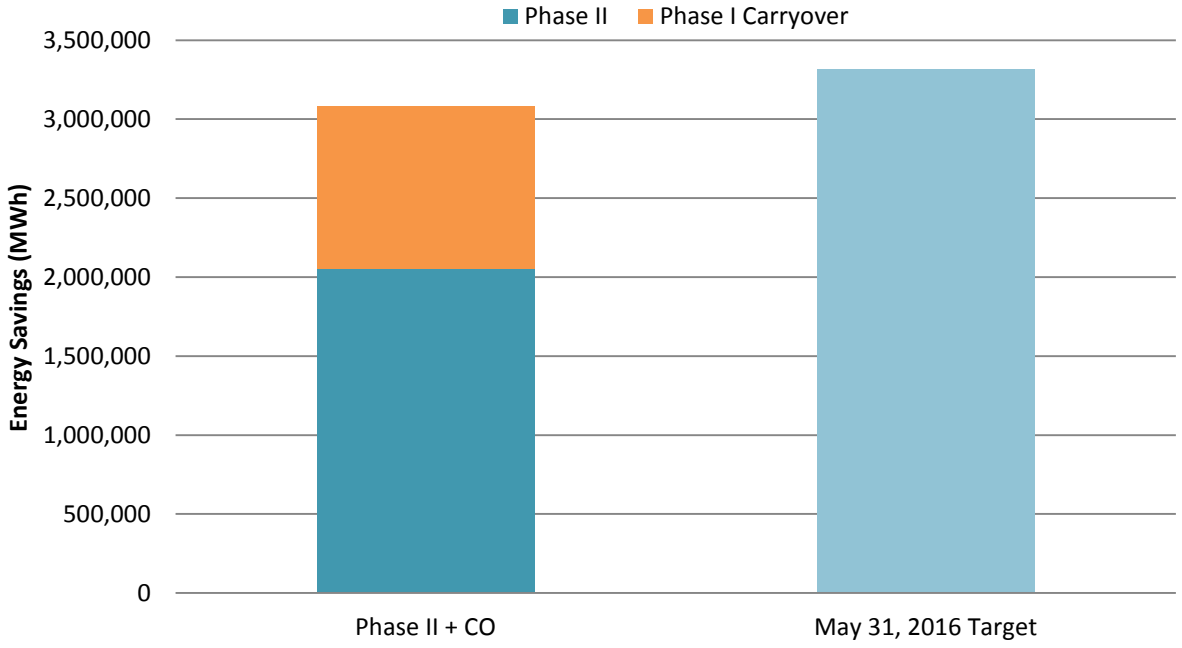


Table 2-4 presents the reported and verified gross annual savings achieved by each EDC in PY6 and across the first two years of Phase II. The verified net annual savings and verified net lifetime savings for each EDC are also provided for PY6 and Phase II. Details regarding the performance of each EDC are provided in Chapters 4–10.

Table 2-4: Summary of EDC PY6 and Phase II Impacts – Gross and Net Annual Savings and Lifetime Savings

EDC	Phase II Reported Gross Savings (MWh/yr)	Phase II Verified Gross Savings (MWh/yr)	Phase II Net Savings (MWh/yr)	Phase II Net Lifetime Savings (MWh)	PY6 Reported Gross Savings (MWh/yr)	PY6 Verified Gross Savings (MWh/yr)	PY6 Net Savings (MWh/yr)	PY6 Net Lifetime Savings (MWh)
Duquesne	240,030	235,061	198,477	1,441,600	110,216	106,553	69,969	771,295
FE: Met-Ed	240,929	239,896	160,801	1,280,194	133,164	133,730	93,352	596,440
FE: Penelec	238,075	233,186	159,523	1,348,599	135,214	133,973	97,249	752,710
FE: Penn Power	84,826	90,633	59,711	545,193	52,863	57,514	39,534	358,483
FE: West Penn	242,824	245,859	161,420	1,378,949	151,716	155,026	107,799	819,848
PECO	494,558	593,953	419,175	3,943,851	280,499	307,626	214,208	2,083,050
PPL	399,440	417,068	313,564	3,363,821	189,843	217,360	154,972	1,779,970
Total	**1,940,682**	**2,055,656**	**1,472,671**	**13,302,207**	**1,053,515**	**1,111,782**	**777,083**	**7,161,616**

In addition to making progress toward Phase II targets in PY6, the EDCs also performed well with respect to their low-income measure requirements and their low-income and GNI carve-out goals.[9] The number of measures offered to the low-income sector varies between 14% and 16% for each EDC except PPL. PPL reported that 54% of measures were offered to the low-income sector. All seven EDCs were in compliance with their respective low-income measure requirements. Table 2-5 summarizes each EDC's progress toward carve-out goals for Phase II. Six of the EDCs have achieved their low-income (LI) carve-out goals, and PPL is approaching its goal, having achieved 82% of its target. Four EDCs (Penn Power, West Penn, PECO, and PPL) have achieved their GNI carve-out goals.

Table 2-5: EDC Progress Toward Phase II Low-Income and GNI Carve-out Goals

Low-Income			
EDC	Verified MWh/yr Savings (LI)	MWh/yr Target	Progress Toward Target
Duquesne	15,358	12,452	123%
FE: Met-Ed	28,058	15,199	185%
FE: Penelec	31,836	14,347	222%
FE: Penn Power	10,366	4,298	241%
FE: West Penn	24,446	15,189	161%
PECO	53,564	50,663	106%
PPL	30,479	36,948	82%
GNI			
EDC	Verified MWh/yr Savings (GNI)	MWh/yr Target	Progress Toward Target
Duquesne	22,690	27,672	82%
FE: Met-Ed	16,570	33,775	49%
FE: Penelec	28,112	31,881	88%
FE: Penn Power	9,827	9,550	103%
FE: West Penn	79,230	33,753	235%
PECO	180,545	112,585	160%
PPL	139,496	82,107	170%

2.3 COMPARISON OF PY6 EXPENDITURES TO APPROVED EE&C PLAN BUDGET ESTIMATES

The EDCs provided information pertaining to their spending on a portfolio and by-program basis. Table 2-6 summarizes the seven EDCs' spending on incentives and program overhead costs in PY6. The table also shows that the EDCs' portfolios collectively generated nearly $700 million in NPV benefits in PY6. This compares with total TRC costs of approximately $420 million. The total EDC incentives were about $80 million, and net participant costs accounted for nearly $200 million. The total EDC program overhead costs were nearly $140 million. The total TRC B/C ratio of all EDC programs was more than 1.6, which means that as a group, the EDCs continued to operate their programs in a very cost-effective manner in PY6.

[9] Carve-out goals for the low-income and GNI sectors are set forth in the Phase II Implementation Order.

Table 2-6: Summary of Statewide Portfolio Finances for PY6

Element	PY 6 ($000)
Incremental Measure Costs	$277,645
EDC Incentives to Participants	$80,038
EDC Incentives to Trade Allies	$246
Participant Costs (net of incentives/rebates paid by utilities)[a]	$197,361
Program Overhead Costs	$139,261
Design and Development	$244
Administration, Management, and Technical Assistance[b]	$103,160
Marketing[c]	$20,545
EDC Evaluation Costs	$12,887
SWE Audit Costs	$2,425
Total TRC Costs[d]	$416,906
Total NPV Lifetime Energy Benefits	$587,077
Total NPV Lifetime Capacity Benefits	$62,963
Total NPV Benefits[e]	$674,003
TRC B/C Ratio[f]	1.62

NOTES
[a] Per the 2013 TRC Test Order – Net participant costs; in Pennsylvania, the costs of the end-use customer.
[b] Includes the administrative conservation service provider (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.
[e] Total TRC benefits equal the sum of total lifetime energy benefits and total lifetime capacity benefits, plus operations and maintenance savings from avoided bulb purchases (not shown in table). Based on 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 2-7 compares the PY6 actual energy efficiency program expenditures by EDC to the approved budget in each EDC's Phase II EE&C Plan. The PY6 overall energy efficiency program budget for all seven EDCs was $239 million, whereas actual spending was $216.8 million. Thus, actual spending in PY6 on a statewide basis was 9% lower than the approved budget. Actual spending in PY6 was lower than the EE&C Plan PY6 budget for five EDCs. Only Duquesne and PPL spending exceeded the planned budget for PY6.

Table 2-7: Comparison of EDC PY6 Total Expenditures in Each EDC's EE&C Plan

EDC	Actual PY6 Expenditures ($)	Estimate in EE&C Plan for PY6 ($)	Difference between Actual and Estimate ($)	% Difference
Duquesne	$21,403,000	$19,497,797	$1,905,203	9.8%
FE: Met-Ed	$16,906,000	$24,545,042	-$7,639,042	-31.1%
FE: Penelec	$16,720,000	$22,621,761	-$5,901,761	-26.1%
FE: Penn Power	$5,395,000	$6,597,259	-$1,202,259	-18.2%

EDC	Actual PY6 Expenditures ($)	Estimate in EE&C Plan for PY6 ($)	Difference between Actual and Estimate ($)	% Difference
FE: West Penn	$16,814,000	$23,477,398	-$6,663,398	-28.4%
PECO	$80,825,000	$85,203,613	-$4,378,613	-5.1%
PPL	$58,754,000	$57,198,896	$1,555,104	2.7%
Total	**$216,817,000**	**$239,141,766**	**-$22,324,766**	**-9.3%**

Table 2-8 compares the forecasted PY6 acquisition cost and the actual acquisition cost (per first year kWh saved) for each EDC and for all EDCs combined (statewide).

Table 2-8: Forecasted Acquisition Costs versus Actual Acquisition Costs in PY6

EDC	PY6 Verified MWh/yr Savings (not including CO)	Forecasted PY6 Acquisition Cost per First Year kWh Saved	Actual PY6 Acquisition Cost per First Year kWh Saved	Actual Acquisition Cost: % Difference from Budget
Duquesne	106,553	$0.183	$0.201	9.8%
FE: Met-Ed	133,730	$0.184	$0.126	-31.1%
FE: Penelec	133,973	$0.169	$0.125	-26.1%
FE: Penn Power	57,514	$0.115	$0.094	-18.2%
FE: West Penn	155,026	$0.151	$0.108	-28.4%
PECO	307,626	$0.277	$0.263	-5.1%
PPL	217,360	$0.263	$0.270	2.7%
Total	**1,111,782**	**$0.215**	**$0.195**	**-9.3%**

A key finding of this annual report relates to the level of the actual PY6 acquisition cost per first year kWh saved. Overall, the seven EDCs saved 1,111,782 MWh/yr during PY6 and spent a total of $216,817,000. This yields an acquisition cost per first year kWh saved of $0.195 per kWh, 9.3% less than the forecasted acquisition cost for PY6 of $0.215 per first year kWh saved.

2.4 IMPLICATIONS OF LAWS AND REGULATIONS

During PY6, certain federal standards and ENERGY STAR® certification standards went into effect that will have a significant impact on future savings associated with both residential and non-residential equipment programs. Some of the changes included increasing the base efficiencies of air source heat pumps to 14 SEER (Seasonal Energy Efficiency Ratio)/8.2 HSPF (Heating Seasonal Performance Factor), and raising the efficiency factor (EF) of residential electric storage water heaters.[10] Smaller efficiency advancements in consumer product performance for items such as refrigerators and clothes washers were introduced and approved on a national level. These updates were incorporated into the 2015 TRM along with improved guidance for savings algorithms to allow for the policy transition in future program years. The implications of the Federal Energy Independence and Security Act (EISA) standard ruling have been discussed in prior Act 129 reports, and the implication of the Clean Power Plan is intentionally not discussed here.

[10] The amended energy conservation standards for residential electric storage water heaters with rated storage capacities between 20 and 120 gallons as of April 16, 2015 are as follows, depending on the storage capacity of the tank: for tanks with a rated storage volume at or below 55 gallons: EF = 0.960-(0.0003 × rated storage volume in gallons); for tanks with a rated storage volume above 55 gallons: EF = 2.057-(0.00113 × rated storage volume in gallons).

3 STATEWIDE EVALUATOR AUDIT ACTIVITIES

The SWE Team audit activities consist of various efforts that contribute to the review of EDC program implementation and evaluation activities. During PY6, the SWE Team held teleconferences as needed with each EDC to discuss current and planned M&V activities, schedule upcoming site visits to commercial and industrial facilities, and address any questions or unresolved issues that arose throughout the evaluation process. During PY6, SWE Team members traveled to each EDC and to specific project sites to conduct on-site audits of the various programs implemented in PY6. In addition to site visits, the SWE Team continued to conduct desktop audits for various programs. The main purposes of these desktop audits are to verify that data was entered correctly into the program's tracking database and to ensure that savings calculations were performed correctly. The SWE Team also implemented a procedure to review and comment on all EDC process evaluation survey instruments before these surveys were implemented in PY6 to ensure that researchable issues were defined clearly and that question wording and ordering would not bias responses by survey participants. This chapter summarizes SWE Team activities conducted in PY6 as well as ongoing SWE Team audit activities and includes an overview of Program Evaluation Group (PEG) and EDC meetings; updates of various SWE Team efforts, including work on the TRM; market research studies; and overviews of several evaluation and measurement issues.

3.1 AUDIT ACTIVITIES

This section summarizes SWE Team audit activities by program type. The programs are categorized as residential, low-income, and non-residential. The results of the SWE Team audits of each EDC's programs are provided in Chapters 4–10 of the report.

3.1.1 Residential Programs

SWE Team audit activities of residential programs encompass four types of programs: lighting, appliance recycling, energy efficient products, and home performance. Activities specific to each program type are discussed below.

3.1.1.1 Lighting Programs

To audit the residential lighting programs, the SWE Team took one of two approaches, dependent on the evaluation activities performed by the evaluation contractors. If the EDC's evaluation contractor performed an audit and true-up, the SWE Team requested and reviewed the results of the audit and performed an audit based on a sample of ten bulb types (steps 1–6 detailed below). This audit checked to ensure that energy and demand savings calculations were performed correctly for each bulb type. If there was no EDC evaluator audit and true-up, the SWE Team audited the entire lighting program tracking database (steps 2–6 described below).

Step 1: Review EDC Audit. In order to avoid duplicative efforts, the SWE Team leveraged EDC-based audits if and when they were administered. The SWE Team assessed EDC evaluation contractor audit results performed for the same period under review. The SWE Team reviewed all evaluation findings and recommendations included in EDC evaluation contractor reports. The SWE Team's review of EDC evaluation contractor findings helped the SWE Team target key areas for SWE audit activities.

Step 2: Verify Number of Bulbs. The SWE Team compared the number of bulbs reported in the EDC's PY6 annual report to the number of bulbs tracked in the EDC's database and tracking system.

Step 3: Verify Savings Protocols. The SWE Team verified that the EDCs were using the correct engineering algorithms and default values as stipulated in the 2014 Pennsylvania TRM. The method used by the SWE Team to verify the protocols typically involved two approaches, which depend on the structure of the EDC's database and tracking system.

***Step 3A: Review of Formula*.** Some EDCs provide an Excel file with formulas. In this case, the SWE Team verified that the formula matched the engineering algorithm in the 2014 Pennsylvania TRM.[11] This is the preferred format for data review.

***Step 3B: Review of Variance*.** Some EDCs provide an Excel file in which the numbers are hard-coded, so the formulas used to estimate energy savings are not transparent. In these instances, it was necessary to recalculate the energy savings, using the baseline and compact fluorescent lightbulb (CFL)/light-emitting diode (LED) wattages provided by the EDCs, and compare the SWE Team's computed savings to the EDC-reported savings on a measure-by-measure basis.

The SWE Team reviewed the individual measure savings and noted measure types for which the savings computed by the SWE Team and those reported by the EDC were not identical. For measure types with variance, the SWE Team recommended that the EDC use the correct formula for that particular measure type going forward. Once the individual measure savings were computed, the SWE Team compared the total SWE-computed savings with the total EDC-computed savings to determine the variance. The SWE Team reported any variance; if it was significant, the SWE Team explained why the variance occurred.

Step 4: Verify Baseline Assumptions. The baseline assumption review verified that the correlation of incandescent to CFL/LED wattages fell within the ranges specified in the 2014 TRM for EISA-compliant bulb types. In instances where the lumen ranges did not fall within the baseline equivalencies, or the bulb was considered exempt from EISA (e.g., 3-way lamps), the SWE Team reviewed the bulb and the manufacturing specifications. In most instances, bulbs that fell outside the guidelines were specialty bulbs and the wattages provided by the EDCs corresponded to the equivalencies listed in the manufacturing specifications. The SWE Team also verified that EDCs used the correct bulb ISR value and average daily bulb hours of use (HOU) value from the 2014 TRM, and reported any instances when an EDC used incorrect values.

Step 5: Invoice Verification. The EDCs typically provide all invoices received for bulbs distributed through their upstream programs in the current reporting quarter. Each invoice typically contains multiple "sub-invoices" for the various retail outlets. The SWE Team selected five sub-invoices to review and verify that the EDC's database and tracking system accurately tracked bulb counts.

For some EDCs, the invoices, sub-invoices, bulb types, and other information were labeled clearly; the SWE Team used filters to quickly verify the bulb counts. However, other EDCs' databases were not as thorough. In these cases, it was easier to verify that the total reimbursements tracked matched the reimbursements invoiced. Either method verifies that the bulb counts and money spent are accurate. If the SWE Team found any discrepancies, the SWE Team noted the finding and instructed the EDC to correct any issues going forward.

Step 6: Verify Evaluation Results. If the EDCs applied results from evaluation activities that affected their reported savings, the SWE Team requested full documentation for the parameters in question. For CFL and LED lighting, this primarily concerned cross-sector sales, particularly since this parameter has not

[11] The 2014 Pennsylvania TRM is the TRM that is applicable to PY6.

been included in the TRM (as of the 2015 TRM). The SWE Team requested the methodology, analysis, and findings from all studies of cross-sector sales and determined how the results were applied to the tracking database for quarterly and annual reporting. For instance, the SWE Team might learn if all bulbs were treated equally and allocated into residential/non-residential groups, or if certain specialty bulbs were excluded from this allocation. The SWE Team requested that each EDC submit complete supporting documentation (the cross-sector sales research report, including methodology and findings), and a description of how it applied the cross-sector sales research results to the CFL and LED populations in the tracking and reporting systems. The SWE Team carefully reviewed the approach and methodology to ensure that the research was conducted in a valid and reliable manner, that the data were error-free, and that the evaluation contractor applied the results to the reported savings appropriately.

3.1.1.2 Appliance Recycling Programs

The appliance recycling programs include those programs for which JACO Environmental, Inc. (JACO), the conservation service provider (CSP) for all EDCs' appliance recycling programs during PY6, removes older, inefficient appliances from the home. The CSP must verify that the appliance is in working order before removing it from the home in order for the recycling program to generate energy savings. The SWE Team verified total measure counts as reported in the annual reports and verified MWh savings calculations for this program, including verifying whether EDCs used correct deemed savings from the 2014 TRM (for EDCs that used deemed savings values). In cases where customer surveys were used to determine the proportions of refrigerators and freezers being replaced, the SWE Team verified that these results were used appropriately in the TRM savings algorithms.

3.1.1.3 Energy Efficient Products Programs

Energy efficient products programs include programs that offer rebates for ENERGY STAR or high-efficiency appliances. All of the eligible measures for these programs have deemed savings values or appropriate algorithms in the 2014 TRM. The SWE Team verified the total measure counts as reported in the annual reports, and verified that EDC measure savings calculations used either the correct TRM deemed savings values or 2014 TRM savings algorithms. The SWE then reviewed whether the EDCs realization rates were calculated correctly and whether these were then applied appropriately to the population to achieve verified savings.

3.1.1.4 Home Performance Programs

Home performance programs include programs that provide direct installation of energy efficiency measures, customer-installed energy efficiency kits, new construction programs, and behavior-based home energy report (HER) programs. The SWE Team verified that EDCs used the appropriate deemed savings values or algorithms from the 2014 TRM for the kits and direct-install measures. The SWE Team reviewed whether new construction projects were evaluated according to each EDC's evaluation plan and that the realization rates determined by the evaluation contractor from additional REM/Rate models were correctly applied to the ex ante savings. Because of the one year measure life for HER programs, not every EDC had an evaluation performed on that type of program in PY6. If an evaluation was performed, the SWE Team reviewed the billing analysis for accuracy and appropriateness.

3.1.2 Low-Income Programs

Act 129 requires each EDC to offer a number of energy conservation measures to low-income households that are "proportionate to those households' share of the total energy usage in the service territory."[12] During PY6, the SWE Team conducted various audit activities to ensure that reported low-income energy

[12] 66 Pa.C.S. §2806.1(b)(i)(G).

efficiency measures were being installed, savings impacts were being calculated and reported appropriately, and EDCs complied with the Act 129 low-income proportion of measures requirement.

One facet of the SWE Team's audit process involves the verification of low-income measures' energy and demand savings for those EDCs that base program savings on deemed savings or algorithms in the 2014 TRM (instead of on statistical billing analyses). This step involves a review of calculations of savings at the measure level for a sample of installed measures per the database records, as well as a review of calculations for all energy efficiency kits given away through the programs. Correct use of, and results from, the 2014 TRM algorithms were checked when deemed measure savings were involved. If any discrepancies were found, the SWE Team resolved them with the EDC. At the conclusion of the program year, the SWE Team verified that any adjustments to the reported data for deemed measures were in accordance with the 2014 TRM. Any billing analyses performed for low-income programs were reviewed by the SWE for appropriateness and correctness.

The final step in the SWE Team's audit was to determine whether each EDC achieved its specific Act 129 requirements for the number of low-income measures offered. The SWE Team verified the proportion of low-income measures in PY6 by requesting measure lists from the EDCs. The SWE Team also verified that the per-participant and per-measure savings and counts were consistent with the program energy and demand savings reported in the EDCs' annual reports.

Table 3-1 shows each EDC's minimum percentage of low-income measures requirement and the percentage of low-income measures offered in PY6. Every EDC complied with the Act 129 low-income requirements.

Table 3-1: EDC Achievement of Act 129 Low-Income Requirements in PY6

EDC	% Low-Income Measures Requirement	% Low-Income Measures Offered in PY6
Duquesne	8.402%	14.6%
FE: Met-Ed	8.787%	15%
FE: Penelec	10.231%	15%
FE: Penn Power	10.639%	15%
FE: West Penn	8.794%	15%
PECO	8.799%	16.4%
PPL	9.950%	45%[13]

3.1.3 Non-Residential Programs

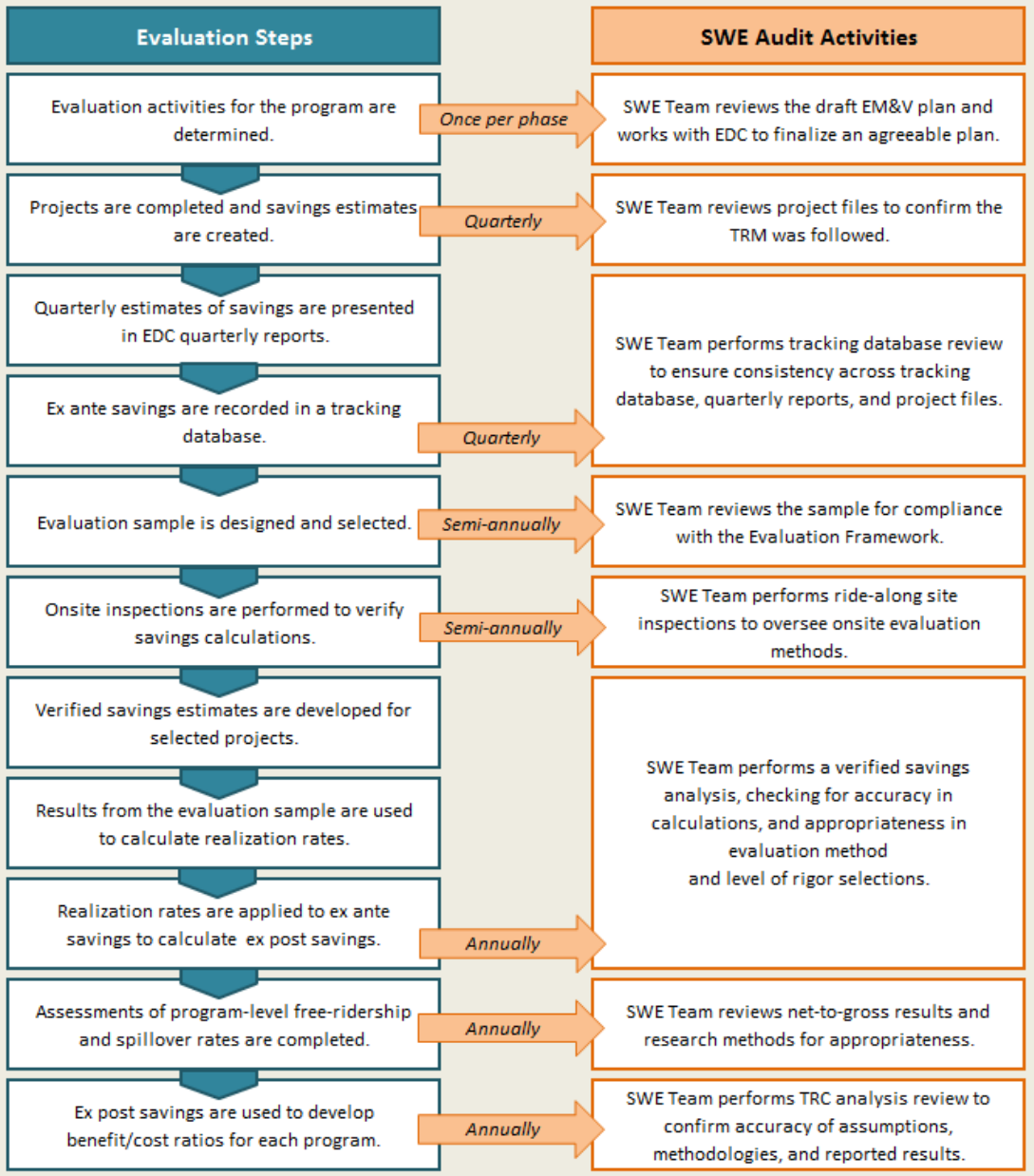
SWE audit activities are intended to give the Commission confidence in the accuracy and reliability of the verified energy and demand savings reported by each EDC toward the mandated consumption reduction targets. Moreover, the SWE audit activities ensure proper implementation of EE&C programs and evaluation of such programs in a manner consistent with the 2014 Evaluation Framework.[14] The Evaluation Framework established common metrics that are used to make accurate comparisons among

[13] 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.

[14] Evaluation Framework for Pennsylvania Act 129 Phase II Energy Efficiency and Conservation Programs, prepared by the SWE Team, June 30, 2014, p. 49.

EDC programs. The SWE Team audited each step of the program implementation and evaluation process for non-residential programs. Figure 3-1 diagrams this evaluation and audit process.

Figure 3-1: Evaluation Steps and SWE Auditing Activities – Non-Residential Programs



3.1.3.1 EM&V Plan Review

The SWE Evaluation Framework, updated in June 2014, required each EDC to complete an evaluation plan for each program in its portfolio, describing its evaluation activities for Phase II. The review of evaluation plans (or EM&V plans) has been an ongoing process through which the SWE Team worked with the EDCs and EDC evaluation contractors to realize the common goal of accurately tracking and reporting realized energy and demand savings. The SWE Team reviewed each EDC's evaluation plan for Phase II during PY6 and provided written comments on the plan to each EDC.

3.1.3.2 Project File Reviews

The SWE Team performed desk audits of project files for non-residential energy efficiency projects that were submitted as part of the SWE quarterly and annual data requests. Project file reviews are designed to audit the accuracy of the savings values stored in the program tracking database and confirm that calculations are being performed in accordance with the applicable TRM. The majority of project file reviews were conducted on installations of energy efficiency measures in individual C/I facilities. In the case of custom measures installed in such C/I facilities, for which there is no applicable TRM protocol, the project file review focused on whether the methodology used to calculate savings was reasonable and well documented. The uploaded project files included project-level savings calculation workbooks, specification sheets for equipment installed, invoices, customer incentive agreements, and post-inspection forms.

The SWE Team verified many key aspects of each project file for C/I projects, providing feedback and recommendations to the EDC and EDC CSP when appropriate. These key points of interest included:

- Was the appropriate version of the TRM used properly?
- Were all assumptions reasonable and well documented?
- Did quantities and values match across all documents (e.g., invoices, calculation workbooks, incentive agreements, and post-inspection forms)?
- Were appropriate energy savings calculation methods and values used for custom measures?
- Did the energy savings, peak demand savings, and rebate amounts called out in the project files match what was stored in the program tracking database?

3.1.3.3 Program Tracking Data and Quarterly Report Review

In PY6 each EDC was expected to submit its up-to-date program tracking database and accompanying progress reports on a quarterly basis. After receiving this information, the SWE Team checked for consistency between the project file documentation, tracking database, and ex ante impacts claimed in the EDC quarterly and annual reports. For measures installed in C/I facilities, the SWE Team also checked for consistency between individual project file documentation and tracking systems as part of the project file review discussed previously.

The SWE Team verified the consistency between the tracking system impacts and impacts noted in the quarterly and annual reports for each EDC report using the following equation:

$$Reported\ Figure\ - Database\ Summary = Discrepancy$$

Discrepancies were calculated within each C/I program and at the portfolio level for the following: participants, MWh, MW, and incentives. If the SWE Team discovered any discrepancies, they investigated and discussed the nature of the root cause and, when applicable, provided recommendations for future database and report submissions.

3.1.3.4 Evaluation Sample Design Review

Each EDC was required to select a sample of its C/I projects for analysis. Each EDC's evaluation contractor calculated realization rates from the sample and applied them to the entire program. The SWE Team ensured that each EDC evaluation contractor selected a proper sample for C/I programs in accordance with the Evaluation Framework. The key pieces of each sampling plan reviewed for compliance were:

- Was the sample for the non-residential portfolio as a whole designed to achieve ±10% precision at the 90% confidence level annually?
- Was the sample for each non-residential program designed to achieve ±15% precision at the 85% confidence level annually?
- If GNI project savings were expected to exceed 20% of all non-residential savings, were GNI projects sampled appropriately (i.e., targeting ±15% precision at the 85% confidence level)?
- Were the initial error ratios and/or coefficients of variation appropriate and in keeping with industry standards or previous program-year data?
- Was the stratification of C/I programs appropriate?

After reviewing each sample plan, the SWE Team provided recommendations concerning corrections to the plans and improved adherence to industry standards and best practices.

3.1.3.5 Ride-Along Site Inspection

Site inspections were essential to the accurate evaluation of C/I programs and represented a significant portion of the EDCs' EM&V efforts for non-residential programs. Because of the importance of this task, the SWE Team worked closely with the EDC evaluation contractors to ensure that C/I site inspections were carefully planned and executed. To complete the ride-along inspections, the SWE Team accompanied the EDC evaluation contractors on a selected subset of their sampled projects to assess performance of the evaluation activities. The SWE Team based the sample selection on either measure diversity or high-impact projects.

Following the ride-along site inspections, the SWE Team issued RASIRs to the EDCs and the EDC evaluation contractors. The reports included site visit findings, a review of the evaluation contractor's analysis, and if necessary, recommendations for the evaluation contractor, EDC, or SWE Team action items. The evaluation contractor reviewed the RASIRs and provided feedback to the SWE Team. When necessary, the evaluation contractors revised their savings calculations and the SWE Team subsequently revised the RASIRs to reflect the changes. In many cases, SWE RASIRs resulted in both quantitative and qualitative modifications to evaluation procedures, ensuring that the impacts reported by EDCs complied with statewide standards.

Ride-along inspections proved valuable, by providing constructive interaction between the SWE Team auditor and the evaluation contractors. The evaluation contractors immediately incorporated the SWE Team's suggestions and corrective actions into their audit practices for all of their future inspected project audits. Similarly, evaluation contractors could answer the SWE Team's questions quickly and efficiently.

3.1.3.6 Verified Savings Analysis

In an effort to strengthen the M&V approaches used by the EDCs' evaluation contractors to determine verified savings estimates for sampled projects, the SWE Team reviewed, analyzed, and provided feedback on the verified savings methodologies used.

The SWE Team first reviewed each EDC evaluation contractor's evaluation sample as a whole. Key aspects of the examination included types of M&V used (e.g., simple verification, Option A, Option B), the frequency with which each M&V approach was used, and the frequency with which end-use metering was used. If the evaluation contractor used stratification, the SWE Team also examined strata definitions and

sizes and evaluated them for their impact on M&V type. The SWE Team also checked the evaluation sample for adherence to the previously submitted EDC EM&V plans and the Evaluation Framework.

In addition to reviewing each evaluation sample as a whole, the SWE Team reviewed 5 to 10 projects from each C/I sample in accordance with the SWE annual data request. Data requested for each specific C/I project included site-specific measurement and verification plans (SSMVPs), calculations, and site inspection photos and reports. From these materials, the SWE Team evaluated each evaluation contractor's savings verification approach. The key elements reviewed included the appropriate use of values and calculations, appropriate level of rigor, and administrative or calculation errors found. The SWE Team provided feedback on the effects these elements had on the projects' ex post savings and realization rate.

After the review, the SWE Team developed recommendations concerning specific project comments and general M&V approaches. The SWE Team's concurrent review of the C/I evaluation samples as a whole and individual project analyses enabled them to provide more relevant and useful recommendations to the evaluation contractors concerning their M&V practices.

3.2 PROGRAM EVALUATION GROUP MEETINGS

The Commission continued to hold PEG meetings in PY6, although less frequently than in previous years. There were three PEG meetings in PY6 (compared with nine in PY5); these were attended by several parties involved in various aspects of program evaluation, including the SWE Team, TUS staff, and representatives from the EDCs, their evaluation contractors, and the Pennsylvania Energy Association. Table 3-2 summarizes the issues discussed during the PEG meetings in PY6.

Table 3-2: Summary of Issues Discussed in PY6 Program Evaluation Group Meetings

Date of PEG Meetings	Key Topics
Meeting #1 – June 19, 2014	Residential lighting baseline assumptions
	SWE Evaluation Framework
	2015 TRM
	Status report on energy efficiency potential study
	Status report on demand response potential study
	On-site inspections for low-income programs
	Data analysis plan for commercial lighting study
	Use of results of NTG research
	SWE guidance memos
Meeting #2 – September 18, 2014	Future approach for EDC NTG research (program vs. measure)
	Development of avoided transmission and distribution (T&D) costs
	2016 TRM updates
	Status report on energy efficiency potential study
	Status report on demand response potential study
	SWE residential lighting metering study
	Status of data analysis for SWE commercial lighting metering study

Date of PEG Meetings	Key Topics
	SWE guidance memos
Meeting #3 – December 18, 2014	New measures for 2016 TRM
	SWE avoided T&D cost study
	Presentation of SWE 2014 residential and commercial lighting metering studies
	Release dates for SWE energy efficiency and demand response potential studies and lighting metering study
	SWE Evaluation Framework updates
	NTG research updates

During PY6, the PEG meetings continued to provide an important channel of communication between the SWE Team, the EDCs, their evaluation contractors, and the TUS staff in the administration of Act 129. The meetings are continuing in PY7 to address technical issues as they arise.

3.3 STATUS OF THE TECHNICAL REFERENCE MANUAL UPDATE

In accordance with previous Commission Orders, the TRM was updated for PY8 and the duration of Phase III effective June 1, 2016 (2016 TRM). The TRM will no longer follow annual program year modifications or updates; rather, during Phase III, it will be updated as necessary to revise or introduce protocols. The focus of the 2016 TRM update was to measure savings estimates and savings protocols that will be sound (and unlikely to change significantly) during the five year duration of Phase III of the Act 129 programs. The 2016 TRM Final Order (with manual and appendices) was approved early in PY7 on July 8, 2015.

General updates found in the 2016 TRM include, but are not limited to:

- Incorporation of federal and state code changes that will occur in future program years of Phase III.
- Updates to some protocols to align with updates to the U.S. Environmental Protection Agency's (EPA's) ENERGY STAR requirements.
- Inclusion of demand response protocols to provide direction to the EDCs for algorithms to use to calculate kWh and kW savings for both residential and commercial demand response programs.
- The addition of an electric line loss guidance table to provide guidance on the calculations of MW savings in Phase III.
- Minor formatting updates to the TRM as a whole that allow for easier navigation.

Updates in the 2016 TRM pertaining to residential measures include, but are not limited to:

- Updates to the measure life of CFL and LED bulbs to 10,000 hours and 25,000 hours, respectively.
- Additional language to address the introduction of the 2020 backstop provision.
- Updates to the HOU and coincidence factor (CF) for ENERGY STAR lighting measures to align with the 2014 residential and commercial baseline study.
- The addition of a "defacto space heating" option as listed in Section 3.4 (Interim Measure Protocols) below, allowing for the heating, ventilating, and air-conditioning (HVAC) measure to be used for homes that are using space heating as a primary source of heat.

- Modification to the Room AC Retirement measure default values to address new ENERGY STAR requirements.
- Modification to the Refrigerator/Freezer Recycling protocol to remove all language implying a net savings approach and further reference the Uniform Methods Project (UMP) protocol for guidance.
- The addition of savings algorithms and measure modifications for Tier 2 smart strip plug outlets.

Updates in the 2016 TRM pertaining to non-residential measures include, but are not limited to:

- Modification of the lighting protocols to update HOU and CF values for alignment with the 2014 Lighting Metering Study, inclusion of alternate HOU and CF values for screw-based bulbs, and defaults for street lighting.
- Adoption of interactive factors (IFs) for lighting to be used with Appendix C of the TRM in comfort-cooled spaces.
- Shifting of the linear fluorescent baseline to T8s from T12s in accordance with EISA standards and the removal of the savings adjustment factors and methodology.
- Addition of language allowing light loggers to satisfy the M&V requirements for projects above the metering threshold.
- Modification of the New Construction Lighting protocol baseline values to account for the American Society of Heating, Refrigerating, and Air-Conditioning Engineers (ASHRAE) requirement of occupancy sensors in three new construction types.
- Updates to the Heat Pump Water Heater measure baseline EF values to reflect code changes.
- Addition of language to the High Efficiency Refrigerator/Freezer Cases protocols to address new federal standards.
- Numerous modifications to the Appendix C Lighting Audit and Design Tool Calculator and the Appendix D Motor & VFD Audit and Design Tool to promote easier usability and enhance the sorting features.
- Removal of Appendix E Lighting Audit and Design Tool for C/I New Construction Projects from the TRM.

3.4 INTERIM MEASURE PROTOCOLS

Interim measure protocols (IMPs) are used for measures that do not exist in the TRM and for additions that expand the applicability of an existing protocol. IMPs allow EDCs to claim ex ante savings and verify ex post savings using deemed or partially deemed protocols that are not provided in the current TRM. The SWE Team approves IMPs after a collaborative and iterative review process with the EDCs.

New measure interim protocols are new measures or additions that expand the applicability of an existing protocol, provided that the additions do not change the existing TRM algorithms, assumptions, or deemed savings values. TRM modification interim protocols are proposed additions to an existing TRM protocol that modify the existing TRM algorithm, assumption, and/or deemed savings values. It is very important to note that IMPs cannot override savings protocols in the TRM applicable for a program year.

In PY6, the SWE Team and EDCs developed seven new residential and five new commercial IMPs. All IMPs were approved between January 22, 2015 and February 23, 2015 for inclusion in the 2016 TRM. Table 3-3 and Table 3-4 summarize the residential and C/I IMPs that were approved in PY6.

Table 3-3: Residential Interim Measure Protocols Approved in PY6

Category	Protocol	Approval Date
Building Shell	Crawl Space Insulation	2/13/15
	Rim Joist Insulation	2/13/15
	Residential Air Sealing	1/22/15
HVAC	Defacto Heating Addition to Electric HVAC	2/23/15
	Packaged Terminal Systems	2/13/15
Consumer Electronics	Smart Strip Outlets	2/13/15
Domestic Hot Water	Thermostatic Shower Restriction Valve (modification)	2/13/15

Table 3-4: Commercial/Institutional Interim Measure Protocols Approved in PY6

Category	Protocol	Approval Date
Appliances	Air Tanks for Load-No Load Compressors	2/13/15
Lighting	LED Fixtures Codes Memo	2/13/15
	Street Lighting Memo	2/13/15
Refrigeration	Adding Doors to Existing Refrigerated Display Cases	2/13/15
	Refrigerated Display Cases with Doors Replacing Open Cases	

3.5 TOTAL RESOURCE COST TEST ISSUES

The SWE Team examined the TRC model calculations for each EDC and found that most of their respective TRC ratios for PY6 were calculated correctly. However, the SWE Team found some discrepancies regarding the TRC ratio calculations at both the portfolio and program levels. The SWE Team describes the details of the issues in each EDC-specific TRC section in this report. The SWE Team recommends to the Commission that errors in the calculation of the TRC ratios be corrected and the affected tables be refiled with the Commission in a subsequent memo when the TRC ratio for an EDC's program portfolio changes by 1% or more. Inconsistencies or calculation errors that have a smaller impact (less than 1%) on the TRC results should be corrected in the PY7 report.

The TRC Test depends on several common assumptions, which each EDC addresses differently. These assumptions include the line loss factor (LLF), discount rate, participant costs, avoided costs of energy, and capacity costs. The remainder of this section presents the SWE Team's findings regarding common assumptions, as well as the dual baseline approach used by the EDCs to calculate lifetime savings in their TRC models.

3.5.1 Line Loss Factor

LLFs must be applied to savings associated with TRC calculations to account for energy lost during electric transmission and distribution due to electrical resistance. Increasing the LLF will increase the benefits associated with a program, so it follows that larger LLFs will result in higher TRC ratios. Table 3-5 presents LLFs used by each EDC by sector.

Table 3-5: Line Loss Factors by EDC and Sector

EDC	Residential	Commercial	GNI	Industrial
Duquesne	6.9%	6.9%	6.9%	6.9%
FE: Met-Ed	7.18%	5%	5%	5%
FE: Penelec	9.45%	7.2%	7.2%	7.2%
FE: Penn Power	9.49%	5.45%	5.45%	5.45%
FE: West Penn	9.1%	7.9%	7.9%	7.9%
PECO	7.1%/16%[a]	7.1%/10%[a]	7.1%/10.5%[a]	7.1%/10%[a]
PPL	8.33%	8.33%	6.23%	4.12%
NOTES [a] LLF for energy savings/LLF for demand savings				

Six EDCs used the same LLFs for energy savings and peak demand savings for their programs within the same sector, while PECO used different values for LLFs for energy and demand savings. Duquesne is the only EDC that used a universal LLF for programs in all sectors. PECO used the largest LLFs for peak demand savings.

3.5.2 Discount Rate

The nominal discount rate is another underlying assumption that has considerable effect on the final TRC ratio. In a TRC test, the discount rate reflects the utility cost associated with borrowing debt and equity capital. This rate is used to compare the NPV of program benefits that will occur throughout a measure's lifetime to the upfront costs of installation and implementation. The PY6 discount rates for all seven EDCs are listed in Table 3-6. Duquesne used the lowest discount rate of all seven EDCs. Per the Commission's TRC Order, the applicable discount rate for cost-effectiveness calculations is the rate listed in the EDC's Phase II EE&C Plan.

Table 3-6: Discount Rate by EDC

EDC	Discount Rate (TRC Model for Annual EDC Report to the PUC)	Discount Rate (EE&C Plan)
Duquesne	6.9%	6.9%
FE: Met-Ed	7.52%	7.52%
FE: Penelec	7.92%	7.92%
FE: Penn Power	11.14%	11.14%
FE: West Penn	9.15%	9.15%
PECO	7.6%	7.4%
PPL	8.14%	8.14%
Average	**8.34%**	**8.31%**

As in PY5, an inconsistency was found regarding the discount rates used in the TRC model and in the EDC EE&C Plan for PECO. No further explanation was provided in the PECO PY6 annual report to reconcile the issue. PECO filed a modified EE&C Plan in January 2013 but did not make an adjustment to the 7.4% discount rate.

3.5.3 Avoided Costs

In PY5, the SWE TRC audit confirmed that the EDCs were utilizing the appropriate avoided energy and capacity costs that were consistent with the approved Phase II EDC EE&C Plans. The SWE noted that variability in avoided costs of capacity has decreased considerably when compared with the estimations in Phase I. For PY6, the SWE TRC audit again reviewed the avoided cost inputs to ensure consistency with EE&C Plan filings and confirm that the PY6 models had been updated to value energy and demand savings with the appropriate avoided cost stream. Table 3-7 provides each EDC's avoided energy supply and capacity cost stream time frames and the avoided T&D method.

Table 3-7: Avoided Cost Stream Time Frames for EDCs

EDC	Avoided Energy Supply Cost ($/kWh) Stream used in PY6	Avoided Capacity Cost ($/kW-Yr) Stream used in PY6	Avoided T&D Method
Duquesne	2015-2029[a]	2015-2029[a	Energy ($/kWh) Adder
FE: Met-Ed	2015-2029	2015-2029	Demand (kW-yr) Adder
FE: Penelec	2015-2029	2015-2029	Demand (kW-yr) Adder
FE: Penn Power	2015-2029	2015-2029	Demand (kW-yr) Adder
FE: West Penn	2015-2029	2015-2029	Demand (kW-yr) Adder
PECO	2015-2029	2015-2029[b]	Energy ($/kWh) Adder
PPL	2015-2029	2015-2029	Energy ($/kWh) Adder

NOTES
[a] The SWE found that the approved capacity costs in the Duquesne EE&C Plan do not accurately align with the PJM RTO's RPM capacity prices. The Duquesne TRC model, however, uses the correct capacity avoided cost stream.
[b] The PECO TRC model specifies the 2014-2028 avoided cost stream of PY6, but the SWE confirmed that the avoided costs align properly with the June 1, 2014- May 31, 2015 PY6 timeframe.

Six out of 7 EDCs used the 2015-2029 avoided cost stream in their PY6 TRC models. This avoided cost stream is appropriate for PY6 and is consistent with guidance provided by the SWE in Guidance Memo GM-19: Application of 15 Year Avoided Cost Streams, and the Phase II Evaluation Framework. The SWE discusses the approach used by Duquesne and our recommendations for updating the PY6 TRC results in Section 4.2 of this report.

The EDCs employed different methods for valuing the benefit of avoided transmission and distribution costs in the Phase II avoided costs and PY6 TRC models. However, the Phase II TRC Order does not prescribe a single methodology and the SWE found the valuation of avoided T&D costs in PY6 to be reasonable and accurate.

3.5.4 Phase II TRC Results

The SWE noted a discrepancy in the approach used between the EDCs to develop the overall Phase II TRC NPV benefits and NPV costs. PPL discounted all Phase II benefits and costs back to a single year in their estimate of Phase II TRC results, whereas the remaining EDCs used the sum of PY5 and PY6 benefits and costs to calculate the Phase II totals.

3.5.5 Dual Baseline

The 2014 TRM directs the EDCs to begin using dual baselines for TRC B/C analysis calculations in PY6 when calculating lifetime savings of linear fluorescent fixture retrofits.[15] As a result of changing federal baselines, standard T8s become the baseline for all T12 linear fluorescent retrofits beginning June 1, 2016. Therefore, measures installed in PY6 and PY7 are only permitted to claim full savings (relative to T12 fixtures) until June 1, 2016. In their TRC test calculations, the EDCs may adjust lifetime savings either by applying savings adjusted factors or by reducing the effective useful life (EUL) to adjust lifetime savings.

Although not required in PY5, PPL and the FirstEnergy Companies acknowledged the forthcoming calculation change and reflected dual baselines for appropriate measures in their TRC models by creating savings adjustments over the lifetime of the energy efficiency measures, and continued this approach in PY6. Alternatively, Duquesne and PECO adopted the adjusted measure life approach to reflect dual baselines in their PY6 TRC benefit calculations. The SWE Team considers both to be effective and appropriate methods to determining savings that better reflects how the annual savings of a measure changes over time.

More detailed findings for the review of each EDC's TRC model and analyses are included in the EDC-specific TRC sections.

3.6 NET-TO-GROSS ISSUES

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. The ratio of net savings to gross savings is known as the NTG ratio. This section briefly describes the common NTG methods and the SWE Team's work to audit the EDCs' NTG methods and findings, including the SWE Team's determination of how closely EDC NTG evaluations aligned with the evaluation protocols.

3.6.1 Summary of SWE Common Methods for NTG Assessment

To promote a clear and consistent format among the EDCs for reporting NTG assessments, the SWE Team developed common approaches for assessing free-ridership in downstream programs and for assessing participant and nonparticipant spillover for Phase II, and which the EDCs first used for PY5. The SWE Team described these approaches in the PY5 SWE Annual Report.[16]

In PY5 and PY6, the SWE Team held several meetings with representatives of the various EDCs and their evaluation consultants to discuss the assessment of NTG in upstream lighting programs, including the feasibility of developing a common approach for such assessment. As part of this process, the SWE Team asked the EDC evaluators to provide a list of approaches they planned to use and of the types of data they planned to collect for those approaches. This process resulted in the development of two SWE Team memoranda, dated March 20 and August 31, 2015. The purpose of the memoranda was to clarify this process and address the evaluators' concerns and to present the information gathered during the process, and the SWE Team's conclusions, to the evaluators to help inform their planned research.

[15] See Section 3.2 of the 2014 TRM for discussion on accounting for new code standards in lighting improvement calculations. Tables 3-4 and 3-5 define the savings adjustment factors and adjusted EUL associated with the baseline shift.

[16] Act 129 Statewide Evaluator Annual Report. Program Year 5: June 1, 2013 – May 31, 2014. Presented to: Pennsylvania Public Utility Commission. February 27, 2015. Prepared by: Statewide Evaluator Team – GDS Associates, Inc.; Nexant Inc.; Research Into Action, Inc.; and Apex Analytics. http://www.puc.state.pa.us/Electric/pdf/Act129/SWE_PY5-Final_Annual_Report.pdf.

The memos noted that developing NTG protocols for upstream lighting would be more difficult than for other measures, given the difficulty in identifying the purchasers of program-discounted bulbs, the lack of market sales data, and the lack of a single, proven assessment method. Therefore, the SWE Team instead focused on developing a common list of market progress indicators (MPIs). A common list of MPIs serves the purpose of supporting program design to maximize the effectiveness of incentives and provides inputs for developing better and more consistent NTG estimates for upstream lighting programs.

The August memo[17] presented a final list of MPIs identified by the various EDC evaluation consultants and the recommended data collection methods for measuring each MPI; showed how some of the MPIs relate to NTG assessment methods; and reviewed the strengths and limitations of various NTG assessment methods for upstream lighting programs.

3.6.2 Overview of NTG Audit Activities

The SWE Team conducted an audit of the NTG analyses done in PY6, submitted by the following EDC Evaluation consultants:

- Navigant for Duquesne
- ADM Associates (ADM) and Tetra Tech for the four FirstEnergy EDCs
- Navigant for PECO
- Cadmus Group for PPL

The SWE Team analyzed how the evaluation consultants for each EDC applied the NTG method. The SWE Team reviewed each EDC's NTG files uploaded to the TUS-SWE SharePoint site. The SWE Team checked whether the evaluation consultants provided, for each evaluated program, raw data from the NTG research and the syntax, if SPSS, or formula-activated worksheets (if Excel) showing how the raw data produced the stratum- and program-level NTG values. The SWE Team either examined the syntax or a sample of data records for each program to determine whether the NTG values were calculated correctly at the respondent level. The findings from the analyses are included in the respective NTG audit sections for each EDC, in Chapters 4–10.

3.6.3 Summary of NTG Audits for Each EDC

Table 3-8 summarizes the SWE Team's findings in regard to the use of common NTG methods by each EDC. 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 where the SWE Team did not establish a common method.

Table 3-8: Summary of Findings on the Application of NTG Methods by EDCs

EDC	NTG Data and Documents Available?	Use of Common NTG Methods	Common NTG Methods Applied Correctly?
Duquesne	Yes, with few exceptions	Yes, with acceptable modifications	Yes, with few exceptions[b]
FirstEnergy EDCs[a]	Yes, with few exceptions	Yes	Yes, with few exceptions[b]
PECO	Yes	Yes, with acceptable modifications	Mostly

[17] SWE Team Memo, Lighting Net-to-Gross Methods, August 31, 2015.

EDC	NTG Data and Documents Available?	Use of Common NTG Methods	Common NTG Methods Applied Correctly?
PPL	Yes, with few exceptions	Yes, with acceptable modifications	Yes, with few exceptions[b]

NOTES
[a] The evaluators for FirstEnergy applied the same NTG methods for all four FirstEnergy EDCs.
[b] Where possible to confirm.

Table 3-9 summarizes the portfolio-level net-to-gross ratios (NTGRs, or NTG ratios) reported by the EDCs in their PY6 annual reports. The EDCs weighted the portfolio-level NTGRs by program savings for programs reporting NTGRs.

Table 3-9: PY6 Portfolio Net-to-Gross Ratios by EDC

EDC	Free-Ridership	Spillover	NTGR[a]
Duquesne	.44	.09	.66
FE: Met-Ed	.26	.06	.80
FE: Penelec	.27	.06	.78
FE: Penn Power	.34	.09	.75
FE: West Penn	.37	.11	.73
PECO	.39	.07	.68
PPL	.30	.01	.71

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.

Table 3-10 displays the EDCs' NTGR calculations across sectors. Across programs in the residential sector, the EDCs' program-specific NTGR values ranged from .32 to .99 (with the exception of three programs for which the evaluation consultant assumed a NTRG of 1.0). In most cases, the EDCs' evaluation consultants assumed a NTGR of 1.0 for low-income programs; the exception was Duquesne's Low-Income Energy Efficiency Program (LIEEP), for which the evaluation consultant reported a NTGR of .76. The EDCs' NTGRs for non-residential programs ranged from .39 to .99 (with the exception of two programs for which the evaluation consultant assumed a NTRG of 1.0).

Table 3-10: PY6 Program Net-to-Gross Ratios by Sector and Program – All EDCs

EDC	Program	Free-Ridership	Spillover	NTGR	Sample Size
Residential					
Duquesne	Residential Energy Efficiency Program (REEP)	0.54	0.23	0.69	69
	Residential Appliance Recycling Program (RARP)	0.51	0.15	0.64	63
	School Energy Pledge Program (SEP)	0.42	0.34	0.92	31
	Whole House Energy Audit Program (WHEAP)	0.28	0.13	0.84	17
FE: Met-Ed	Appliance Turn-In	0.43	0	0.57	39
	Energy Efficient Products[a]	0.51	0.16	0.65	75

EDC	Program	Free-Ridership	Spillover	NTGR	Sample Size
	Home Performance[b]	0.13	0.02	0.89	141
FE: Penelec	Appliance Turn-In	0.51	00	0.49	45
	Energy Efficient Products[a]	0.57	0.11	0.54	70
	Home Performance[b]	0.15	0.02	0.87	127
FE: Penn Power	Appliance Turn-In	0.47	00	0.53	37
	Energy Efficient Products[a]	0.55	0.13	0.57	65
	Home Performance[b]	0.18	0.06	0.88	116
FE: West Penn	Appliance Turn-In	0.68	0	0.32	51
	Energy Efficient Products[a]	0.52	0.05	0.52	65
	Home Performance[b]	0.02	0.01	0.99	159
PECO	Smart Home Rebates (SHR) – lighting measures[c]	Not reported	Not reported	0.42	602
	Smart Home Rebates (SHR) –non-lighting measures	0.71	0.08	0.37	200
	Smart Appliance Recycling (SAR)	0.65	N/A	0.35	100
	Smart Multi-Family (SMF) Solutions Program	0.25	0.0	0.75	44
	Smart AC Saver – Residential[d]	0.0	0.0	1.0	N/A
PPL	Residential Retail Program[e]	0.48	0.0	0.52	150
	Appliance Recycling Program (ARP)[f]	-	0.20	0.60	140
	Student and Parent Energy-Efficiency Education Program[d]	0.0	0.0	1.0	N/A
	Residential Energy-Efficiency Behavior & Education Program[d]	0.0	0.0	1.0	N/A
Low-Income					
Duquesne	Low-Income Energy Efficiency Program (LIEEP)	0.42	0.18	0.76	82
FE: Med-Ed	Low-Income	0.0	0.0	1.0	N/A
FE: Penelec	Low-Income	0.0	0.0	1.0	N/A
FE: Penn Power	Low-Income	0.0	0.0	1.0	N/A
FE: West Penn	Low-Income	0.0	0.0	1.0	N/A
PECO	Low-income EE [d]	0.0	0.0	1.0	N/A
PPL	E-Power Wise [d]	0.0	0.0	1.0	N/A
	Low-Income Winter Relief Assistance Program (WRAP)[d]	0.0	0.0	1.0	N/A
Non-Residential					
Duquesne	Small Commercial Direct Install (SCDI) Program	0.07	0.07	0.99	37
	Multifamily Housing Retrofit (MFHR) Program	0.05	0.0	0.95	16
FE: Med-Ed	Small C/I Equipment	0.41	0.12	0.71	44
	Large C/I Equipment	0.32	0.05	0.73	54
	Government and Institutional	0.37	0.11	0.73	18
FE: Penelec	Small C/I Equipment	0.38	0.12	0.75	54

EDC	Program	Free-Ridership	Spillover	NTGR	Sample Size
	Large C/I Equipment	0.27	0.08	0.80	51
	Government and Institutional	0.54	0.12	0.57	18
FE: Penn Power	Small C/I Equipment	0.74	0.13	0.39	44
	Large C/I Equipment	0.36	0.11	0.75	12
	Government and Institutional	0.54	0.12	0.57	18
FE: West Penn	Small C/I Equipment	0.39	0.10	0.71	63
	Large C/I Equipment	0.34	0.08	0.73	43
	Government and Institutional	0.54	0.12	0.57	18
PECO	Smart Equipment Incentives (SEI) – Commercial and Industrial	0.34	0.11	0.77	23
	Smart Equipment Incentives (SEI) – Government, Nonprofit, and Institutional	0.60	0.02	0.42	19
	Smart Construction Incentives (SCI)	0.48	0.00	0.52	19
	Smart Multi-Family (SMF) Solutions Program	0.17	0.00	0.83	40
	Smart AC Saver – Commercial [d]	0.0	0.0	1.0	N/A
PPL	Prescriptive Equipment Program	0.28	0.02	0.74	60
	Custom Incentive Program	0.55	0.0	0.45	15
	Master Metered Low-Income Multifamily (MMMF) Program	0.14	0.0	0.86	5
	Continuous Energy Improvement (CEI) Program	0.0	N/A	1.0	8

NOTES
[a] NTG findings do not include the Consumer Electronics component as that was not included in the PY6 research.
[b] NTG findings do not include the Home Energy Review component as the impact research provides net savings for that component; it does not include the New Homes component as that was not included in the PY6 research.
[c] Navigant used five approaches to estimate NTGR for upstream lighting SHR Program. Navigant recommended NTGR from only one of the five NTG approaches – the general population NTG survey. The SWE Team reports NTGR from the general population survey in this table.
[d] Assumed free-ridership and/or spillover values.
[e] Program-level NTGR combines downstream and upstream NTG values. Downstream NTGR was estimated from surveys with 150 participants. Upstream NTGR was estimated using sales data.
[f] The table includes spillover and NTGR values reported in the ARP-specific section of the PPL annual report, which differ from those reported in the NTG summary table in the first chapter of the PPL annual report. Cadmus did not report a free-ridership estimate in the ARP specific section of the PPL annual report. Spillover was reported but did not figure into the NTGR.
General Note: 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.

Evaluation consultants assumed a NTGR of 1.0 for most low-income programs as well as for three residential programs that were not low-income and for two non-residential programs. The Evaluation Framework does not specify any conditions under which EDCs and their evaluators may assume a NTGR of any specific value for any program, including low-income programs. The SWE did not question evaluation consultants' assumption of a NTGR of 1.0 for low-income programs in PY5. However, the SWE Team is planning to look into this issue in PY7 and to discuss this issue with TUS staff.

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 consultant indicated that there would be no motive to curtail demand without the program.

In the case of the two residential non-low-income programs, the SWE Team does not agree with the assertion that the assumption of a 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 mean that there were no free-riders.

The SWE anticipates that evaluation consultants will review all assumptions about NTG in future studies. Looking forward, the SWE recommends that NTG research be conducted for all market segments where an EDC offers Act 129 programs, including the residential low-income sector.

3.7 PROCESS EVALUATION ISSUES

In Phase II, the SWE Team has provided guidance on process evaluation activities to provide more timely and actionable results. In particular, the SWE Team has provided guidance in three areas: (1) creating clear and consistent process evaluation plans with researchable issues clearly identified, (2) developing consistent survey methodology and survey questions that provide the information needed, and (3) using a clear and consistent format for reporting methodology and results. This section describes the actions that the SWE Team took in PY6 to provide this guidance and summarizes key findings from the SWE Team's audit of the EDCs' PY6 annual reports.

3.7.1 Review of Process Evaluation Plans

The SWE Team reviewed the EDCs' overall Phase II evaluation plans in PY5, focusing on the alignment of plan objectives and proposed research questions, as well as on the details of planned research activities. To ensure consistency in the review process, the SWE Team followed a common approach in reviewing each plan, described in the PY5 SWE Annual Report.

In PY6, the SWE Team reviewed plan updates submitted by the EDCs' evaluation consultants. The plan updates consisted either of redline revisions of the previously reviewed overall evaluation plans, memoranda detailing updates or revisions to specific aspects of the evaluation plans, and/or memoranda specifically detailing sampling plans. The SWE Team's review of the plan updates had the same focus and addressed the same questions as did the review of the overall process evaluation plans in PY5. The SWE Team provided feedback to the EDCs' evaluation consultants through comments in the memos and a brief email summarizing any comments or questions.

3.7.2 Review of Process Evaluation Instruments

In PY5, the SWE Team requested that EDCs submit draft interview and survey instruments for review and comment. To facilitate this effort and ensure a consistent approach to reviewing instruments, the SWE Team created a worksheet to log and track the instrument reviews and a template for preparing review summaries, which also served as a guide for reviewing the instruments. The review guide/summary template included a summary of the goals established in the Evaluation Framework for interview and survey instruments and a series of checklists and instructions for reviewing instruments. The PY5 SWE Annual Report described the tracking worksheet and review template as well as the process that the SWE Team reviewers followed in reviewing instruments. The SWE Team reviewer made comments and suggested edits in a copy of the submitted instrument, created a summary of the review, and returned both the reviewed copy of the instrument and the completed summary to the EDC (or evaluator) contact who submitted the instrument.

The SWE Team established a target of completing the initial review of each instrument within a mean of five business days after receiving it. Often the SWE Team would receive multiple draft instruments from various EDC evaluation consultants at about the same time. In such cases, if it appeared that it would take more than five business days to complete reviews, a SWE Team member would contact the EDC evaluators involved to establish review priorities. The SWE Team completed the initial review of each instrument within a mean of five business days after receiving it and completed more than 90% of reviews within eight business days after receiving the instruments.

The SWE Team reviewed 82 PY5 instruments and 99 PY6 instruments. To date during Phase II, the SWE Team has reviewed and provided comments on 181 process evaluation survey instruments: 28 for Duquesne, 23 for the FirstEnergy EDCs, 49 for PECO, and 81 for PPL.

3.7.3 Audit of Process Evaluations – Overview of Audit Effort and Findings

In PY6 of Phase II, the SWE Team conducted an audit of the completed process evaluations submitted by the following EDC evaluation consultants:

- Navigant for Duquesne
- ADM and Tetra Tech for the four FirstEnergy EDCs
- Navigant for PECO
- Cadmus Group for PPL

In its PY6 data request memorandum to EDCs, the SWE Team made the following request relating to the process evaluation:

> *"Please provide a copy of the report or memo report that documents the methodology, findings, conclusions and recommendations for each process evaluation, including appendices. Also provide the current status (accepted, rejected, or under consideration) of each process evaluation recommendation made by the EDC's program evaluation consultant during PY6. If the EDC rejects a PY6 process evaluation recommendation, please explain why."*[18]

On September 22, 2015, the SWE Team provided EDC evaluation consultants with a report template specifying the inclusion of standardized elements that would facilitate comparison across the EDCs. For the process reporting, the template provided the following directions – note the passages in bold:

> *"Every program should have a process evaluation at least once during Phase II. Each process evaluation should include the findings from the research tasks and draw conclusions and recommendations that address the research objectives. The EDC, SWE, and the PUC cannot implement long lists of recommendations. Instead, targeted, actionable recommendations are expected."*
>
> *The following information is required for each program where a process evaluation has been conducted during the Program Year:*
>
> - ***The evaluation consultant's process evaluation methodology, sampling approach, findings, conclusions, and recommendations for all process and market evaluations***

[18] Memorandum: PY6 Act 129 Annual Data Requests – Evaluation and Cost-Effectiveness. From: Dick Spellman, SWE Team Manager. To: All EDCs. September 19, 2014.

conducted during the Program Year are to be presented in the EDC draft and final annual reports to the PA PUC. *Describe the process evaluation methodology for each program including sampling strategy and achieved sample for each data collection activity. If the process evaluation sample was the same as the impact evaluation sample, this needs to be noted.*

- ***Briefly explain what was planned and whether the data collection activities deviated from the plan and why***."

The template provided in Table 3-11 below is to be included in each EDC's process evaluation report.

Table 3-11: [Program 1] Sampling Strategy for Program Year X

Target Group or Stratum (if appropriate)	Stratum Boundaries (if appropriate)	Population Size	Assumed Proportion or CV in Sample Design	Assumed Levels of Confidence & Precision	Target Sample Size	Achieved Sample Size	Percent of Population Frame Contacted to Achieve Sample	Used For Evaluation Activities (Impact, Process, NTG)
[STRATUM NAME]								
[STRATUM NAME]								
[STRATUM NAME]								
Program Total								

The SWE Team reviewed the submitted process evaluation reports as well as the backup documentation and data that the EDCs' evaluation consultants provided to answer the following questions:

- Did the process evaluation follow the evaluation plan? (If not, how did it depart from the plan?)
- What data sources did each evaluation use?
- Did the report provide sufficient detail on methods for a reader to be able to determine what was done?
- Did the report provide sufficient detail on the results for a reader to be able to determine whether the results support the conclusions?
- Did the report list the recommendations and the EDCs' responses to the recommendations?
- Were the recommendations clear, actionable, and supported by findings?
- If NTG analysis was done, was the common NTG method correctly used to collect and analyze NTG data?

The SWE Team's scope *did not* include providing an exhaustive list of possible improvements to the various evaluations; however, the reviewers did identify some instances in which a more detailed analysis might prove valuable.

The SWE Team has summarized the EDC-specific process evaluation activities and findings in Sections 4.3.3 (Duquesne), 5.3.3 (the four FirstEnergy EDCs), 9.3.3 (PECO), and 10.3.3 (PPL). The results of the SWE Team's audit of the process evaluations are in Sections 4.4.4.2 (Duquesne), 5.4.4.2 (the four FirstEnergy EDCs), 9.4.4.2 (PECO), and 10.4.4.2 (PPL). Table 3-12 summarizes the SWE Team's findings from its audit of the process evaluations that the various EDC evaluation consultants completed.

Table 3-12: Summary of SWE Team's Review of Process Evaluations for Duquesne, PECO, PPL, and the FirstEnergy EDCs

Elements Reviewed in the EDC Process Evaluation Report or Memo	Findings of SWE Team Audit			
	Duquesne	FirstEnergy EDCs[a]	PECO	PPL
Inclusion of Required Elements per Report Template				
Description of the methods	Consistent with SWE guidelines, with minor exceptions	Consistent with SWE guidelines, with minor exceptions	Consistent with SWE guidelines, with minor exceptions	Consistent with SWE guidelines
Summary of findings	Consistent with SWE guidelines, with minor exceptions	Consistent with SWE guidelines, with minor exceptions	Consistent with SWE guidelines, with minor exceptions	Consistent with SWE guidelines
Summary of conclusions	Findings but no conclusions presented	Findings but no conclusions presented	Findings but no conclusions presented	Consistent with SWE guidelines
Table of recommendations and EDC's response	Consistent with SWE guidelines	Consistent with SWE guidelines	Consistent with SWE guidelines	Consistent with SWE guidelines
Consistency with the Evaluation Plan				
Process evaluation implemented the evaluation plan	In most cases, with minor exceptions noted	In most cases, with exceptions noted	In most cases, with minor exceptions noted	Yes
Evidence-based Recommendations				
Recommendations supported by findings and conclusions	Yes (supported by findings)	In most cases, with exceptions noted	Yes (supported by findings)	In most cases, with exceptions noted
Recommendations actionable	Yes	In most cases	Yes	Yes

NOTES
[a] The evaluation consultants for the four FirstEnergy EDCs used the same methods and presented the same evaluation findings in the same format for all four EDCs. Therefore, the findings from the SWE Team's audit of the process evaluation reports are the same for all four FirstEnergy EDCs.

The program evaluation consultants included their recommendations, and the EDCs' responses to their recommendations, in each EDC's process evaluation. The SWE Team has summarized the recommendations and responses in Appendix E| PY6 Process Evaluation Recommendations and Actions.

Table 3-13 summarizes the number of recommendations, as well as the types of responses the EDCs provided to the recommendations, for each EDC and program. For recommendations that EDCs are considering, the SWE Team also summarized whether or not the EDC provided substantive comments about how it was considering the recommendation. PPL's evaluator, Cadmus, and PECO's evaluator, Navigant, had the highest proportion implemented (or planned for implementation in PY7). A total of 181 recommendations were made across all programs, with 66 being implemented and 110 being considered by the EDCs. Only five recommendations were rejected.

Table 3-13: Summary of Recommendations and Responses

Program	Total Number for Program	Number Implemented [a]	Number Being Considered	Number Rejected	Number with Substantive Comments
Duquesne					
Residential Energy Efficiency Program	5	0	5	0	0
Residential Appliance Recycling Program	2	0	2	0	1
School Energy Pledge Program	2	0	2	0	1
Low-Income Energy Efficiency Program	3	0	3	0	1
Commercial	3	0	3	0	1
Industrial	3	0	3	0	1
FirstEnergy EDCs					
Continuous Energy Improvement Program	0	0	0	0	0
Residential Appliance Turn-In Program	3	1	1	1	2
Energy Efficient Products Program	7	1	6	0	1
Home Performance Program	6	1	5	0	6
Residential Low-Income Program	2	1	1	0	1
Small Energy Efficient Equipment Program – C/I	2	1	1	0	1
Small Energy Efficient Buildings Program – C/I	1	0	1	0	2
Large Energy Efficient Equipment Program – C/I	3	2	1	0	1
Large Energy Efficient Buildings Program – C/I	1	0	1	0	2
Government and Institutional Program	4	2	2	0	1
PECO					
Industrial	0	0	0	0	0
Smart Appliance Recycling	2	2	0	0	3
Smart Home Rebates	7	3	4	0	7
Smart House Call	8	4	2	2	9
Smart Builder Rebates	4	3	1	0	5
Low-Income Energy Efficiency	5	1	4	0	6
Smart Energy Saver	6	3	3	0	5
Smart Usage Profile	4	1	3	0	5
Smart Equipment Incentives – C/I	5	3	2	0	6

Program	Total Number for Program	Number Implemented [a]	Number Being Considered	Number Rejected	Number with Substantive Comments
Smart Equipment Incentives – GNI	5	3	2	0	6
Smart Business Solutions	6	4	2	0	7
Smart Multi-Family Solutions	7	2	4	1	8
Smart Construction Incentives	5	2	3	0	6
Smart On-Site	6	0	6	0	7
Smart Air Conditioner Saver – Commercial	2	0	2	0	3
PPL					
Portfolio[b]	1	0	0	0	1
Residential Retail Program	7	6	1	0	6
Prescriptive Equipment Program	11	7	5	0	9
Appliance Recycling Program	3	2	1	0	4
Student and Parent Energy Efficiency Education Program	8	2	6	0	9
Custom Incentive Program	4	4	0	0	5
Low-Income Winter Relief Assistance Program	2	2	0	0	3
Residential Home Comfort Program – Equipment	9	0	9	0	10
E-Power Wise Program	5	0	5	0	6
Master-Metered Low-Income Multi-Family Housing Program	4	0	3	1	5
Residential Energy Efficiency Behavior and Education Program	3	3	0	0	3
Continuous Energy Improvement Program	5	0	5	0	6
Total	**181**	**66**	**110**	**5**	**172**

NOTES
[a] Or planned to be implemented in PY7.
[b] Not a specific program, but a general portfolio recommendation.

3.7.4 Cross-Cutting Findings

Three evaluation contractors—Navigant, Cadmus, and Tetra Tech—carried out process evaluations for Duquesne, the four FirstEnergy EDCs, PECO, and PPL. This section offers the SWE Team's high-level summaries of key findings across EDCs. The purpose is to highlight commonalities or notable differences

across the evaluations in findings relating to key research topics. EDC-specific summaries of the process evaluations and NTG findings, and of the SWE Team's audit of those activities, are in Chapters 4–10; details are provided in Appendix C| Audit Activity Detail – Process Evaluation.

Note that the EDCs may serve the same target populations through a common core of measures and services but often do so in different ways. Various measure types may be split among programs for one EDC or grouped together for another, and the delivery mechanisms may vary. These differences across programs highlight the value of process evaluations at the program level, which focus on processes and challenges that are often unique even across similar programs. Indeed, the various evaluations of similar programs often differed in the research questions they addressed.

The following summaries integrate the high-level findings from the various evaluations, identifying the source of each finding discussed.

3.7.4.1 Residential Process and NTG Findings

As noted above, EDCs may differ in how they group measure offerings among programs. This summary is organized in terms of groups of measure offerings rather than programs per se, but it identifies the EDC-specific programs relevant to each subsection. In addition to including program-specific findings, this summary includes sector-specific market intelligence findings reported in the evaluations.

3.7.4.1.1 Appliance, HVAC, and Weatherization Programs

Appliance, HVAC, and/or weatherization measures were offered through the Residential Energy Efficiency Program (REEP) (Duquesne and the FirstEnergy EDCs), PECO's Smart Home Rebates (SHR) Program, and PPL's Residential Retail Program (RRP) and Residential Home Comfort (RHC) Program.

The evaluators for the Duquesne and FirstEnergy EDC programs both reported high customer satisfaction, and FirstEnergy participants reported understanding eligibility requirements. However, the Duquesne evaluation found a minority of participants dissatisfied with the application process, and consistent with this finding, the PPL RRP evaluation found that rebate processing times had not improved since PY5. The FirstEnergy EDC evaluation found that contractors reported slightly lower program satisfaction than participants. Satisfaction among contractors was lowest for technical support and training, and a substantial minority of contractors rated paperwork requirements as difficult.

The PPL evaluation found ductless heat pumps to be popular, particularly SEER 18 or higher; a limited-time offer of increased rebate for air source heat pumps increased installation of SEER 16 or higher systems.

While the FirstEnergy EDC customers identified utility mail and web contact as the preferred approaches for hearing about programs, they reported that retailers and contractors were the most common sources of information about the program. In that context, it is noteworthy that the PECO evaluation found sales staffs' enthusiasm and knowledge for selling energy efficient appliances had decreased since PY5.

The FirstEnergy EDC evaluation found that about half of contractors were receiving the contractor newsletter and that contractors prefer to receive program information personally, such as in one-on-one meetings or direct calls with their implementer representative.

3.7.4.1.2 Home Audit Programs

Home audits were offered through Duquesne's Whole House Energy Audit Program (WHEAP), PECO's Smart Home Comfort (SHC) Program, PPL's RHC, and the FirstEnergy EDCs' Home Performance Program (HPP).

The FirstEnergy EDC evaluation reported high participant program satisfaction. Bill inserts (Duquesne, FirstEnergy EDCs) and HERs (FirstEnergy EDCs) drove participation. In terms of effective messaging, auditors in the FirstEnergy program reported that "solving a problem" for the customer is more effective than focusing on the house's deficiencies or pointing out how much money the customer will save.

As was the case with REEP, the FirstEnergy participants reported wanting to be notified about future program options via email.

Several evaluations pointed to potential barriers or opportunities for greater savings. The PPL evaluation found that the cost of an audit is a barrier to participation for some customers, and feedback from auditors in the FirstEnergy EDC program suggested that the rebate structure for recommended upgrades may suppress follow-through with audit recommendations. Pertinent to this latter suggestion is the PECO evaluation's finding that, while energy advisors reported that about half of participants intended to pursue additional measures, overlap between the home audit program and other programs was low to moderate (5%–25%). The Duquesne evaluation found that no participant used the associated loan program for additional energy upgrades.

The PECO and FirstEnergy EDC evaluations addressed aspects of contractor satisfaction. While the FirstEnergy EDC evaluation found that auditors were enthusiastic program promoters and reported satisfaction with the implementation staff, they reported mixed satisfaction with the audit tool. Auditors also reported difficulty identifying the requisite 350 kWh in savings in houses with non-electric heating and/or water heating. While the PECO evaluation reported that marketing materials helped program staff build relationships with participating contractors, it also reported dissatisfaction among energy advisors and contractors regarding cross-training on program offerings and program encouragement for follow-up with audit customers.
Finally, the Duquesne evaluation reported that the program CSP found that the program's use of EISA-compliant bulbs as the savings baseline may result in underestimated savings, as some sockets in several visited houses had 60W incandescent bulbs installed.[19]

3.7.4.1.3 Home Energy Report Programs

In PY6, evaluations were carried out on PECO's Smart Usage Profile (SUP) Program and PPL's Residential Energy-Efficiency Behavior & Education Program, which provide HERs.

The evaluations of both programs reported that the program was producing energy savings, and the PPL evaluation further reported that HERs provided a small uplift in participation in other PPL programs. However, the PPL evaluation found no significant differences between treatment and control group respondents in reported engagement in 12 out of 13 energy savings improvements or behaviors at 90%

[19] The SWE notes, however, that the key reason why EISA compliant bulbs are used as the savings baseline is that non-EISA compliant bulbs are generally no longer available for purchase in the U.S. marketplace. Second, according to the 2014 TRM, the EISA compliant bulb must be used as the baseline for all bulbs subject to the EISA requirements. Table 2-74 on page 154 of the 2014 TRM provides the TRM watt savings values for EISA compliant bulbs installed during PY6. For direct installation programs where the removed bulb is known, and the bulb is in working condition, the 2014 TRM states that EDCs may use the wattage of the replaced bulb in lieu of the tables in the 2014 TRM.

confidence.[20] The PPL evaluators concluded that HERs exercised gradual influence over time in customers' decisions to make energy savings improvements.

Both evaluations found paper HERs to produce more customer engagement than email reports. The PECO evaluation further found that participants reported visiting the program web portal less than did nonparticipants, which the evaluators took to mean that participants were getting what they needed from the printed reports. This seems to conflict somewhat with that evaluation's finding that satisfaction with the mailed HERs was somewhat lower than for other HER programs the evaluators have evaluated. The SWE Team notes, however, that based on the sample size, the 90% confidence interval for the reported satisfaction level in the current evaluation puts it within the range of the satisfaction levels that the evaluators reported from other HER program evaluations. The SWE Team suggests that the evaluators carry out follow-up research on satisfaction with the mailed HERs in future program years.

3.7.4.1.4 Appliance Retirement Programs

All EDCs offer appliance retirement programs, and all programs were evaluated in PY6.

Both the PECO and FirstEnergy EDC evaluations reported that participant program satisfaction remained high. The Duquesne evaluation found the cash incentive to be the primary motive for refrigerator recycling, but that free, in-home pickup was a motive as well.

The Duquesne evaluation found that its program is well established and relied heavily on recommendations from friends and family. By contrast, the FirstEnergy EDC evaluation reported that bill inserts were the most common source of program information, and the PPL evaluation reported that a scaled-back approach to marketing may have been responsible for a 32% drop in the number of appliance units recycled in PY6.

Other key evaluation findings were that, while the PECO program has had an effect on the disposal market for refrigerator and freezers, it has had a limited effect on the secondary retail market, and that a sizeable proportion of participants in the PPL program may be parents with children who have recently gone off to college. This latter finding may be of use in developing targeted program marketing.

3.7.4.1.5 School-based Education and Kit Distribution Programs

The Duquesne School Energy Pledge (SEP) Program, the PECO Smart Energy Saver (SES) Program, and the PPL Student and Parent Energy-Efficiency Education (SPEE) Program all provide distribution of kits containing free energy efficiency measures to school students. In addition, Duquesne's REEP provides distribution of kits with free energy efficiency measures through targeted community outreach events and online requests. FirstEnergy EDCs offer free energy efficiency kit distribution through the Opt-in Kits and School Kits components of its Home Performance Programs.

The Duquesne and FirstEnergy EDC evaluations reported high participant satisfaction, although the Duquesne REEP evaluation found that satisfaction was lowest for kit energy savings. In both the Duquesne

[20] PPL surveyed 361 treatment group and 180 control group respondents. PPL used a power analysis to calculate survey sample sizes in PY6 to detect a difference of at least 11 to 15 percentage points in reported improvements or behaviors at the 0.05 level of statistical significance with 80% power. In the PY6 survey results, the largest and only significant difference in reported behaviors was 11-points between the treatment and control group. Most differences were less than 5-points. In PY7, PPL will consider increasing the sample sizes so that significant differences of this magnitude can be detected at the 0.05 level with 80% power. This provides about 80% power to detect a difference of at least 11 to 15 percentage points in reported improvements or behaviors at the .05 level of statistical significance. It has 80% power to detect at least an 11-point difference if the lower reported incidence is 10% and a 15-point difference if the lower reported incidence is 50%. Larger samples would be needed for an equivalent level of power to detect smaller differences.

SEP and REEP evaluations, participants recommended including additional measures in the kits. Satisfaction ratings perhaps should be interpreted in light of the survey return rates: the PECO evaluation reported return rates of 32% for student surveys, 25% for teacher satisfaction surveys, and 2% for parent satisfaction surveys. It is possible that those dissatisfied with participation may be less likely to return surveys than satisfied participants.

As was the case with the FirstEnergy EDCs' REEP and Home Performance Programs, FirstEnergy EDC participants reported wanting to be notified about future program options via email.

The PECO evaluation reported additional findings of interest regarding program delivery. Participating teachers reported challenges getting homework assignments and installation surveys from students whose parents have low levels of English comprehension and reported that requiring parental consent for sending kits home with students resulted in lower kit distribution. The evaluation also found that teachers followed varied practices regarding completion of student installation surveys, suggesting that the program may function differently than what is expected by the program design.

3.7.4.1.6 New Construction Programs

Two of the programs evaluated in PY6 targeted new home construction. PECO Smart Builder Rebates (SBR) Program offers builders rebates for new homes that achieve ENERGY STAR certification. The PPL Residential Home Comfort (RHC) Program offers energy savings products and rebates for new construction and retrofitted existing homes.

The evaluations of both programs indicate that current incentive levels and/or options do not generate sufficient program interest. For example, the PECO evaluation found that the largest participant in the program decided to stop building ENERGY STAR homes because the incentives were insufficient. The PPL evaluation concluded that builders need more rebate options and continuing education to support the new construction component.

3.7.4.1.7 Market Information – Lighting and HVAC

All evaluations reported market information from participant and/or nonparticipant surveys. Most of those findings pertained to awareness and adoption of high-efficiency lighting.

At least two evaluations (Duquesne and FirstEnergy EDCs) found high awareness of CFLs, and the Duquesne evaluation also found moderately high awareness of LEDs. Findings were somewhat mixed regarding the actual level of adoption of LEDs, although they generally indicated growing adoptions.

The Duquesne evaluation reported that overall adoption of CFLs and LEDs was high in the EDC's population, while the PECO evaluation reported low adoption, and the PPL evaluation reported a potential for increased adoption of LEDs.

Several evaluations reported on customer response to specific LED features. The Duquesne evaluation reported relatively high satisfaction with LED light quality but low understanding of LED features. The PECO and PPL evaluations reported somewhat conflicting findings on price as a barrier to LED adoption. In the former, feedback from manufacturers and retailers suggested that LED price is ceasing to be a barrier, while availability of efficient lighting products could still be a barrier because of stocking practices. By contrast, the PPL evaluation found that customers are still sensitive to LED price, with most customers willing to pay between $5 and $7 for an LED.

The PPL evaluation also found that CFL disposal behavior remains relatively unchanged from prior years, with over half of customers disposing of CFLs in the trash, in spite of more recycling bins in diverse locations.

The PECO evaluation was the only one to report market information on HVAC. In that evaluation, feedback from Delphi panelists and HVAC installers indicated that less than 50% of the market has adopted high-efficiency HVAC equipment.

3.7.4.2 Low-Income Process Findings

The EDCs for which process evaluations were conducted in PY6 offered low-income programs that varied in many ways in terms of measures and delivery mechanisms. For instance, Duquesne's low-income program was the amalgam of its residential programs as delivered to low-income customers. However, all programs offer distribution of low-cost energy efficiency measures (e.g., CFLs, low-flow showerheads) at no cost to the recipient as well as some weatherization and appliance measures. The SWE Team has identified several high-level findings that may be of value to the EDCs. These findings are discussed below.

Two evaluations reported findings related to program awareness. The PPL SPEE evaluation reported that the program's targeted marketing and personalized outreach efforts increased program awareness and helped increase participation. The Duquesne LIEEP evaluation reported that LIEEP participants' levels of awareness of other EDC programs were equivalent to their market-level counterparts.

Most of the evaluations reported high customer satisfaction, either for the program(s) as a whole (Duquesne LIEEP Smart Strip recipients, PPL, FirstEnergy EDCs), the program representatives (Duquesne, PPL Master Metered Low-Income Multifamily [MMMF] Program), or the equipment (PPL MMMF Program). One exception was that the Duquesne LIEEP evaluation reported that several customers expressed dissatisfaction with the quality of the refrigerators they received through the program.

On a related note, the PPL SPEE evaluation found a lower-than-expected return rate for Home Energy Worksheets (HEWs), and respondents suggested reducing the paperwork involved with the HEWs or switching to an online survey.

Several evaluations reported findings related to the installation of direct-install items as well as the programs' effectiveness in influencing participants to adopt additional energy saving actions. The PPL evaluations for the SPEE, MMMF, and E-Power Wise Programs all found lower installation rates for water products than for lighting products. The PPL evaluation reported a benchmarking study finding that partnering with another utility in the same region to reach customers who were serviced by two different utilities may increase installation rates for water products.

The PPL E-Power Wise evaluation also found that confusion about how to use the furnace whistle and incompatible heating types has resulted in low installation rates for that measure. More generally, the FirstEnergy evaluation reported that the energy specialist or auditor did not install or did not fully install direct-install measures in nearly half of home energy audit households.

The PPL E-Power Wise evaluation found that agency staff who interact with low-income populations may not have a clear understanding of program offerings available. It is not clear whether that may partly explain the relatively low installation rates for water measures and furnace whistles.

The evaluations for the PECO LEEP, PPL Low-Income Winter Relief Assistance Program (WRAP), and FirstEnergy EDC low income programs all reported that program participants reported additional energy saving activities beyond use of the program-provided measures.

Finally, two evaluations reported findings that may be relevant to the future direction of low-income programs. First, the PPL E-Power Wise evaluation reported that some agencies expressed concerns that the distribution of energy savings kits was reaching a high saturation level in the target population, so that they were encountering clients that had already received a kit, sometimes through a separate school program. No other evaluation presented similar findings or suggestions; the EDCs may wish to consider investigating the level of kit saturation and the possible effects of distribution of kits through multiple programs in future research. Second, the PECO LEEP evaluation found that 75% of homes visited during ride-along surveys had unfinished basements with no floor insulation, and up to 25% had windows that did not shut properly or were broken. These findings suggest a continuing need for weatherization measures.

3.7.4.3 Non-Residential Process Findings

The non-residential portfolios of programs across Duquesne, the four FirstEnergy EDCs, PECO, and PPL varied considerably to offer a breadth of services to meet the needs of their customers. Programs offered incentives to encourage energy efficiency projects, the adoption of strategic energy management activities, or the adoption of combined heat and power (CHP) systems. Programs variously targeted C/I, government and institutional, and multifamily sectors and covered retrofit measures as well as new construction opportunities. Some programs coupled incentives with other services such as facility audits, technical services, or direct installation of measures.

While all EDCs reported on process evaluations across a range of non-residential programs for PY6, many of those process evaluations were limited primarily to interviews with program and implementer staff. The findings from those evaluations often are highly program-specific and do not provide valuable cross-cutting findings.

Table 3-14 shows the non-residential programs for which the EDCs' evaluation consultants carried out more robust process evaluations, including participant surveys and interviews with key market actors. Note that there are only two types of programs for which at least two EDCs carried out robust process evaluations: C/I retrofit incentives and multifamily housing. However, the two multifamily housing programs are sufficiently different in focus and delivery that the findings do not provide for any useful cross-cutting insights. Therefore, this section focuses on the findings from the C/I retrofit incentive programs.

Table 3-14: Non-Residential Programs with Detailed Process Evaluations, by EDC

Program Type	Duquesne	FirstEnergy EDCs	PECO	PPL
C/I Retrofit Incentives		C/I Efficient Equipment; Government and Institutional Programs	Smart Equipment Incentives (SEI)	Custom Incentive; Prescriptive Equipment
Multifamily Housing	Multifamily Housing Retrofit (MFHR)		Smart Multifamily (SMF) Solutions	
Strategic Energy Management				Continuous Energy Improvement (CEI);

Program Type	Duquesne	FirstEnergy EDCs	PECO	PPL
				School Benchmarking Program
Combined Heat and Power			Smart On-Site (SOS)	
Small Business	Small Commercial Direct Install (SCDI)			
New Construction			Smart Construction Incentives (SCI)	

All three robust evaluations of C/I retrofit programs indicated high customer satisfaction with the program, although in the PPL evaluation customer satisfaction fell slightly short of the program's key performance indicator. Further demonstrating the importance of timely application processing, the PECO evaluation reported that contractors and participants both noted that a long wait time after submitting a pre-application is a barrier to completing projects within the planned project timeline.

The FirstEnergy EDC evaluation delved deeply into another aspect of timing. It found that about one-quarter of participants indicated they had a budget cycle that affects project planning and implementation. The evaluation further reported that, while small C/I and GNI customers were most likely to report planning periods of one year or less, large customers were most likely to report a planning period of five or more years. The PECO evaluation reported that the majority of participants confirmed that the program can be more influential during the planning phase of the project cycle, further demonstrating the importance of taking customers' planning periods into account.

Several evaluations addressed other issues relating to program processes. Some of the findings were general in nature, such as the PECO evaluation's report that participants and contractors found the paperwork requirements to be more burdensome than those of other utility programs, and the PPL evaluation finding that some customers have difficulty determining whether a project will qualify for the program. Other findings touched on aspects of the program processes relating to energy and cost calculations. The PECO evaluation found that participants and contractors suggested that the program provide assistance on engineering requirements to establish a project baseline. Similarly, the PPL evaluation reported that energy and cost calculations can be challenging for some customers, creating the need to hire a third-party, adding costs and creating project delays. Based on feedback from contractors and participants, the PECO evaluation suggested that the cost of verifying savings is such that the rebates for all but very large non-lighting and custom projects are not enough to affect decision-making.

3.8 ENERGY EFFICIENCY AND DEMAND RESPONSE POTENTIAL STUDY UPDATES

During PY6 the SWE Team completed statewide energy efficiency and demand response potential studies. The purpose of the electric energy efficiency and demand response potential studies was to determine the remaining opportunities for cost-effective electric energy and demand savings and to provide information to assist the Commission to establish the reduction targets for Phase III for the electric distribution companies (EDCs) subject to Act 129. The SWE Team began its analysis in early PY6 and issued final reports on February 25, 2015. The results of the analyses included estimates of the technical, economic, achievable and program potential for electric energy efficiency and demand response

programs in each EDC's service area. The final reports provided technical, economic, achievable and program potential savings estimates for electric energy efficiency and demand response programs for the five-year time period covering Phase III of Act 129, assuming an annual spending ceiling that limits the total program spending for each EDC to 2% of 2006 annual EDC electric revenues as defined in Act 129. [21]

The Commission received a number of comments and reply comments from Act 129 stakeholders regarding the targets set forth in the Tentative Implementation Order. Several of the comments and proposed modifications persuaded the Commission to request the SWE to analyze program potential using revised assumptions and inputs. In May 2015, the SWE issued a memo that included revised estimates of program potential for energy efficiency and demand response.

3.8.1 Findings of the SWE Energy Efficiency Potential Study for Phase III for Program Potential

The SWE energy efficiency potential findings for program potential energy savings and budget values are listed below in Table 3-15 for each EDC and the Commonwealth of Pennsylvania. The Phase III estimates of program potential savings are 4.2% of actual 2010 retail kWh sales for the Pennsylvania EDCs subject to Act 129 energy efficiency requirements.

Table 3-15: Five-Year Phase III Program Energy Efficiency Potential Savings and Budgets by EDC

	Portfolio Spending Ceiling (Million $)	Program Acquisition Costs ($/1st-YR MWh Saved)	2016-2020 Potential Savings (MWh/yr)	% of 2010 Forecast
2016-2020 – Five-Year Program Potential				
Duquesne	$97.7	$199.5	489,907	3.5%
FE: Met-Ed	$124.3	$190.9	651,470	4.4%
FE: Penelec	$114.9	$202.9	566,168	3.9%
FE: Penn Power	$33.3	$190.4	174,857	3.7%
FE: West Penn	$117.8	$196.0	601,096	2.9%
PECO	$427.0	$195.8	2,180,732	5.5%
PPL	$307.5	$202.4	1,518,985	4.0%
Statewide	**$1,222.5**	**$197.7**	**6,183,214**	**4.2%**

3.8.2 Findings of the SWE Demand Response Potential Study for Phase III for Program Potential

The Commission's Final Phase III Implementation Order established demand response targets for each EDC covered by Act 129. For its Demand Response Potential Study, the SWE ran multiple simulations altering the number of expected events per year; the duration of those events; and the time of day during which those events occur. Based on these simulations, the SWE developed an optimal program design that it believes will be effective in capturing high value hours and reducing PJM's peak load forecast. The SWE determined that the following design would capture the most important hours associated with demand response dispatch for a 24-event-hour program:

- Dispatch criterion – EDC's day-ahead forecast is above 96% of forecasted annual system peak;
- Dispatch hour – events beginning at 2:00 p.m.;
- Event duration – four hours;
- Maximum number of events – six per year.

[21] The SWE 2015 statewide energy efficiency and demand response potential reports are available on the web site of the Pennsylvania Public Utility Commission, in the Act 129 Information section of the Commission's web site.

The SWE used this program design to determine the demand response potential in each EDC service territory, with estimates of PJM demand response commitments and any potential tied to non- cost-effective direct load control (DLC) measures removed. These potential numbers were used to develop demand response acquisition costs for each utility for a five-year phase.

The SWE then considered four hypothetical scenarios regarding the Phase III budget breakdown, between energy efficiency and DR, of the EDCs' 2% spending cap. These scenarios were as follows:

1) 100% of the budget allocated to EE; 0% allocated to DR;

2) 90% of the budget allocated to EE; 10% allocated to DR;

3) 85% of the budget allocated to EE; 15% allocated to DR; and

4) 80% of the budget allocated to EE; 20% allocated to DR.

The annual demand response budget determined from these scenarios was used to develop, on a five-year basis, the average annual demand response potential savings (in MW) for each utility. The potential energy and peak demand savings associated with the 10% funding demand response scenario over a five-year Phase III are presented in Table 3-16 below. Statewide, the program potential for demand response programs is 370 MW at the end of Phase III.

Table 3-16: Statewide Demand Response Program Potential - 10% Funding Scenario

	5-Year Spending Ceiling (Million $)	Program Acquisition Costs ($/MW/year)	Average Annual Potential Savings
2016-2020 – 10% Demand Response Spending			
Duquesne	$9.8	$57,976	34
FE: Met-Ed	$12.4	$51,210	49
FE: Penelec	$11.5	$50,782	0
FE: Penn Power	$3.3	$49,349	13
FE: West Penn	$11.8	$46,203	51
PECO	$42.7	$66,370	129
PPL	$30.8	$41,622	95
Statewide	**$122.3**	**$53,876**	**370**

3.8.3 Energy Efficiency and Demand Response Savings Targets for Phase III of Act 129

Based on the findings of the SWE potential studies, stakeholder input, and policy considerations the Commission requested the SWE Team to calculate energy efficiency potential assuming a 90% funding allocation to EE and a 10% funding allocation to DR. However, Penelec, Met-Ed, and PPL would be unable to spend 10% of Act 129 funds on DR because of a lack of DR potential in their service territory. The final budget allocations by EDC are shown in the Table 3-17 below.

Table 3-17: Budget Allocation by EDC

EDC	% of Total Spending on EE	% of Total Spending on DR
Duquesne	90%	10%
FE: Met-Ed	92%	8%
FE: Penelec	100%	0%
FE: Penn Power	90%	10%
FE: WPP	90%	10%

EDC	% of Total Spending on EE	% of Total Spending on DR
PECO	90%	10%
PPL	95%	5%

On June 19, 2015, the Commission entered a Final Phase III Implementation Order, at Docket No. M-2014-2424864, establishing a timeline for program implementation and establishing Phase III energy efficiency targets for each EDC covered by Act 129. The Final Implementation Order established a five-year Phase III term commencing on June 1, 2016 and ending on May 31, 2021. The percentage reduction targets for energy efficiency programs, as well as the five-year value of reductions in MWh/yr, appear below in Table 3-18.

Table 3-18: Act 129 Phase III Five-Year Energy Efficiency Reduction Compliance Targets by EDC

	Portfolio Spending Ceiling (Million $)	Program Acquisition Costs ($/1st-YR MWh Saved)	2016-2020 Potential Savings (MWh/yr)	% of 2010 Forecast
2016-2020 – Five-Year Program Potential				
Duquesne	$88.0	$199.5	440,916	3.1%
FE: Met-Ed	$114.4	$190.9	599,352	4.0%
FE: Penelec	$114.9	$202.9	566,168	3.9%
FE: Penn Power	$30.0	$190.4	157,371	3.3%
FE: West Penn	$106.0	$196.0	540,986	2.6%
PECO	$384.3	$195.8	1,962,659	5.0%
PPL	$292.1	$202.4	1,443,035	3.8%
Statewide	**$1,129.6**	**$197.8**	**5,710,488**	**3.9%**

The Final Phase III Implementation Order also established demand response targets for EDC covered by Act 129. The percentage reduction targets, as well as the value of reductions in MW, appear below in Table 3-19.

Table 3-19: Act 129 Phase III Five-Year Demand Response Reduction Compliance Targets by EDC

	Portfolio Spending Ceiling (Million $)	Program Acquisition Costs ($/1st-YR MWh Saved)	2016-2020 Potential Savings (MW)	% of 2010 Forecast
2016-2020 – Five-Year Program Potential				
Duquesne	$9.77	$57,976	42	1.7%
FE: Met-Ed	$9.95	$51,210	49	1.8%
FE: Penelec	$0.00	$50,782	0	0.0%
FE: Penn Power	$3.33	$49,349	17	1.7%
FE: West Penn	$11.78	$46,203	64	1.8%
PECO	$42.70	$66,370	161	2.0%
PPL	$15.38	$41,622	92	1.4%
Statewide	**$92.90**	**$54,714**	**424**	**1.6%**

3.9 UPDATE OF ACT 129 EVALUATION FRAMEWORK

The SWE Team worked to update the Act 129 Evaluation Framework during PY6. The Evaluation Framework includes guidelines and expectations for the seven EDCs whose EE&C program plans were

approved by the Commission to promote the goals and objectives of Act 129. The update to the Evaluation Framework was completed and released in early PY7.

An overview of the outline of the Evaluation Framework and its contents was provided in Section 3.12 of the SWE PY5 Annual Report. In PY6 the SWE Team held discussions during nine biweekly meetings with the TUS to discuss several updates to the Evaluation Framework. The SWE Team worked on updates based on these discussions during the latter half of PY6. The areas on which the SWE Team focused include:

- Clarification of NTG issues and MPIs for the update of the Evaluation Framework and for inclusion in the Phase III Implementation Order
- Guidance on how to estimate impacts on demand response
- Guidance on what to report in terms of NTG ratios in EDC annual reports
- Clarity with respect to alignment of Evaluation Framework to the TRM
- Update on process used to develop deemed savings – use and role of the TRM working group
- Clarity with respect to use of the TRM to determine ex post savings
- Clarity with respect to use of protocols not in the TRM to determine savings
- Clarity with respect to definition of in-service date
- Changed "Custom Measure Protocols (CMP)" to "site specific M&V methods for custom projects"
- Added a paragraph regarding data production accuracy pertaining to enhanced rigor of EM&V activities and measure installation verification
- Issued requirement about need for EM&V plans of behavior and education programs
- Provided additional guidance on how EDCs may conduct NTG research
- Provided suggestion on sampling of high-impact measures
- Added information about NTG common methods for upstream lighting programs
- Removed flexibility of providing process findings in a separate report without market evaluation findings
- Issued requirement regarding reporting of net savings in EDC annual reports
- Issued requirement regarding how to address errors in EDC annual reports
- Provided edits to Appendix C of the Evaluation Framework (Residential Measure EM&V Data Requirements)
- Issued guidance memos for common approaches for measuring net savings in appliance retirement programs, free-riders in downstream programs, and spillover in downstream programs

3.10 LIGHTING METERING STUDY

The SWE Team conducted a lighting metering study which concluded in PY6. The study addressed the residential and commercial sectors. The purpose of this study was to provide updated lighting load profile information to the PUC to assist in the calculations of peak demand and energy savings for lighting energy efficiency programs in Pennsylvania. The report provided lighting load shapes, coincidence factors, HOU, and HVAC interactive factors. The study gathered lighting load profile data that is specific to Pennsylvania and the seven EDC service territories included in this study.

Key results of the residential study are summarized in Table 3-20 and Table 3-21. Overall, residents of Pennsylvania use lights an average of 2.5 hours per day. HOU are highest for exterior lights, kitchen lights, and living room lights. Closets observed the lowest HOU out of all room types by far, with less than one hour of use per day. The statewide CF for a residential home is 0.101, with kitchens, dining rooms, and exterior lights having the highest CF.

Efficient bulbs, defined as CFL and LED lights, have a statistically higher average HOU than all bulbs, but not a statistically different CF. Efficient bulbs are used an average of 3.0 hours per day statewide while non-efficient bulbs are used an average of 2.3 hours per day.

Table 3-20: Residential Statewide Average Hours of Use Per Day

Room Type	No. Loggers	Average HOU	90% CI
Basement	80	1.7	(1.0 , 2.4)
Bathroom	151	2.3	(1.8 , 2.8)
Bedroom	147	1.8	(1.4 , 2.2)
Closet	77	0.6	(0.4 , 0.9)
Dining Room	114	2.7	(2.2 , 3.2)
Exterior	58	3.9	(3.1 , 4.7)
Hall/Foyer	125	1.9	(1.4 , 2.4)
Kitchen	142	3.9	(3.3 , 4.5)
Living Room	147	3.7	(3.1 , 4.2)
Other	150	1.7	(1.4 , 2.0)
Home - All Bulbs	***206***	***2.5***	***(2.4 , 2.6)***
Efficient Bulbs	***518***	***3.0***	***(2.7 , 3.2)***
Non-Efficient Bulbs	***673***	***2.3***	***(2.1 , 2.5)***

Table 3-21: Residential Statewide Average Coincidence Factor

Room Type	No. Loggers	Average CF	90% CI
Basement	80	0.066	(0.042 , 0.091)
Bathroom	151	0.096	(0.073 , 0.119)
Bedroom	147	0.064	(0.044 , 0.085)
Closet	77	0.029	(0.011 , 0.046)
Dining Room	114	0.108	(0.080 , 0.136)
Exterior	58	0.265	(0.192 , 0.338)
Hall/Foyer	125	0.076	(0.050 , 0.101)
Kitchen	142	0.142	(0.115 , 0.170)
Living Room	147	0.098	(0.073 , 0.123)
Other	150	0.061	(0.044 , 0.079)
Home	***206***	***0.101***	***(0.097 , 0.105)***
Efficient Bulbs	***518***	***0.106***	***(0.095 , 0.116)***
Non-Efficient Bulbs	***673***	***0.099***	***(0.086 , 0.112)***

Key results of the commercial component of the Light Metering Study are summarized below in Table 3-22.

Table 3-22: Commercial Light Metering Study Key Results

	Hours of Use (HOU)		Coincidence Factor (CF)		Interactive Factor (IF)	
Building Type	Screw-Based Bulbs	General Service Ltg.	Screw-Based Bulbs	General Service Ltg.	Energy	Demand
Education	2,944	2,371	0.39	0.45	1.84%	12.34%
Grocery	7,798	6,471	0.99	0.93	-1.36%	19.24%
Health	2,476	2,943	0.47	0.52	-2.17%	19.41%
Institutional/Public Service	1,456	1,419	0.23	0.23	2.68%	16.57%
Lodging	2,925	3,579	0.38	0.45	-7.12%	19.63%
Miscellaneous	2,001	2,830	0.33	0.58	-0.08%	21.61%
Office	1,420	2,294	0.26	0.48	3.14%	22.64%
Restaurant	3,054	4,747	0.55	0.77	-7.15%	19.32%
Retail	2,383	2,915	0.56	0.66	-2.56%	21.53%
Warehouse	2,815	2,545	0.50	0.48	2.65%	19.89%

4 DUQUESNE LIGHT COMPANY

This chapter summarizes Duquesne's program performance in PY6. It includes an overview of the cumulative energy savings and demand reductions achieved by Duquesne's Act 129 EE&C programs in Phase II through the end of PY6; 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.

4.1 SUMMARY OF ENERGY AND DEMAND REDUCTIONS

Table 4-1 provides an overview of Duquesne's cumulative reported gross (RG) and verified gross (VG) savings impacts, and carryover (CO) savings since the EE&C programs' inception through the end of PY6.

Table 4-1: Summary of Duquesne's Phase II Savings Impacts

Savings Impacts	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/yr)	Savings Achieved as % of 2016 Targets[i]
Total Energy Savings (MWh/yr)	240,030	235,061	133,717	368,778	276,722	133%
Total Demand Reduction (MW)	30.742	33.185	N/A	33.2	N/A	N/A
TRC Benefits ($1,000)[a]	N/A[g]	$119,116	N/A	$119,116	N/A	N/A
TRC Costs ($1,000)[b]	N/A[g]	$60,827	N/A	$60,827	N/A	N/A
TRC B/C Ratio[c]	N/A[g]	1.96	N/A	1.96	N/A	N/A
CO_2 Emissions Reduction (Tons)[d][e]	204,866	200,625	114,127	314,752	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 1,707 lb CO_2 per MWh according to the latest available (2014) PJM Emission Report of marginal off-peak annual CO_2 emission rate based on direction provided by Commission staff.
[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 Savings 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 Gross Savings 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.

As Table 4-1 shows, Duquesne achieved 133% of its Act 129 Phase II energy savings target by the end of PY6. The TRC B/C ratio (or TRC ratio) of Duquesne's programs through PY6 is 1.96, which indicates that Duquesne's portfolio of EE&C programs is cost-effective on an aggregated basis.

Table 4-2 lists the 20 EE&C programs for which Duquesne reported PY6 gross energy and/or demand savings.

Table 4-2: Duquesne EE&C Programs with Reported Gross Savings in PY6

Programs Reporting PY6 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
Commercial Sector Umbrella EE[a]	Commercial
Healthcare EE	Commercial
Industrial Sector Umbrella EE	Industrial
Chemical Products EE	Industrial
Mixed Industrial EE	Industrial
Office Building - Large EE	Commercial
Office Building - Small EE	Commercial
Primary Metals EE	Industrial
Public Agency/Non-Profit	Commercial
Retail Stores - Small EE	Commercial
Retail Stores - Large EE	Commercial
Multifamily Housing Retrofit	Commercial
Small Commercial Direct Install	Commercial

NOTES
[a] Commercial Sector Umbrella EE (Upstream Lighting) had no reported gross savings according to new research.

Table 4-3 provides a breakdown of the contribution of the verified gross energy savings (MWh/yr) and gross demand savings (MW) for each program, and the contribution of each program's savings toward the total portfolio energy and demand savings. The Residential EE Program (Upstream Lighting) accounts for 32% of the total Phase II verified gross energy savings in Duquesne's portfolio, making it the most impactful energy savings program in the residential sector. The Office Building – Large EE program accounts for 12% of the total Phase II verified gross savings in Duquesne's portfolio, making it the most impactful energy savings program in the non-residential sector. The low-income programs contributed about 6% of portfolio savings. Collectively, the 20 programs yielded more than 235,000 MWh/yr of verified gross energy savings and more than 33 MW of verified gross demand savings for Phase II through PY6.

Table 4-3: Summary of Duquesne EE&C Program Impacts on Verified Gross Portfolio Savings

Program	Phase II VG Savings (MWh/yr)	% of Portfolio Phase II VG MWh/yr Savings	Phase II VG Savings (MW)	% of Portfolio Phase II VG MW Savings
Residential: EE Program (REEP): Rebate Program	7,065	3%	0.703	2%
Residential: EE Program (Upstream Lighting)	75,967	32%	5.533	17%
Residential: School Energy Pledge	411	0%	0.025	0%
Residential: Appliance Recycling	4,454	2%	0.575	2%
Residential: Whole House	82	0%	0.008	0%
Residential: Low-Income EE	2,619	1%	0.334	1%
Residential: Low-Income EE (Upstream Lighting)	12,473	5%	0.723	2%
Commercial Sector Umbrella EE	1,305	1%	0.345	1%
Commercial Sector Umbrella EE (Upstream Lighting) [a]	27,079	12%	7.591	23%
Healthcare EE	2,273	1%	0.486	1%
Industrial Sector Umbrella EE	1,678	1%	0.326	1%
Chemical Products EE	619	0%	0.093	0%
Mixed Industrial EE	9,209	4%	1.479	4%
Office Building - Large EE	28,389	12%	4.700	14%
Office Building - Small EE	838	0%	0.203	1%
Primary Metals EE	26,124	11%	3.042	9%
Public Agency/Non-Profit	12,873	5%	2.892	9%
Retail Stores - Small EE	7,418	3%	1.702	5%
Retail Stores - Large EE	6,896	3%	1.546	5%
Multifamily Housing Retrofit	2,095	1%	0.160	0%
Small Commercial Direct Install	5,195	2%	0.717	2%
Total Portfolio	**235,061**	**100%**	**33.2**	**100%**

NOTES
[a] Commercial portion of upstream lighting program is shown separately, as in the Duquesne PY6 annual report.

The NTG research yielded estimates of NTG ratios for the Duquesne programs.

Table 4-4 provides the verified net savings alongside the VG savings for PY6 and Phase II. The portfolio-level NTG ratio for PY6 was 0.66. Section 4.4.4.1 provides findings and details on the SWE Team audit of the NTG research conducted for Duquesne programs.

Table 4-4: Summary of Duquesne EE&C Verified Net Savings – by Sector

Sector	PY6 VG Savings (MWh/yr)	PY6 Verified Net Savings (MWh/yr)	Phase II VG Savings (MWh/yr)	Phase II Verified Net Savings (MWh/yr)
Residential	39,110	27,152	103,071	91,113
Commercial and Industrial	53,215	34,522	117,022	98,329
Government, nonprofit, and institutional	14,228	8,295	14,968	9,035
Total Portfolio	***106,553***	**69,969**	***235,061***	**198,477**

4.2 TOTAL RESOURCE COST TEST

Table 4-5 presents TRC NPV benefits, TRC NPV costs, present value of net benefits, and TRC ratio for Duquesne's PY6 individual programs and total portfolio according to the Duquesne TRC model provided to the SWE for initial review. An initial comparison between the Duquesne TRC model and the TRC NPV benefits and TRC NPV costs in the PY6 Annual Report[22] showed minor differences across a few programs. The TRC NPV benefits and costs were approximately $4 million and $230,000 higher, respectively, in the PY6 Annual report compared to the TRC Model provided to the SWE.

The SWE Team was able to coordinate with Navigant and determine that an error in the summation of avoided incandescent bulb purchases as the basis for the discrepancy in TRC NPV benefits. The SWE Team also noted an inconsistency between the TRC model and PY6 report with regard to Home Energy Report and Healthcare EE TRC NPC costs. Navigant provided a revised TRC model to the SWE that aligned the TRC model's NPV costs with those in the PY6 report, but additional corrections to the TRC model resulted in a slight deviation of the NPV benefits relative to the PY6 report. Further discussion of these modeling corrections is discussed below.

Table 4-5: Summary of Duquesne's PY6 TRC Factors and Results

Program	TRC NPV Benefits ($)	TRC NPV Costs ($)	Present Value of Net Benefits ($)	TRC Ratio
Appliance Recycling	$1,150,730	$559,495	$591,235	2.06
Home Energy Reports	-	$1,333,000[a)]	$(1,333,000)[a)]	0.00
Residential EE Program	$16,165,187[a)]	$9,279,197	$6,885,990[a)]	1.74[a)]
School Energy Pledge	$20,947	$176,000	$(155,053)	0.12
Whole House	$29,412	$376,225	$(346,813)	0.08
Low-Income EE	$960,757[a)]	$864,230	$96,527[a)]	1.11[a)]
Commercial Sector Umbrella EE	$510,719	$699,333	$(188,614)	0.73
Healthcare EE	$21,423	$190,867[a)]	$(169,444)[a)]	0.11[a)]
Multifamily Housing Retrofit	$1,155,914	$1,309,193	$(153,279)	0.88

[22] See Table 1-13: PYTD TRC Ratios by Program. DLC Program Year 6 Annual Report. Submitted November 16, 2015. Page 17.

Program	TRC NPV Benefits ($)	TRC NPV Costs ($)	Present Value of Net Benefits ($)	TRC Ratio
Office Building EE	$13,386,956	$8,070,909	$5,316,047	1.66
Public Agency/Non-Profit	$9,692,114	$5,310,729	$4,381,385	1.83
Retail Stores EE	$7,280,486	$4,162,700	$3,117,786	1.75
Small Commercial Direct Install	$3,004,011	$2,766,460	$237,551	1.09
Industrial Sector Umbrella EE	$116,715	$127,212	$(10,497)	0.92
Chemical Products EE	$160,191	$394,305	$(234,115)	0.41
Mixed Industrial EE	$6,341,838	$1,621,211	$4,720,627	3.91
Primary Metals EE	$5,375,625	$2,901,657	$2,473,968	1.85
Common Costs	-	*$0*	-	-
Total Portfolio	**$65,373,026[a]**	**$40,142,725[a]**	**$25,230,301[a]**	**1.63[a]**

[a] Denotes differences between the Duquesne TRC model shown in this table and the TRC NPV benefits and costs shown in Table 1-13 of the Duquesne PY6 Annual Report.

In summary, 9 of 17 Duquesne programs were found to be cost-effective and 7 were found to be non-cost-effective. An additional program, Home Energy Reports, had costs but no participation in PY6. The breakout of cost-effective and non-cost-effective programs is shown below.

Cost-Effective Programs

(TRC Ratio > 1.0)

- *Residential Appliance Recycling Program*
- *Residential Energy Efficiency Program*
- *Low-Income Energy Efficiency Program*
- *Office Building EE*
- *Public Agency/Non-Profit*
- *Retail Stores EE*
- *Small Commercial Direct Install*
- *Mixed Industrial*
- *Primary Metals EE*

Non-Cost-Effective Programs

(TRC Ratio < 1.0)

- *School Energy Pledge Program*
- *Whole House EE*
- *Commercial Sector Umbrella EE*
- *Healthcare EE*
- *Multifamily Housing Retrofit*
- *Industrial Sector Umbrella EE*
- *Chemical Products EE*

No Participation

(TRC Ratio = 0)

Home Energy Reports

4.2.1 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 also used a LLF of 6.9% for calculating energy and demand savings for all programs in PY6. Table 4-6 shows details for discount rates and the energy and demand LLF values that Duquesne used for all programs.

Table 4-6: Duquesne's Discount Rates and LLFs

Program	Sector	Discount Rate	Energy LLF[a]	Demand LLF[a]
Appliance Recycling	Residential	6.9%	6.9%	6.9%
Home Energy Reports	Residential	6.9%	6.9%	6.9%
Residential EE Program	Residential	6.9%	6.9%	6.9%
School Energy Pledge	Residential	6.9%	6.9%	6.9%
Whole House	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%
Multifamily Housing Retrofit	Commercial	6.9%	6.9%	6.9%
Office Building EE	Commercial	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%
Small Commercial Direct Install	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%
Primary Metals EE	Industrial	6.9%	6.9%	6.9%

NOTES
[a] Duquesne's PY6 annual report shows line losses as a multiplier (1.074). SWE has converted to a LLF for consistency in reporting across EDCs.

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 2014 TRM and found only small variances. For example, the Duquesne TRC model uses an EUL of 15 years for programmable thermostats whereas the 2014 PA TRM stipulates an EUL of 11 years. In addition, the TRC model used a five-year EUL for advanced smart strips, and the 2014 PA TRM has a deemed EUL of five years. The SWE Team recommends that the TRM be used as the primary source for these values when they are available. The SWE Team also found the measure lives applied to custom measures not explicitly stated in the TRM to be reasonable.

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 Duquesne's PY6 annual report. The

incremental cost values came from a variety of sources, including the SWE incremental cost database, C/I Fluorescent Lighting Cost Study,[23] 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 a small difference (6 MWh) between the verified energy savings in the TRC model and the PY6 Annual Report. The evaluator confirmed that this difference was due to rounding. Overall, the difference is < 1% of the total portfolio's verified energy savings. The verified demand savings in the TRC model and PY6 Annual Report were in alignment.

In PY6, the 2014 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 PY6. 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

4.2.2 Avoided Cost of Energy

Duquesne's TRC model assigns a value ($/kWh) to the avoided cost of energy for each year from 2015 through 2029 under four different load conditions: summer on-peak, summer off-peak, winter on-peak, and winter off-peak. Each measure in Duquesne's portfolio was assigned to an end-use load shape most correlated with the affected equipment. The energy impacts of a given measure were divided across the four load conditions based on the associated load profile. The impacts under a given load condition were multiplied by the avoided cost of energy for that condition and summed to calculate the annual avoided energy benefits produced by the measure.

During the TRC audit process, the SWE Team observed a calculation error in the TRC model that used an incorrect avoided cost stream that effectively provided all measures with an additional 2 years of TRC benefits. The SWE Team notified Navigant of this error and the evaluator submitted a corrected model to the SWE Team.

4.2.3 Avoided Cost of Capacity

The Duquesne PY6 TRC model assigned an annual amount ($/kW-year) to the cost of adding generation capacity, which was used for the avoided cost of capacity for all programs and sectors. Ex post demand savings were adjusted for line losses and multiplied by the avoided cost of capacity estimates to determine the financial benefit of peak-demand impacts.

The SWE suggests that incorrect capacity avoided cost stream was utilized in the calculation of the PY6 NPV benefits. For PY6 the appropriate initial year avoided capacity cost should align with the PJM 2014/2015 RTO base residual auction clearing price ($45.99 kW-Yr). The second year in the avoided capacity cost stream should align with the 2015/2016 RTO base residential auction clearing price, with all subsequent years escalated by a rate of inflation. The SWE contends that Duquesne's approved EE&C plan also mistakenly assigns the avoided capacity cost stream to incorrect years. Table 4-7 below shows the different avoided capacity cost streams for a sample of years.

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

Table 4-7: Differences in Avoided Capacity Cost used by Duquesne

Year	EE&C Plan ($/kW-Yr)	PY6 TRC Model ($/kW-Yr)	SWE Recommended ($/kW-Yr)
2012	$10.12	-	-
2013	$45.99	$10.12	-
2014	$49.64	$45.99	$10.12
2015[a]	$51.66	$49.64	$45.99
2016	$53.76	$21.67	$49.64
2017	$55.95	$43.80	$51.66
2018	$58.23	$45.03	$53.76
2019	$60.59	$46.29	$55.95
2020	$63.06	$47.58	$58.23

[a] 2015 is expected to be the initial year of the avoided cost stream used to analyze the TRC benefits in PY6. Avoided cost stream for PY6 is 2015-2029.

Duquesne submitted a revised TRC model that uses the 2015-2029 avoided cost capacity cost stream consistent with the SWE recommended values above. These values align the 2014/2015 RTO base residual auction clearing price as the initial year PY6 avoided cost stream.

4.2.4 Conclusions and Recommendations

The Duquesne TRC model was very transparent; all inputs were well-documented and consistent with other documentation provided to the SWE Team for review. The SWE Team found minor errors in the summation of TRC benefits and the evaluator submitted a revised model to correct the current calculations. As a result, the PY6 NPV benefits decreased slightly from $69.5 million to $68.9 million and the TRC Ratio decreased from 1.72 to 1.71 in PY6. The SWE Team recommends Duquesne use the revised TRC model submitted to the SWE and reflect these updates in the PY7 report.

4.3 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.

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
- Outline process evaluation methodology
- Outline cost-effectiveness evaluation methodology
- Propose a timeline 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 provides either party the opportunity to request additional time if unforeseen circumstances arise. Key milestones completed by Duquesne and the SWE are shown in Table 4-8. This 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 4-8: 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 are summarized in the SWE PY5 Annual Report to the PUC. The revisions to the Duquesne evaluation plan provided by the company on December 31, 2013 and January 9, 2014 were approved by the SWE Team.

Duquesne made three clarifications to Duquesne's evaluation plan for PY6. The three clarifications were not formally submitted until PY6 had concluded, but they are mentioned in this report because of their relevance to the evaluation of PY6 program activity. These clarifications include the following:

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 sectors market segments) based on shared characteristics. Each program group includes multiple subprograms. All programs have the same incentives and measures. The differences among programs are marketing channel and approach. The three major program groups are the Commercial Program Group, GNI Program Group, and Industrial Program Group. These program groupings have existed since Phase I of Act 129.

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 their 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 Groups 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 includes stratification based on expected energy savings from PY5. In July 2015 Duquesne clarified to the SWE the sampling plan for the Industrial Program Group.

4.3.2 Measurement and Verification Activities and Findings

By the end of PY6, Duquesne had achieved 133% of its total Phase II energy savings compliance target, based on aggregated verified savings as of May 31, 2015 from Phase II in addition to Phase I carryover. Realization rates compare gross savings reported by the EDC to 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 4-9 summarizes M&V findings based on activities conducted by Navigant, on details provided in Duquesne's PY6 annual report, and on information obtained from the SWE Team's data requests and audits. Table 4-9 shows the realization rates for energy and demand savings for each of Duquesne's energy efficiency programs in PY6.

Table 4-9: Duquesne Energy Efficiency Programs – Realization Rates for Energy and Demand Savings in PY6

Program	Realization Rate – Energy	Achieved Precision – Energy	Realization Rate – Demand	Achieved Precision - Demand
Residential: EE Program (REEP): Rebate Program	67%	11.9%	64%	15.4%
Residential: EE Program (Upstream Lighting)	100%	0.0%	107%	0.0%
Residential: School Energy Pledge	56%	13.9%	58%	14.4%
Residential: Appliance Recycling	101%	1.8%	101%	1.8%
Residential: Whole House	96%	4.9%	97%	4.8%
Residential: Low-Income EE	95%	3.0%	95%	2.8%
Residential: Low-Income EE (Upstream Lighting)	100%	0.0%	107%	0.0%
Commercial Sector Umbrella EE	93%	8.5%	154%	21.9%
Commercial Sector Umbrella EE (Upstream Lighting)[a]	N/A	0%	N/A	0%
Healthcare EE	93%	8.5%	154%	21.9%

Program	Realization Rate – Energy	Achieved Precision – Energy	Realization Rate – Demand	Achieved Precision - Demand
Industrial Sector Umbrella EE	101%	12.9%	100%	12.2%
Chemical Products EE	101%	12.9%	100%	12.2%
Mixed Industrial EE	101%	12.9%	100%	12.2%
Office Building - Large EE	93%	8.5%	154%	21.9%
Office Building - Small EE	93%	8.5%	154%	21.9%
Primary Metals EE	101%	12.9%	100%	12.2%
Public Agency/Non-Profit	93%	29.4%	109%	5.8%
Retail Stores - Small EE	93%	8.5%	154%	21.9%
Retail Stores - Large EE	93%	8.5%	154%	21.9%
Multifamily Housing Retrofit	96%	2.9%	82%	4.1%
Small Commercial Direct Install	96%	2.4%	98%	5.0%

NOTES
[a] Commercial portion of upstream lighting program is shown separately, as in the Duquesne PY6 annual report.

4.3.2.1 Residential Programs

Realization rates for energy savings from Duquesne's residential programs range from 56% (School Energy Pledge) to 101% (Appliance Recycling). Realization rates for energy savings from Duquesne's commercial programs range from 93% to 101%. Realization rates for demand reductions from Duquesne's residential programs range from 58% (School Energy Pledge) to 107% (Residential Upstream Lighting and Residential Low-Income Upstream Lighting).

The Duquesne residential programs saw mixed results for both energy and demand realization rates in PY6 relative to PY5, though the overall residential realization rate increased slightly, from 98% to 99%. Although the energy savings realization rate for the overall residential portfolio increased slightly, the realization rate for the Residential Upstream Lighting Program, which represented the largest residential program, dropped slightly, from 102% in PY5 to 100% in PY6, and the School Energy Pledge program experienced a steep decline (from 73% in PY5 to 56% in PY6).

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 measures with rebates less than $2,000. The basic level of verification rigor therefore included a telephone survey of a random sample of participants to verify participation and installation rates (except for the Residential Upstream Lighting Program, where end-use customer participant information is unavailable). Table 4-10 presents an overview of the M&V verification process and findings.

Table 4-10: Overview of Duquesne Residential Program M&V Verification and Installation Rate

Program	Component	Inspections Entity (CSP, EDC, M&V, Other)	Telephone or On-Site	Sample Size – Participant (Part), Measure	Installation Rate
Residential: EE Program (REEP): Rebate Program	Rebate	M&V	Telephone	Part n=43, Measure n=62	2 thermostats and 1 dishwasher not installed
	Kits	M&V	Telephone	Part n=26, Measure n=182	37% of CFLs not installed; 30% of smart strips not installed; 39% of LED night lights not installed
	Lighting	N/A	N/A	N/A	N/A
Residential: School Energy Pledge (SEP)	All	M&V	Telephone	Part n=31, Measure n=248	43% of CFLs not installed
Residential Appliance Recycling (RARP)	All	M&V	Telephone	Part n=63, Measure n=68	Misclassified (1 freezer was refrigerator) and one participant had 2 recycled and not 1 in database
Residential: Whole House (WHEAP)	Small Homes	M&V	Telephone	Part n=11, Measure n=17	7% of CFLs not installed
	Large Homes	M&V	Telephone	Part n=6, Measure n=12	All installed
Residential: Low-Income EE (LIEEP)	Kits/RARP/SEP/ WH/Smart Strip	M&V	Telephone	Part n=82, Measure n=181	4% of kits not installed; 42% of SEP kits not installed; 1 smart strip removed, 1 smart strip extra
	Lighting	N/A	N/A	N/A	N/A

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 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 upstream lighting component received a 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 PY5 evaluation, the kits component of the program had the lowest realization rate, which is attributable to participants not installing the CFLs (n=7 of 26), smart strips (n=9 of 26), or LED nightlights (n=5 of 26). Installation rates for the kits remained relatively unchanged since PY5. It should be noted that the energy savings realization rate for REEP (rebate, kits, and upstream components combined) has improved, climbing from 91% in PY4 to 95% in PY5 and 99% in PY6. The improvement can be attributed mostly to the shift in overall savings toward the upstream lighting component: in PY5, the upstream lighting component represented 82% of REEP savings, compared with 95% of REEP savings in PY6.

The evaluation contractor's primary M&V efforts for the 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 (a statistical parameter which is the ratio of the means of two variables) to review the measure and project qualification, verify participation and installation, and verify deemed savings application, and then apply the sample population realization rate to the entire participant population. The relatively low savings realization rate of the SEP is due to participants not installing the smart strips (n=13 out of 31) and LED limelights (n=10 out of 31), while a smaller population did not install the CFLs (n=6 of 31). Though the energy savings realization rate for this program had improved from PY4 (63%) to PY5 (73%), it declined to 56% in PY6—the lowest realization rate in several years.

The evaluation contractor's primary RARP M&V efforts included a survey of a random sample of participants to verify removal and/or replacement and estimate realization rates. One of the primary goals of the survey efforts was to collect data regarding the distribution of participants who replaced their old appliance with a new ENERGY STAR unit against those who replaced their old unit with a non–ENERGY STAR unit. 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 survey did not find any change in ENERGY STAR (93%) versus non–ENERGY STAR (7%) replacements from the prior survey in PY4. The energy realization rate for this program has remained high, at 101% in PY4, 102% in PY5, and 101% in PY6.

The WHEAP is a new program with participation 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, and verify deemed savings application, and then apply the sample population realization rate to the entire participant population. For WHEAP, two strata were defined (exclusive of the LIEEP participants): Whole House Small and Whole House Large. The strata were defined by total savings per project, with reported savings of 1,000 kWh serving as the cutoff between small and large.

Evaluation activities found that a majority of market rate customers (as designated in the PMRS database) were actually low-income customers. Reclassification of market rate participants as low-income participants reduced the WHEAP population by two-thirds (from 338 to 122). Navigant, through its evaluation, discovered that the CSP used a utility-approved methodology to identify customers who are low-income. Unfortunately, the low-income designations were not transferred into the PMRS system, apparently due to issues with the interface, which the utility plans to remedy for Phase III.

The WHEAP is currently limited to direct installation, and therefore high realization rates were expected. The evaluation found realization rates over 90%, proving that even with direct installation there will always be participants who remove, replace, or have issues with the installed measures and disconnects between tracking reported and verified quantities. The evaluation team also found there wasn't a clear path to determine the WHEAP participants who had also followed through with additional measures, primarily through the REEP, though the evaluation team was able to successfully link follow-up participants in other programs (approximately 5% of WHEAP had add-on measures through other programs, primarily REEP). Finally, the evaluation team also discovered that Duquesne may be underreporting savings since it is relying on the TRM-based default assumptions (using code baseline) rather than the existing baseline from the replaced measures.

The evaluation contractor's primary M&V efforts for the LIEEP included a survey of a random sample of participants based on six subprogram strata (efficiency kits, RARP, SEP, WHEAP, smart strips, and refrigerator replacement) to verify installations and estimate installation rates.[24] The upstream lighting component was evaluated separately and received a database verification consistent with the SWE audit approach, and verified the PMRS tracking database records against the implementer-based invoicing system (ECOVA). The LIEEP-based percentage of upstream lighting was assigned based on a new PY6 telephone survey (general population survey) and decreased from 20.4% in PY5 to 4.9% in PY6 for CFLs. In addition, 2.3% of all LEDs were assigned to the LIEEP—the associated levels of savings and incentive costs were 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, and 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 the LIEEP showed similar installation rates (57%) relative to the stand-alone SEP (56%). The kits component of LIEEP had a higher installation rate in PY6 (90%) than in PY5 (69%), and was substantially higher than the non-low-income REEP kits installation rate (63%). The energy savings realization rate for this program has remained high, climbing from 94% in PY4 to 98% in PY5 and remaining at 98% in PY6.

Similar to 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 had high installation rates (91% overall) but had the lowest installation rate of the WHEAP program (small WHEAP was 94% and large WHEAP was 100%). Similar to market rate RARP, the LIEEP RARP verification effort confirmed that appliances were recycled; the realization rate was 100% and all units were recycled as reported. Of the eight surveyed

[24] The PY6 LIEEP evaluation excludes rebates. Rebates contributed very little to overall program savings.

smart strip LIEEP participants, two did not have their smart strips in use, and one had received two smart strips, for an installation rate of 87.5%.

4.3.2.2 Non-Residential Programs

Realization rates for Duquesne's C/I programs' energy savings ranged from 93% to 101% in PY6. Realization rates for demand reductions from these programs range from 82% to 154%. 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.

Figure 4-1 displays the frequency of each M&V approach performed by Navigant in PY6 for Duquesne's Commercial and GNI Program Group 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 4-1: Frequency and Associated Savings by M&V Approach – Commercial and GNI Program Groups

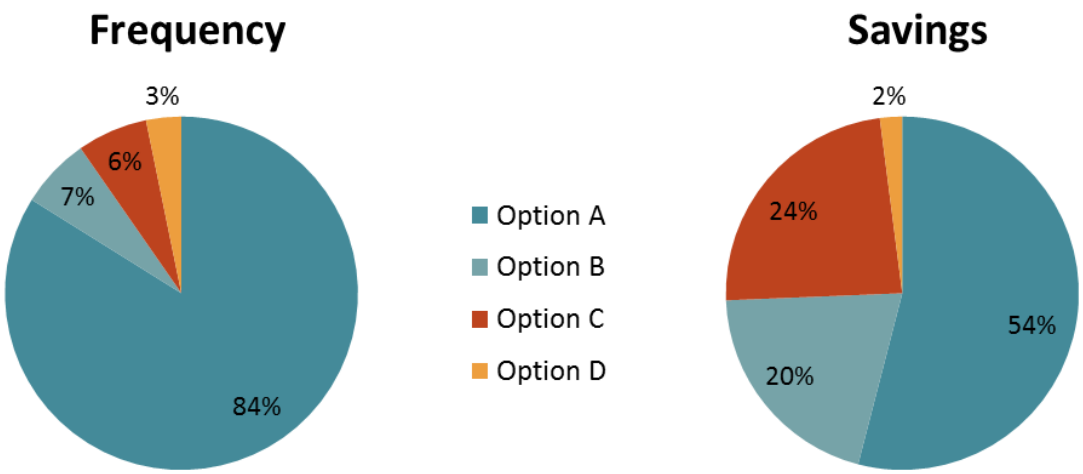


Figure 4-1 indicates that Navigant used IPMVP Option A for 84% of the projects selected for sampling. However, these projects accounted for 54% of the sample's energy savings. Option B was used for only 7% of projects, but they accounted for 20% of the savings. Option C was used for 6% of projects, but these accounted for 24% of the savings. Option D was used on one project, which accounted for 3% of projects and 2% of the savings.

Figure 4-2 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 predominately for this program group. The only other option used was B, which accounted for 9% of program savings yet was applied to just 1% of projects.

Figure 4-2: Frequency and Associated Savings by M&V Approach – Industrial Program Group

Two additional programs, the Small Commercial Direct Install program and the Multifamily Housing Retrofit program, fall within the commercial sector, but these programs received separate treatment in PY6 because they were new this year. Navigant used IPMVP Option A for 100% of the projects in the evaluation samples of these two programs.

4.3.3 Process Evaluation Activities and Findings

The process evaluation that Navigant conducted included a review of key program documents and databases; surveys of program participants, program-affiliated contractors, and other market actors; and interviews with program staff and program CSPs—although not every evaluation included all of these elements. Navigant chose to file its process evaluations in separate volumes (one residential and one non-residential) and high-level findings in the Duquesne annual report. Table 4-11 provides a high-level summary of the data sources Navigant used and its key findings for each program.

Table 4-11: Summary of Key Findings and Data Sources – Duquesne

Program	Key Findings	Data Sources
Residential		
Residential Energy Efficiency Program (REEP)	– Overall customer satisfaction was high. Participant satisfaction with rebate was lower in Q3/Q4 than in Q1/Q2 of PY6. – A small minority of customers were dissatisfied with the application process, noting that their applications were initially rejected due to perceived minor errors. – Participants recommended including other measures in the kits beyond the CFLs currently supplied. – Kit recipients reported a high level of satisfaction, though they rated satisfaction with kit energy savings consistently lower than other program aspects. – Almost all general population customers are aware of CFLs (98%) and many are aware of LEDs (66%). – CFL socket penetration is high – only 14% of customers do not have at least one CFL installed; 46% have no LEDs installed.	– Participant surveys (n=69) – General population lighting survey (n=1,547) – In-store lighting intercept survey (n=137) – Delphi panel

Program	Key Findings	Data Sources
	– Two-thirds of customers are satisfied with LED light quality, but understanding of LED features remains low, with 10% reporting knowing LEDs lasted 15 years or more, and about half reporting awareness of LEDs' energy savings potential.	
Residential Appliance Recycling Program (RARP)	– The program budget expenditure to savings ratio was high in PY6. – Duquesne staff indicated that the EE&C Plan understated certain implementation costs by including them in REEP. The PY7 report will report adjusted costs. – RARP is well established and relied heavily on recommendations from friends and family for outreach. Participation grew from 2,172 in PY5 to 2,788 in PY6. – Most participants reported they were motivated to recycle their refrigerator through the program because of the cash incentive. Some noted the convenience of a free, in-home pickup as another reason to participate.	– Participant surveys (n=63)
School Energy Pledge Program (SEP)	– The program achieved a small proportion of its savings goals (7%) while expending 30% of its budget. – Participating parents reported high satisfaction with the program. – Participants recommended including additional measures in the kit they received.	– Participant surveys (n=31)
Whole House Energy Audit Program (WHEAP)	– WHEAP achieved 31% of its goals and spent 140% of its budget; however, many low-income customers were incorrectly categorized as market customers. Duquesne's LIEEP claimed savings garnered from these customers rather than WHEAP. – WHEAP was limited to claiming the direct-install savings. Any additional auditor actions such as changing settings on energy-using equipment were unclaimed by WHEAP. The CSP noted that they knew, anecdotally, of several instances in which sockets had 60W incandescent bulbs rather than EISA-compliant bulbs. Current savings estimates were based off EISA baselines, therefore underestimating savings. – No participant used the Keystone loan program for additional energy upgrades. – Bill inserts effectively drove potential customers to the program. – According to one auditor interviewed, the program could potentially have installed 25% more energy efficiency lamps if dimmable CFLs or LEDs were included in the direct-install measure mix. – The original low-income WHEAP offering included a set of larger whole-house measures. Costs for these larger projects were high relative to WHEAP's program budget. These projects were rejected, leading to some homeowner and contractor dissatisfaction. – The utility tracking system did not incorporate low-income status information collected by the CSP when CSP participation data were transferred to the utility.	– Participant surveys (n=17) – Duquesne program manager and CSP interviews (n=5) – CSP auditor interviews (n=4)
Low-Income		

Program	Key Findings	Data Sources
Low-Income Energy Efficiency Program (LIEEP)	– The findings listed above for REEP, RARP, SEP, and WHEAP apply to LIEEP. – Several customers who had their refrigerator replaced through LIEEP expressed dissatisfaction with the quality of the refrigerator. – Smart strip recipients reported high levels of satisfaction with LIEEP and Duquesne representatives. – Participants' program awareness levels were equivalent to their market level counterparts.	– Participant surveys (n=69)
Non-Residential		
Commercial and Industrial Programs	– EnerNOC expanded its trade ally network for the CSP for the chemical and mixed industrial sector programs. – CSPs reported issues with the PMRS, noting that they now have to go through an additional step to query the database. Generally, CSPs reported dissatisfaction with the PMRS, particularly when working with larger projects. – All CSPs now pre-meter large projects to establish accurate baselines. – Project documentation on the PMRS has improved when compared with PY5.	– Duquesne program manager and CSP interviews (n=7)
Small Commercial Direct Install Program (SCDI)	– The program expended its funds and met its goals earlier than expected. A large fraction of the eligible market remains available to serve. – The PMRS restricts the CSP's ability to streamline or automate part of their process. Trade allies reported long delays in payment due to the data-tracking system. – Participants were generally satisfied with the program. Likewise, program trade allies were generally satisfied. Trade allies identified the time it took to obtain payment as the part of the program that could most use improvement. – Participants identified four major barriers to participation – lack of awareness, the complicated nature of the program, the cumbersome paperwork, and difficulty qualifying for the program (13% of respondents). – A subset of trade allies reported it might be easier to recruit participants if there were a modest copayment from the customer (2 of 7 respondents). – When asked how the program could be improved, 5% of respondents reported wanting detailed information from Duquesne, and indicated the program needs more promotion to increase awareness.	– Duquesne program manager and CSP interviews – Participant surveys (n=35) – Trade ally interviews (n=7)
Multifamily Housing Retrofit Program (MFHR)	– The program is well documented and tracked. – CSP and Duquesne staff manually review and process customer eligibility and applications. – The MFHR CSP noted that the program tracking system is outdated and makes streamlining paperwork and project approval difficult. – This is a turn-key program that provides customers with a single point of contact. The CSP also installs the measures, so participants do not have to find a separate contractor. – A minority (31%) of participants visited the program website. Of the small proportion that did so, about a	– Duquesne program manager and CSP interviews – Participant surveys (n=16)

Program	Key Findings	Data Sources
	quarter of participants reported the website provided useful information. – Participants are generally highly satisfied with the program and Duquesne. The few dissatisfied participants noted a lack of direct contact with Duquesne, or (one indicated) that a contractor was unprofessional. – To improve the program, participants suggested more proactive communication from Duquesne, and more detailed energy efficiency information. Participants also noted the program needs more promotion to increase awareness. – The CSP estimated they would have served only a small segment of the potential market at the end of the program.	

4.4 STATEWIDE EVALUATOR AUDIT ACTIVITIES AND FINDINGS

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

4.4.1 Residential Program Audit Summary

The results of the SWE Team's residential program audits are discussed below. The discussion focuses on the auditing of REEP, SEP, ARP, and WHEAP.

Overall, the SWE Team did not identify any concerns related to the installation rates, verification process, or the application of TRM-based savings for any of Duquesne's residential programs. The SWE Team found that the worksheets provided by Duquesne's evaluation contractor, Navigant, were extremely helpful and easy to follow, and were mostly consistent with the SWE Team's audit procedures. This allowed the SWE Team to conduct a detailed review and audit of the PY6 residential evaluation. The SWE Team identified two areas that could be improved. The first would be to include a discussion regarding installation and verification (impact related) findings to make it clear which measures or components of the programs require improvement. The second would be to include additional discussion related to any significant shifts in parameters used for partially deemed TRM-based savings calculations. The results of the SWE Team's audits of four residential programs (REEP, SEP, ARP, and WHEAP) are discussed below.

4.4.1.1 Residential: Energy Efficiency Program – Rebate, Kits, and Upstream Lighting

For the rebate and kits components of the program, the SWE Team reviewed the evaluation consultant's methods and findings and determined that Step 1 of the annual audit, a desk review of a random sample of rebate applications, was not warranted due to the presence of a comparable desk review administered by the evaluation contractor. The SWE Team reviewed the evaluation contractor's analysis in the files "SWE DR Item 6 - DLC_REEP FR SO and RR analysis.xlsx" and "SWE DR Item 1 - DLC PY6 REEP Application Review.xlsx" and verified that the methodology and values used were correct. The SWE Team also 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 2014 TRM. During this review, the SWE Team was unable to identify any discrepancies between the PMRS tracking system and the 2014 TRM.

For the PY5 audit, the SWE Team discovered some database irregularities for the REEP rebate component that were supposed to have been corrected during PY6 with the implementation of the new database

system (scheduled to be deployed by the second quarter of 2015). The measures still lacking sufficient detail, and representing a small fraction of the overall program savings, included HVAC measures such as heat pumps, ductless mini-split heat pumps, and central air conditioners. Navigant, in response to an email enquiring about this issue,[25] provided the following details:

> *"IT staffing changes at Duquesne Light and at the utility's CSP for rebate application processing made collecting certain data challenging. In particular, as we noted in the past, certain data fields had not been included in PMRS for a few partially deemed measures representing a very small percentage of program savings. With the change in staffing at both companies, in PY6 these data fields again were not populated in the dataset that the Duquesne Light staff uploaded. As a result, Navigant manually collected the missing data and/or made assumptions with respect to specific savings algorithm parameters for the project records selected for sampling and incorporated any differences between the measures/savings reported and the measures/savings verified in our program realization rates. While changes may be made to PMRS to enable uploading and reporting from PMRS of the data fields in question, this is likely to occur only for Phase III rather than trying to implement such a change in the middle of PY7 for a partial year and then make changes again to address Phase III program requirements."*

The SWE Team did not encounter any of the database irregularities during the PY6 audit, though during the application review Navigant flagged several refrigerator and freezer records (n=8 out of 13) that had been misclassified and therefore received adjusted (6 of the 8 received higher) verified savings; these adjustments were reflected in the gross realization rate. It appears that the new database system has mostly resolved the data shortcomings that had been noted previously, though additional data validation appears to still be necessary.

For the upstream lighting component of the program, 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 2014 TRM. Similar to the PY5 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 PY6 ECOVA TRM Comparison.xlsx." Furthermore, both the evaluation contractor and the SWE Team were able to review ECOVA invoices to determine that the bulb counts were accurately tracked in the PMRS database and tracking system (the SWE Team was able to review this step easily since the evaluation contractor's analysis was included in the ECOVA invoice file and the batch and transaction identification made cross-referencing intuitive).

The SWE Team also was able to confirm and verify that while Duquesne used the correct algorithms, incorrect baseline wattage values were used for the savings algorithm for 8% of the records (compared with 21% in PY5), which represented 7% of the total bulbs (compared with 4% in PY5). The SWE Team agrees with the evaluation contractor's ex post verified findings and can verify that the 100% energy realization rate and 107% demand realization rate are correct (the high demand realization rate was based almost entirely on Q1 records and appears to have been addressed for the remaining PY6 Q2–Q4 quarters). No issues were identified in the review of invoices from PY6.

The SWE Team believes it is crucial to include rationale behind the findings, including any differential in realization rates, and there was no discussion in the evaluation report that detailed where the different

[25] Hastie, Steve (personal email communication, December 15, 2015).

components of the program are under or over-performing and why. As noted above, there were a considerable number of upstream lighting records that required making adjustments to verified savings, and while the ex post verified total was almost evenly balanced (the negative ex post adjustments offset the positive ex post adjustments), there should have been a discussion that included the areas of disconnect to allow program administrators the ability to correct for these oversights in the future.

The SWE Team therefore reached out to Navigant to discuss the continued lighting issues, and Navigant was able to convey the following:[26]

> *"Navigant met with the lighting program CSP (ECOVA) prior to the implementation of the PY6 Upstream Lighting program to ensure that everyone was clear on the various changes required for PY6. The few problems that were identified appear to have been due most often to identification of some bulb types (SKUs) as being general service instead of specialty or reflector bulbs (i.e., not exempt vs. exempt from EISA requirements). Navigant will work with ECOVA to try to ensure that this issue does not continue to be a problem for these bulb types, though with most of the PY7 program completed, there will likely still be a need for Navigant to made corrections for the SKUs in question."*

Furthermore, though the PY6 Residential Upstream Lighting Program energy realization rate was close to 100%, there were two prominent shifts in the findings relative to PY5 that had significant impacts on energy savings values: cross-sector sales and sales to low-income participants (LIEEP). A review of the PY5 and PY6 cross-sector sales and sales to low-income customers are included in Table 4-12 below. CFL cross-sector sales dropped from over 12% down to 0%, while sales to low-income customers dropped from over 20% in PY5 to below 5% for both CFLs and LEDs in PY6. Though there have been several studies that have shown zero cross-sector sales, they have been the outliers and not the norm.[27] The Duquesne PY6 annual report did not include any discussion related to these changes, nor did the report include any discussion regarding a potential change in methodology that may have contributed to the shifts seen below.

Table 4-12: Comparison of Duquesne's PY5 and PY6 Upstream Lighting Cross-sector and LIEEP Sales Parameters

Program Year	Bulb Type	Cross-sector Sales	Sales to LIEEP Customers
PY5	CFL	12.6%	20.4%
PY6		0%	4.9%
PY5	LED	0%	20.4%
PY6		0%	2.3%

The SWE Team had a call with the Navigant team to better understand the underlying drivers behind the significant movement of these parameters. According to Navigant, the method used to estimate cross-sector sales was consistent between PY5 and PY6. Intercept surveys were administered on-site at participating retailers throughout Duquesne's territory to estimate cross-sector sales. However, the method used to estimate sales to low-income customers changed from a phone-based general population survey in PY5 to an online-based survey for PY6 that solicited recipients who had purchased a CFL within the past three months or an LED within the past six months. Furthermore, Navigant was able to provide additional details comparing the PY5 and PY6 intercept surveys which showed consistent distribution

[26] Hastie, Steve (personal email communication, December 15, 2015).

[27] For example, a review of 23 recent cross-sector sales studies found a range of 0%–19% and a mean of 7%; only two studies showed no measureable cross-sector sales. Please see the following report: http://ma-eeac.org/wordpress/wp-content/uploads/Residential-Lighting-Cross-Sector-Sales-Research-Memo.pdf

between weekday and weekend site visits and a similar mix of retailers. The only methodological differences were a considerably larger sample size in PY6 (n=417) than in PY5 (n=182), and that the PY6 intercepts were administered in the spring (March–April) while the PY5 intercepts were in the fall (September), but neither of these differences would be expected to substantially decrease the cross-sector and low-income sales. The Navigant team provided two primary possible explanations, based on the program implementation, for the shift in cross-sector and low-income sales:

1) In PY5, the program offered $0.99/bulb promotions that drew considerable interest. These promotions were not offered in PY6.
2) The program offered a considerably narrower range of bulb types in PY6 than in PY5.

The SWE Team finds the discussion regarding shifts in cross-sector and low-income sales from PY5 to PY6 to be lacking some key information. It would have been beneficial to have reported the sample sizes, distribution of intercept stores, 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 bias between the two samples to ensure that the differences in PY5 and PY6 parameters were entirely driven by changes to program rather than changes in methods and samples. Given the upstream lighting programs' significant contribution to portfolio savings, the SWE Team encourages Navigant to include additional details regarding the methods in future annual reports as well as a discussion related to differences in parameter estimates.

4.4.1.2 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 the School Energy Pledge Program (SEP) (only a pledge form is required for participation). Historical findings from PY2 through PY5 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. Therefore 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 2014 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 found that the SEP chapter in the evaluation report did not include specific details on the realization rates to help pinpoint which measures are not being installed. In Section 4.3.2.1 the SWE Team provided a discussion of the drivers behind the low realization rates. While measure-specific realization rate information was provided in the EDC's response to the SWE's annual data request, the SWE Team recommends that future evaluation reports, themselves, include at minimum a brief discussion (including supporting tables or figures) that help identify specific measures or components of the program that are driving the verified realization rates. Navigant was able to provide some information regarding the previous (PY5) recommendation that sought to increase the installation rates for this program and other kit programs by offering additional educational outreach or follow-up emails. The reasons Duquesne was unable to accommodate this recommendation were:

- A substantial level of effort would have been required to enable such follow-up emails to these efficiency kit participants.
- Staffing changes at Duquesne necessitated a concentration ensuring that the primary implementation tasks associated with the residential programs were operated effectively, and there was no time to address this type of program refinement.
- The number of kit participants dropped significantly in PY6.

According to Navigant, the program has stabilized. Therefore, Duquesne plans to evaluate the SWE Team's recommendation in Phase III of the program.

4.4.1.3 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 SWE Team confirmed that Duquesne used the correct values for energy savings of replaced and retired refrigerators from the 2014 TRM in the calculation of net savings. Though not an error, the PMRS lacked an identifying field to indicate whether a unit was retired as a primary or secondary unit, with savings and avoided cost being the only fields available to identify primary versus secondary unit retirement. Navigant indicated that there were staffing changes in the Duquesne IT department which limited its ability to make certain changes to the PMRS. Savings values were corrected, but measure names could not be updated to match the corrected savings values. Duquesne plans to address this change for Phase III. Ultimately, there were no adjustments or changes made to the verified gross savings estimates reported by the evaluation contractor.

For replaced units, data from telephone verification surveys conducted with program participants from PY6 were used to estimate the percentage of refrigerator/freezer replacement participants who replaced their refrigerator/freezer with an ENERGY STAR refrigerator/freezer versus a non–ENERGY STAR refrigerator/freezer. The survey found that 93% of replacements were ENERGY STAR while the remaining 7% were non–ENERGY STAR. The PY5 percentages were unchanged (93% ENERGY STAR, 7% non–ENERGY STAR). As an example, for replacement refrigerators, the weighted average energy savings of replacing an old unit with an ENERGY STAR unit or a non–ENERGY STAR/standard unit, is equal to 745 kWh. The SWE Team reviewed this logic and the application of the composite savings to the appropriate records in the PMRS system and did not find that any adjustments or changes were required.

4.4.1.4 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 PY6 WHEAP_RR FR SO.xlsx) and cross-checked the reported units against the PMRS database and verified the unit counts between these two data sources. Similar to the SEP and REEP kits programs, Whole House Energy Audit Program (WHEAP) relied on lighting (CFLs and nightlights), small domestic hot water (faucet aerators, low-flow showerheads, and pipe wrap), and plug load (smart strip) measures. 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 SWE Team confirmed that Duquesne (and Navigant's verification) used the correct values for energy savings of the direct-install measures from the 2014 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.[28] As noted throughout the 2014 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 four feet of pipe wrap (40 kWh at 10 kWh per foot) for each pipe wrap installation. Most critically, Duquesne did not use the replaced wattage of the prior bulb for the installed CFLs.

4.4.2 Low-Income Program 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 not warranted due to the presence of a comparable desk review (REEP) and a telephone verification (for all components and represented by a sample of 82 participants) administered by the evaluation contractor. 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 2014 TRM. The SWE Team confirmed that all verified per-measure savings, participant counts, and program energy and demand impacts were consistent with the 2014 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 PY5 (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 not review any site inspections or quality assurance/quality control (QA/QC) procedures from low-income installations, as neither Duquesne, its evaluation contractor, nor any other Duquesne third-party vendor administered any on-site-based inspections or QA/QC procedures for this program during PY6. (As noted above, the evaluation contractor verified installations via a telephone survey.) All of the other EDCs do conduct on-site inspections on a sample of installations for their low-income programs.[29] During PY5, 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 customers are counted for LIEEP rather than the individual other residential programs. In PY6, even though Duquesne introduced a whole-home retrofit program similar to 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 will continue to monitor and assess the need to 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. Duquesne offered 14 types of measures to the low-income sector in PY6, which is double the quantity offered in PY5 (seven). The number of measures offered through the low-income program represented 14.6% 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%.

[28] According to the 2014 TRM, the EISA compliant bulb must be used as the baseline for all bulbs subject to the EISA requirements, unless the bulb is installed through a direct install program delivery approach.

[29] 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.

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 being performed in accordance with the applicable TRM, or by some other reasonable methodology. In general, documentation provided by Duquesne for prescriptive projects was well organized and allowed for a comprehensive review of projects, and the off-TRM values were well documented. In the PY5 annual report the SWE noted that custom projects revealed several concerns, including inconsistent information across accompanying files and insufficient documentation to verify scope of work and savings calculations. In PY6 the SWE identified only minimal inconsistencies across documentation and only two issues that hindered the SWE's understanding of the projects. Specific examples of deficiencies noted in the project file review are explored in Appendix A.1.1. Project files were found to be generally conclusive and organized. At this time, the SWE Team recommends only that more thorough auditing of applications be conducted to ensure clarity of the project files for the SWE review.

The SWE Team reviewed tracking data and quarterly reports when submitted to ensure consistency across tracking and reporting documents. The SWE Team found no variance among the energy and demand savings values presented in Duquesne's PY6 annual report and the cumulative program tracking data. There were minor variations in the quantities of participants and incentive amounts across the documentation reviewed by the SWE Team. Participation rates are subject to the definition of a participant (e.g., rebate application, utility account number, premise address), so these variances are expected and not a cause for concern. Duquesne's financial transactions lag the recording of savings, so these differences also are expected. Further details are provided in Appendix A.1.2.

The SWE Team reviewed Duquesne's PY6 sample design to ensure its compliance with the Evaluation Framework. The results are displayed in Table 4-13, showing relative precision at the 85% confidence level (CL).

Table 4-13: Compliance across Sample Designs for Duquesne's PY6 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	8.5%	21.9%	✓
Industrial	12.9%	12.2%	✓
GNI	29.4%	5.8%	✗
Small Commercial Direct Install*	2.4%	5.0%	✓
Multifamily Housing Retrofit*	2.9%	4.1%	✓

**New in PY6 and evaluated as its own program group. Will typically be evaluated under the umbrella of the Commercial Program Group.*

The goal of 15% precision at the 85% confidence level for energy was reached for all non-residential program groups except GNI. GNI was treated as its own evaluation group, in accordance with the Phase II Evaluation Framework, because savings exceeded 20% of the non-residential sector savings in the previous year. However, the achieved precision for energy was 29.4%, whereas for demand it was 5.8%. The SWE Team recommends targeting a higher sample size for the GNI – Small stratum in future evaluations of this program in order to achieve a higher level of precision. Details about each program evaluation sample are presented in Appendix C.1.

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 variable-frequency drive (VFD) installations. The SWE Team approved of the majority of the inspections, and suggested improvements for five of the 10 sampled projects. Details about all 10 projects and their associated findings are presented in Appendix A.1.4.

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 explored in Appendix A.1.5.

4.4.4 Net-to-Gross and Process Evaluation Audit Summary

Table 4-14 presents a high-level summary of the results of the SWE Team's audit of Navigant's NTG assessment and process evaluation of the Duquesne programs. The following subsections present detailed discussions and a summary of the findings, starting with the audit of NTG reporting and related files, followed by findings based on the review of process reports and supporting documents. Appendix C.1 provides detailed program-specific reviews of the process evaluation activities.

Table 4-14: Summary of SWE Team Review of Duquesne Process and NTG Evaluations

Elements Reviewed in the Duquesne Annual Report	Findings
Inclusion of Required Elements per Report Template	
Description of the methods	Generally consistent with SWE guidelines but with minor exceptions noted
Summary of findings	Generally consistent with SWE guidelines but with minor exceptions noted
Summary of conclusions	Findings, but no conclusions presented
Table of recommendations and EDC's response	Consistent with SWE guidelines
Consistency with the Evaluation Plan	
Process evaluation implemented the evaluation plan	Mostly, with minor exceptions noted
Evidence-based Recommendations	
Recommendations supported by findings and conclusions	Yes (supported by findings, but there were no conclusions)
Recommendations actionable	Yes
Use of NTG Common Method or Explanation for Alternate Method	
Availability of NTG data files and documents	Mostly, with exceptions noted
NTG method used – the common method or another	Common method, with acceptable modifications
NTG common method applied correctly	Yes (where possible to confirm)

4.4.4.1 Net-to-Gross Audit Results

This section documents the results of the SWE Team's NTG audits of Duquesne programs in PY6. The results are provided for residential, low-income, and non-residential programs.

4.4.4.1.1 Residential Programs

Navigant estimated NTG for four residential programs: the Residential Energy Efficiency Program (REEP), the Residential Appliance Recycling Program (RARP), the School Energy Pledge Program (SEP), and the Whole House Energy Audit Program (WHEAP). As in the PY5 evaluation, 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 SWE-informed NTG approaches for an upstream component of one of Duquesne's five residential programs. While the SWE Team did not provide specific guidelines for upstream NTG estimates, the SWE Team did review the strengths and limitations of existing methods.

Navigant summarized the NTG methodology in the Duquesne PY6 annual report and described it in more detail in the PY6 residential process evaluation report. The detailed methods reported in the PY6 process evaluation report were typically sufficiently clear. For SEP, Navigant reported targeting 90/10 confidence/precision, to help ensure that it would achieve the required 85/15 level. The report did not state the achieved levels. The SWE Team determined that Navigant did exceed the required 85/15 confidence/precision. The SWE Team suggests that reports explicitly state that Navigant achieved the required 85/15. In addition, the SWE Team notes that Navigant slightly missed the required 85/15 level of confidence/precision for WHEAP.

Navigant provided the SWE Team with most of its NTG calculations, together with the raw survey data, in Excel workbooks. In reviewing these workbooks, the SWE Team discovered that the spillover and NTGR values that Navigant reported for the rebates component of REEP (24% and 51%, respectively) differed from those shown in Navigant's NTG workbook (19% and a NGTR of 46%). Subsequent discussion with Navigant staff indicated that the workbook represented the interim, survey-only NTGR findings, while the report contains a final NTGR based on the survey and spillover identified in a review of application files. However, the Duquesne PY6 annual report does not describe the application file review, and so there was no way for the SWE Team to determine that such an activity added to the spillover assessment. Since the rebates component had a weight of 1% in the overall NTGR, these differences did not affect the overall NTGR. In the future, the report should more fully explain the spillover assessment procedures used.

Table 4-15 provides a detailed summary of 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.

Table 4-15: 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 a method informed by the common method to estimate Upstream Lighting NTG.	– The detailed methods reported in the PY6 process evaluation report were sufficiently clear. – Navigant's report did not state that the final spillover method included a review of application files.

Program	NTG Method	Review Comments
Residential Appliance Recycling Program (RARP)	The common method was used.	– Navigant used the common method for Appliance Recycling to estimate NTG. The final kWh net savings that included adjustments to net savings based on each scenario were included in the workbook. The free-ridership was calculated correctly at the participant level.
School Energy Pledge Program (SEP)	The common method was used, with acceptable modifications.	– The detailed methods reported in the PY6 process evaluation report were sufficiently clear. – Navigant made acceptable adjustments to the free-ridership intention calculations, including adjustments for number of items installed and for plans to purchase at a later date. – Navigant reported targeting 90/10 confidence/precision but did not state the actual level achieved.
Whole House Energy Audit Program (WHEAP)	The common method was used, with modifications for direct-install measures and counterfactual reports of delayed purchases.	– The detailed methods reported in the PY6 process evaluation report were sufficiently clear. – Navigant made acceptable adjustments to the free-ridership intention calculations, including adjustments for number of items installed and for plans to purchase at a later date. – Navigant reported targeting 90/10 confidence/precision but did not state the actual level achieved. Navigant's sample was just shy of the required 85/15 confidence/precision for NTG estimates.

Table 4-16 summarizes NTG findings from the Duquesne annual report. NTG was greatest for SEP and lowest for RARP.

Table 4-16: Summary of Duquesne NTG Estimates by Program

Approach	Program	Free-Ridership	Spillover	NTGR	Sample Size[a]
Estimated	Residential Energy Efficiency Program (REEP)	0.54	0.23	0.69	69
	Residential Appliance Recycling Program (RARP)	0.51	0.15	0.64	63
	School Energy Pledge Program (SEP)	0.42	0.34	0.92	31
	Whole House Energy Audit Program (WHEAP)	0.28	0.13	0.84	17

NOTES
[a] With the exception of WHEAP, the sample sizes provided at least 85/15 confidence/precision. The sample size for WHEAP provides 16% precision at 85% confidence.

4.4.4.1.2 Low-Income Residential Programs

LIEEP participants were low-income participants within each of the residential programs described above (Section 4.4.4.1.1). Therefore, the comments in the above section also apply here. The SWE Team has two specific review comments for LIEEP: (1) the report did not specifically state the assumption of 0% free-ridership for low-income Refrigerator Replacement, though this was stated in the EDC's annual data request response along with free ridership information for all of the other programs; and (2) while Navigant provided NTG workbooks that showed low-income participants in each program, the SWE Team

did not find any documentation showing how the low-income NTG calculations from the various program components were combined into a single low-income NTG estimate. Subsequent information from Navigant clarified that the program-level low-income NTGR was a savings-weighted average of the component low-income NTGRs. The SWE Team is satisfied with this explanation.

Table 4-17 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 4-17: Summary of NTG Audit of Duquesne's Low-Income Programs

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 and assumed 0% free-ridership for low-income Refrigerator Replacement.	Participants were low-income participants within each program, so the comments in Table 4-15 apply here as well. The report did not explicitly state the assumed 0% free-ridership for low-income Refrigerator Replacement. The SWE Team did not find documentation showing how low-income NTG data for various residential programs were combined into a single low-income NTG estimate.

Table 4-18 shows the NTG ratio as reported in the Duquesne PY6 annual report. The estimated NTG ratio of 0.76 is buoyed by a spillover estimate of 0.18, which counterbalances to some degree a free-ridership of 0.42.

Table 4-18: Summary of Duquesne NTG Estimates by Program

Approach	Program	Free-ridership	Spillover	NTGR	Sample Size[a]
Estimated	Low-Income Energy Efficiency Program (LIEEP)	0.42	0.18	0.76	82
NOTES [a] The sample size provided at least 85/15 confidence/precision.					

4.4.4.1.3 Non-Residential Programs

Navigant estimated NTG values for the Small Commercial Direct Install (SCDI) and Multifamily Housing Retrofit (MFHR) and used the PY5 NTG values for the other two non-residential programs (Commercial Program Group and Industrial Program Group). Navigant used the SWE Team's common method for estimating NTG, with one minor deviation for estimating spillover: instead of using TRM or other deemed savings values, Navigant estimated SCDI spillover savings via respondent reports of how much energy the spillover measures likely saved in relation to their rebated measures. Navigant used the SWE Team's common method for estimating NTG, with one minor deviation for estimating spillover: instead of using TRM or other deemed savings values, Navigant estimated SCDI spillover savings via respondent reports of how much energy the spillover measures likely saved in relation to their rebated measures. Navigant would have used these same methods for MFHR, but no spillover measures were reported. Navigant summarized the NTG methodology in the PY6 annual report and described it in more detail in the PY6 C/I process evaluation report. Navigant provided most of its NTG calculations to the SWE Team, together with the raw data, in Excel workbooks.

Table 4-19 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, outside of the minor deviation mentioned above, the application of the SWE common methods to be error-free.

Table 4-19: Summary of NTG Audit of Duquesne's Non-Residential Programs

Program	NTG Method	Review Comments
Commercial Program Group	Not calculated: used PY5 values.	Due to a small population size, and to prevent overburdening this group, Navigant used the NTG values estimated for the PY5 evaluation.
Industrial Program Group	Not calculated: used PY5 values.	Due to a small population size, and to prevent overburdening this group, Navigant used the NTG values estimated for the PY5 evaluation.
Small Commercial Direct Install (SCDI) Program	The common method was used, with modifications for direct-install measures and spillover savings estimates.	While the Excel workbook provided to the SWE Team indicates that spillover is 7% across all strata, Navigant's annual report (but not the C/I process evaluation report) states that spillover is 7% for each stratum individually. The sample approach table in the annual report reports confidence/precision as "N/A" because Navigant attempted a census. The SWE Team suggests adding a footnote to the table stating this explicitly.
Multifamily Housing Retrofit (MFHR) Program	The common method was used, with modifications for spillover savings estimates.	The sample approach table in the annual report reports confidence/precision as "N/A," because Navigant attempted a census. The SWE Team suggests adding a footnote to the table stating this explicitly.

Table 4-20 shows the NTG estimates reported in the Duquesne PY6 annual report. The Commercial Program Group had the lowest NTG ratio, and the Small Commercial Direct Install Program had the highest NTG ratio.

Table 4-20: Summary of Duquesne NTGR Estimates

Approach	Program	Free-Ridership	Spillover	NTGR	Sample Size[a]
Referenced from PY5	Commercial Program Group	0.49	0.01	0.52	N/A
	Industrial Program Group	0.24	0.02	0.78	N/A
Estimated	Small Commercial Direct Install (SCDI) Program	0.07	0.07	0.99	37
	Multifamily Housing Retrofit (MFHR) Program	0.05	0	0.95	16

NOTES
[a] The sample size provided at least 85/15 confidence/precision.

4.4.4.2 Process Evaluation Review Results

The SWE Team's audit included a review of the process evaluation methods, findings, conclusions, and recommendations in the Duquesne PY6 annual report to determine whether it was 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 SWE Team's review found that the evaluations appeared to be consistent with Navigant's Phase II evaluation plan, with some exceptions. The general report and the two process-focused reports provided a comprehensive overview of the process evaluation key findings and recommendations. Navigant 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 judge the quality of the recommendations. In the following subsections, the SWE Team summarizes the review of the process evaluation sections in Duquesne PY6 the annual report. Detailed summaries by program are in Appendix C.1.

4.4.4.2.1 Summary of Research Activities and Consistency with the Evaluation Plan

The process evaluation conducted by Navigant involved review of key program documentation and surveys with program participants. For new programs, Navigant also conducted interviews with program staff, implementers, and program-affiliated market actors. The research issues addressed varied by program but generally included key aspects of program administration, implementation, and delivery, including customer, contractor, or market actor program satisfaction, engagement, challenges, and recommendations.

Overall, the process evaluations appeared consistent with the evaluation plan, with some exceptions. The most significant exception was that the number of surveys completed for the WHEAP did not achieve 85/15 confidence/precision due to issues noted above with the identification of low-income versus market rate participants. Navigant made a significant effort to attain a statistically valid sample, contacting 89% of the sample frame to attempt reaching the target number of completes.

4.4.4.2.2 Summary of Sampling Strategies

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. All but one survey sample had enough cases to achieve at least 85/15 confidence/precision. For other non-survey research activities—the in-depth interviews with program staff, implementers, or other program actors—the sampling was purposive. In a few instances (documented in Appendix C.1), participants or measures in certain strata were over- or underrepresented in the sample. The annual report does not discuss implications of this over- or underrepresentation on reported findings.

4.4.4.2.3 Report Elements and Clarity of the Reporting

The SWE Team deemed the reporting satisfactory. The list below provides two areas that could be improved:

- There was little detailed information regarding actual levels of confidence and precision (C/P) for most survey efforts. Most tables included target C/P, but did not include actual C/P. While actual C/P would vary among the survey items assessed based on the variances, the SWE Team suggests noting the minimum C/P attained.
- There were two instances where program achieved savings or budget expenditure estimates varied between the annual report and the process evaluation–specific report.

As noted above, Navigant provided process evaluation findings in both the PY6 annual report and the associated process evaluation report (one for residential programs and one for non-residential programs). Between these documents, the report 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.

4.5 STATEWIDE EVALUATOR FINAL RECOMMENDATIONS

The SWE Team has the following recommendations for Duquesne's EE&C programs going forward.

1) Consistent with the PY5 audit, a significant percentage (see Table 4-10 for details) of the participant population for Duquesne's PY6 residential kits programs (REEP kits, SEP kits) still had not installed the measures. The SWE Team continues to recommend that Duquesne provide additional educational materials or send follow-up email reminders to customers to explain the energy savings value of each measure and installation instructions. The SWE Team recognizes, however, that this may not be feasible until the next program cycle (Phase III).

2) It appears that Duquesne's upstream lighting contractor (ECOVA) had followed the PY5 recommendation and modified the lightbulb lumen lookup table and associated logic used in its PMRS system to match the TRM tables and logic. Additionally, ECOVA held meetings with the evaluator (Navigant) to ensure the lighting savings were consistent with the TRM. Even with the updates, the evaluation contractor revised the baseline wattages of a fairly significant number of records, although this resulted in an almost equal distribution of negative and positive 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.

3) Though the audit did not identify any installation, verification, or TRM savings issues and can validate Navigant's evaluation efforts for the annual report, there were several important adjustments where a discussion would have offered valuable insight into program or measure shortcomings and shifts in program input parameters. These include:

- **a.** A few residential programs (REEP, SEP) lacked a discussion relating the final adjusted savings rates to specific measures or reasons.
- **b.** The large decline in upstream lighting sales to low-income participants (from 20% to 4%) and the drop in cross-sector sales (from 12% to 0%) should have included greater details regarding the methods used and should have provided explanations of why these important parameters experienced such significant adjustments.

4) Though not critical to successful implementation of any single program, an enhancement to the PMRS system would be to include functionality allowing participant identification to flag whether participants in programs that encourage cross-program participation have indeed purchased measures or actively participated in other programs. This identification would be particularly useful for the WHEAP, which encourages participants to participate in the REEP rebate program. Even without this functionality, the evaluator was able to use customer identification look-ups to assess cross-program participation.

5) Understanding there is a balance between data collection requirements and cost, the SWE Team encourages 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 may be some potential, as Navigant noted in its annual report, that Duquesne is stranding savings by relying on TRM defaults rather than EDC data collection.

6) The SWE recommends targeting a higher sample size for the GNI – Small stratum in future evaluations of the Commercial Program Group in order to achieve a higher level of precision. The GNI sector (evaluated separately) achieved only 29.4% precision for energy, and 5.8% precision for demand.

7) The SWE Team was impressed with the level of organization of project files and the completeness and clarity of the site reports during the non-residential verified savings review. The SWE would like to see this continue through future program years.

8) Navigant understands that SEP has been implemented at a significant number of schools throughout Duquesne Light's territory and that repeating implementations at the same schools can risk low realization rates and high free-ridership. This is one reason for the low program achievements. The SWE Team recommends that Duquesne Light should consider revisiting certain schools where participant students of SEP have "graduated out" of the targeted grades, such as schools that participated when the program first began.

9) The SWE Team recommends that Duquesne Light should determine whether modifications to the Refrigerator Replacement program process of the low-income energy efficiency program or marketing are warranted. This would include ensuring that details regarding the size of the refrigerator unit are communicated clearly.

10) The SWE Team recommends that Duquesne Light should also determine whether additional quality control checks should be incorporated into the refrigerator installation process of the low-income energy efficiency program. This would include documenting the status of equipment and noting damage, if any exists, before installations occur so that damaged equipment is not installed.

5 METROPOLITAN EDISON COMPANY

This chapter summarizes Met-Ed's program performance in PY6. 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 through the end of PY6; 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.

5.1 SUMMARY OF ENERGY AND DEMAND REDUCTIONS

Table 5-1 provides an overview of Met-Ed's cumulative reported gross (RG) and verified gross (VG) savings impacts, and carryover (CO) savings since the EE&C programs' inception through the end of PY6.

Table 5-1: Summary of Met-Ed's Phase II Savings Impacts

Savings Impacts	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/yr)	Savings Achieved as % of 2016 Targets[i]
Total Energy Savings (MWh/yr)	240,929	239,896	47,187	287,083	337,753	85%
Total Demand Reduction (MW)	25.83	28.80	N/A	28.8	N/A	N/A
TRC Benefits ($1,000)[a]	N/A[g]	$104,036	N/A	$104,036	N/A	N/A
TRC Costs ($1,000)[b]	N/A[g]	$65,694	N/A	$65,694	N/A	N/A
TRC B/C Ratio[c]	N/A[g]	1.58	N/A	1.58	N/A	N/A
CO_2 Emissions Reduction (Tons)[d][e]	205,633	204,751	40,274	245,025	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 1,707 lb CO_2 per MWh according to the latest available (2014) PJM Emission Report of marginal off-peak annual CO_2 emission rate based on direction provided by Commission staff.
[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.

As Table 5-1 shows, Met-Ed achieved 85% of its Act 129 Phase II energy savings target by the end of PY6. The TRC B/C ratio (or TRC ratio) of Met-Ed's programs through PY6 was 1.58, which indicates that Met-Ed's portfolio of EE&C programs was cost-effective on an aggregated basis.

Table 5-2 lists Met-Ed's EE&C programs. All nine programs yielded reported gross energy and/or demand savings in PY6.

Table 5-2: Met-Ed EE&C Programs

Programs Reporting PY6 Gross Savings	Sector(s)
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 5-3 provides a breakdown of the contribution of the evaluation verified gross energy savings (MWh/yr) and gross demand savings (MW) for each program, and the contribution of each program's savings toward the total portfolio energy and demand savings. The Home Performance Program accounts for 37% of the total Phase II verified gross energy savings in Met-Ed's portfolio, making it the most impactful energy savings program in the residential sector. The Large C/I Equipment Program accounts for 19% of the total Phase II verified gross savings in Met-Ed's portfolio, making it the most impactful energy savings program in the non-residential sector. The Efficient Products Program contributed 25% of the total energy savings.

Table 5-3: Summary of Met-Ed EE&C Program Impacts on Verified Gross Portfolio Savings

Program	Phase II VG Savings (MWh/yr)	% of Portfolio Phase II VG MWh/yr Savings	Phase II VG Savings (MW)	% of Portfolio Phase II VG MW Savings
Appliance Turn-In	9,964	4%	1.65	6%
Efficient Products	60,384	25%	6.52	23%
Home Performance	89,589	37%	8.92	31%
Low Income	5,340	2%	0.39	1%
Small C/I Equipment	24,570	10%	4.12	14%
Small C/I Buildings	3,221	1%	0.61	2%
Large C/I Equipment	45,966	19%	6.31	22%
Large C/I Buildings	565	0%	0.20	1%
Gov./Institutional	297	0%	0.08	0%
Total Portfolio	**239,896**	**100%**	**28.8**	**100%**

The NTG research yielded estimates of NTG ratios for the Met-Ed programs. Table 5-4 provides the verified net savings alongside the verified gross savings for PY6 and Phase II. The portfolio-level NTG ratio for PY6 was 0.80. Section 5.4.4 provides findings and details on the SWE Team audit of the NTG research conducted for Met-Ed programs.

Table 5-4: Summary of Met-Ed EE&C Program Verified Net and Gross Savings by Sector

Sector	PY6 VG Savings (MWh/yr)	PY6 Verified Net Savings (MWh/yr)	Phase II VG Savings (MWh/yr)	Phase II Verified Net Savings (MWh/yr)
Residential	90,159	62,670	160,362	103,141
Commercial and Industrial	36,725	25,853	69,394	51,146
Government, Nonprofit, and Institutional	6,846	4,828	10,140	6,515
Total Portfolio	***133,730***	***93,352***	***239,896***	***160,801***

5.2 TOTAL RESOURCE COST TEST

Table 5-5 presents TRC NPV benefits, TRC NPV costs, present value of net benefits, and TRC ratio for Met-Ed's PY6 individual programs and total portfolio. The SWE found no initial inconsistencies between the TRC model outputs and the TRC results shown in the PY6 annual report.

Table 5-5: Summary of Met-Ed's PY6 TRC Factors and Results

Program	TRC NPV Benefits ($)	TRC NPV Costs ($)	Present Value of Net Benefits ($)	TRC Ratio
Appliance Turn-In	$2,254,150	$1,053,738	$1,200,411	2.14
Efficient Products	$10,322,049	$8,591,294	$1,730,755	1.20
Home Performance	$9,457,736	$7,052,093	$2,405,642	1.34
Low Income	$742,842	$1,635,913	$(893,071)	0.45
Small C/I Equipment	$7,895,705	$4,530,914	$3,364,791	1.74
Small C/I Buildings	$1,070,566	$1,197,808	$(127,242)	0.89
Large C/I Equipment	$16,022,181	$12,023,365	$3,998,816	1.33
Large C/I Buildings	$366,897	$481,328	$(114,431)	0.76
Gov./Institutional	$52,810	$137,805	$(84,995)	0.38
Total Portfolio	**$48,184,936**	**$36,704,259**	**$11,480,677**	**1.31**

In summary, 5 of Me-Ed's 9 programs offered were found to be cost-effective and 4 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*

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

- *Residential Low-Income*
- *Small C/I Energy Efficient Buildings*
- *Large C/I Energy Efficient Buildings*
- *Government and Institutional*

The SWE notes that the 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 PY6.

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 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 upfront 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 5-6.

Table 5-6: Met-Ed's PY6 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 2014 TRM. In the non-residential sector, the TRC model applied an EUL at the stratum level rather than at the measure level.

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 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.[30] The FirstEnergy TRC model relied on the evaluation samples as a basis for calculating incremental participant

[30] The DEER 2008 incremental cost database is available for download at http://www.deeresources.com.

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.

In PY6, the 2014 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 PY6. 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, a measure's lifetime was separated into two parts: the first three years, and the remaining lifetime. The removed equipment was treated as the baseline for the first three years, 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.

The SWE review noted one inconsistency in the dual-baseline approach. Usually, reductions in savings will be caused by dual baselines; however, for one project (rebate #CR_PRJ-247291) in Met-Ed's TRC model, the annual kWh savings during the first three years were lower than those shown for the remaining years. The FirstEnergy EDC evaluator concluded that the inconsistency was a result of a data entry error. The evaluator estimates that Met-Ed portfolio verified results are understated by 251 MWh/yr, or 0.2% of PY6 verified MWh/yr. The impact on the TRC benefits was even less significant. The SWE recommends that this data entry error be fixed in the Met-Ed final report to the PUC for Phase II.

5.2.2 Avoided Cost of Energy

The Met-Ed TRC model assigned a value ($/kWh) to the avoided cost of energy for each year from 2015 through 2029 for each measure category based on the load profile of the end use and the sector in which the savings occur. The avoided costs of energy for measures were calculated by multiplying 8,760 energy costs values by 8,760 associated load shapes. The unit impacts were multiplied by the most appropriate avoided cost stream to determine the per-unit avoided energy costs for that program.

5.2.3 Avoided Cost of Capacity

The Met-Ed TRC model assigned a flat annual figure ($/kW-year) to the cost of adding generation capacity based on PJM forward capacity auction prices. A single value was used for the avoided cost of capacity for all programs and sectors. This value was multiplied by the ex post demand savings for each combination of program and sector to determine the benefits to the EDC of not having to expand generation capacity.

5.2.4 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's review of the Met-Ed TRC model found a small calculation error for a single project, but generally believes the PY6 TRC benefits, costs, and ratios to be reasonable and accurate. The observed error has a less than 1% impact on portfolio verified savings and TRC benefits.

5.3 STATUS OF EVALUATION ACTIVITIES

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

5.3.1 Status of Evaluation, Measurement, and Verification Plans

The SWE Phase II Evaluation Framework outlines the standardization of evaluation protocols across EDCs. The 2013 Evaluation Framework, which was finalized on June 28, 2013, is the framework that was in effect for the planning of the PY6 impact and process evaluations. This Phase II Evaluation Framework required each EDC to develop an evaluation plan for each program in its portfolio to address several objectives (see Section 4.3.1 for a summary of these objectives). Table 5-7 displays key milestones completed. FirstEnergy EDCs submitted, and the SWE Team approved, only one EM&V Plan across all four FirstEnergy EDCs.

Table 5-7: 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 FE
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 component, giveaway component, and the Low Income Low Use kit component)

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.

5.3.2 Measurement and Verification Activities and Findings

By the end of PY6, Met-Ed had achieved 85% of its total Phase II energy savings compliance target, based on aggregated verified savings as of May 31, 2015 from Phase II in addition to Phase I carryover. Realization rates compare gross savings reported by the EDC to the verified gross savings determined by the EDC evaluation contractor through M&V activities (see Section 4.3.2 for an overview of how realization rates are calculated and defined).

Table 5-8 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 5-8 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 PY6.

Table 5-8: Met-Ed Energy Efficiency Programs – Realization Rates for Energy and Demand Savings in PY6

Program	Energy Realization Rate	Relative Precision (Energy)[a]	Demand Realization Rate	Relative Precision (Demand)[a]
Appliance Turn-In	116.0%	12.6%	117.8%	10.3%
Efficient Products	113.7%	2.1%	130.1%	4.3%
Home Performance	98.6%	10.8%	99.2%	10.9%
Low-Income	93.7%	4.7%	97.4%	4.5%
Small C/I Equipment	94.5%	12.2%	133.3%	14.8%
Small C/I Buildings	91.2%	14.7%	95.6%	14.7%
Large C/I Equipment	95.3%	8.9%	111.7%	9.6%
Large C/I Buildings	111.6%	10.2%	83.3%	4.6%
Government/Institutional	99.8%	0.0%	105.7%	0.0%

NOTES
[a]Relative precision values are at the 85% confidence level.

5.3.2.1 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, and if the refrigerators and freezers had later been replaced. The replacement option was also designated as either ENERGY STAR or standard so as to be applicable to the 2014 TRM deemed values for each scenario. The program realization rate is mostly a function of the difference between the ex ante and ex post weights of the various replacement scenarios.

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.

The evaluation contractor approached the evaluation differently for each branch of the Home Performance Program. The Home Energy Audit Kits and School Kits were evaluated using the tracking and

reporting (T&R) tracking 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 evaluator, producing results consistent with the ICSP's. The ICSP's results were accepted as verified for the PY6 annual report, with the understanding that the measure life is only one year and that a full evaluation will be performed for PY7.

5.3.2.2 Low-Income Programs

The realization rate for the Low-Income Program is the lowest among the Met-Ed residential programs, at 93.7%. 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 ISRs from the Low Income Low Use Program (LILU) evaluation, as actual ISRs cannot be known directly, but are likely lower than the defaults in the TRM. For the evaluation of the LILU Energy Kit portion of the Low-Income Program, the evaluation contractor employed an approach similar to that chosen for the evaluation of the Home Energy Audit and School Kits: through customer surveys and reviews of the T&R system. As with the Home Energy Audit Kits and School Kits, the 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.

5.3.2.3 Non-Residential Programs

Realization rates for Met-Ed's non-residential programs' energy savings ranged from 91% to 112% in PY6. Realization rates for demand reductions from these programs ranged from 83% to 133%. 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 5-1 shows the frequency of each M&V approach performed by ADM in PY6 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 5-1: Frequency and Associated Savings by M&V Approach – Small C/I Equipment Program

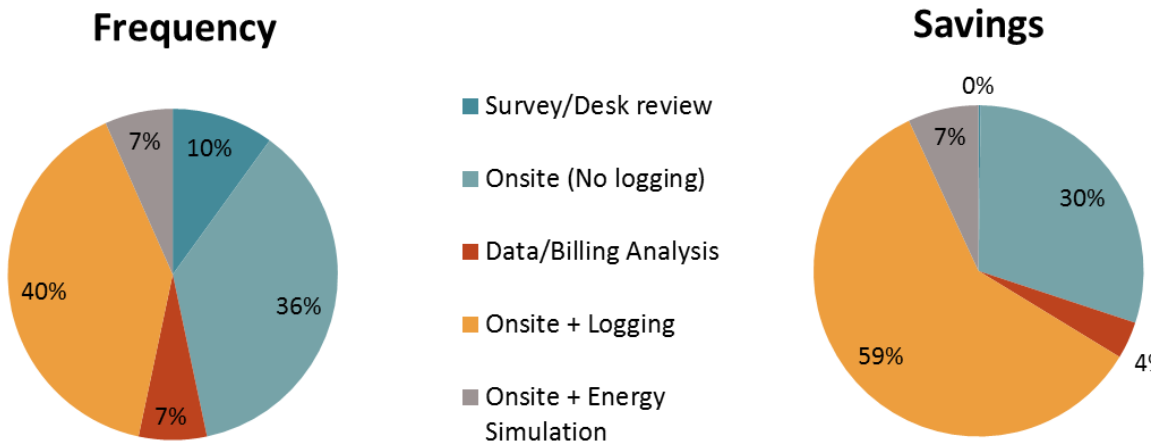


Figure 5-1 indicates that 46% of the sampled measures for the Small C/I Equipment Program were evaluated using a basic level of rigor. However, the representative savings for these measures accounted for only 30% of the energy savings. This suggests that basic rigor was appropriately used, predominately 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 (70%) 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 5-2 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 and billing analysis was the only enhanced rigor approach used for this program, and these projects accounted for 71% of savings.

Figure 5-2: Frequency and Associated Savings by M&V Approach – Small C/I Buildings Program

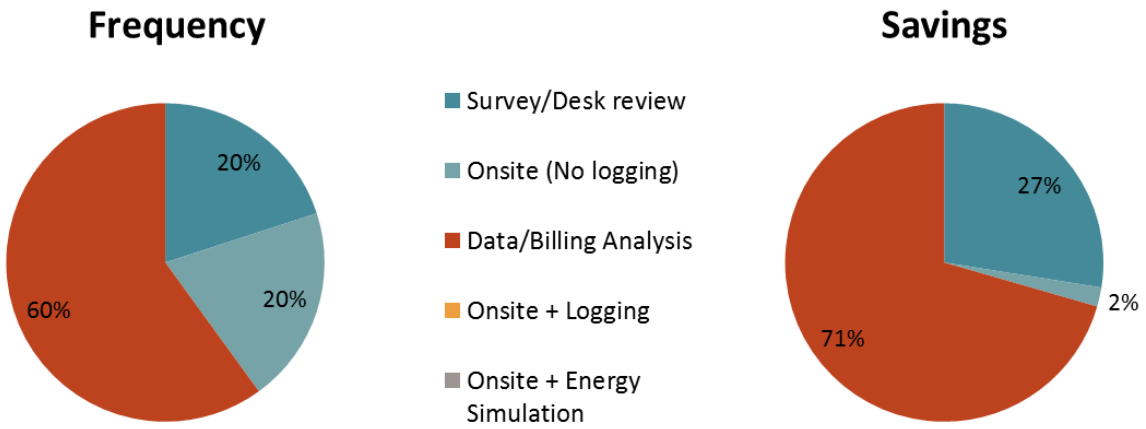


Figure 5-3 shows the frequency of each M&V method used in the Large C/I Equipment Program and the energy savings associated with each method. Enhanced rigor was used for a majority of the projects (72%), and these projects accounted for a large majority of the savings (89%). Basic rigor was limited to those projects with less savings.

Figure 5-3: Frequency and Associated Savings by M&V Approach – Large C/I Equipment Program

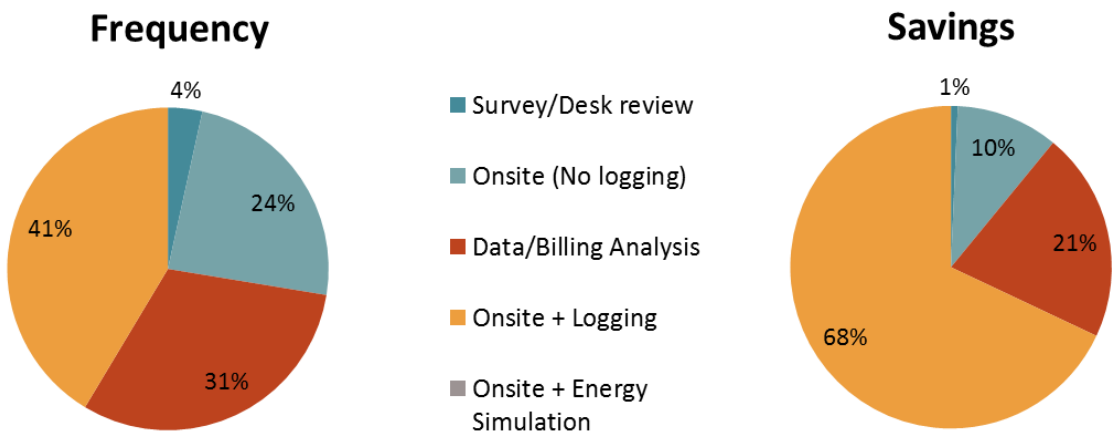


Figure 5-4 shows the frequency of each M&V method used in the Large C/I Buildings Program and the energy savings associated with each method. Enhanced rigor was used for a majority of the projects (66%), and these projects accounted for most of the savings (63%). There were only three projects completed in PY6 for this program.

Figure 5-4: Frequency and Associated Savings by M&V Approach – Large C/I Buildings Program

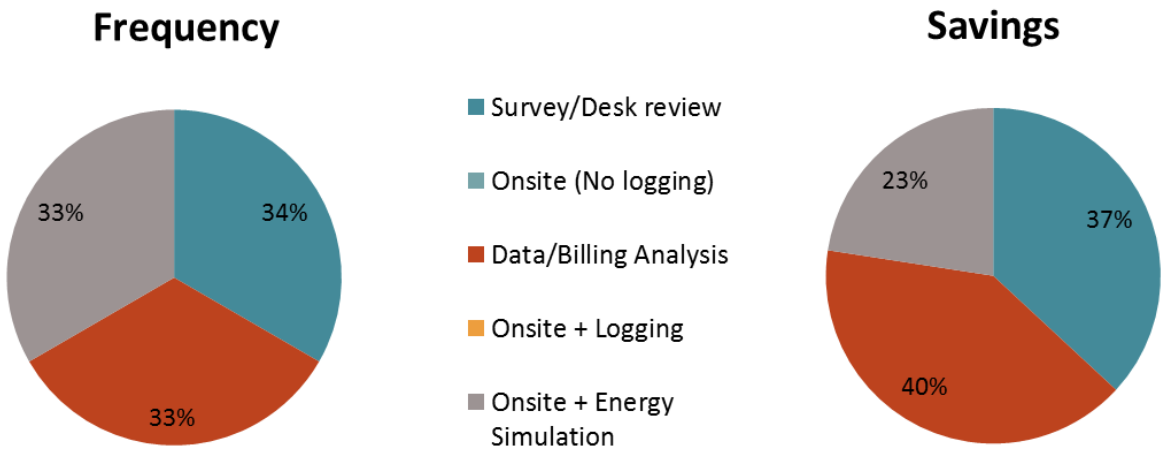
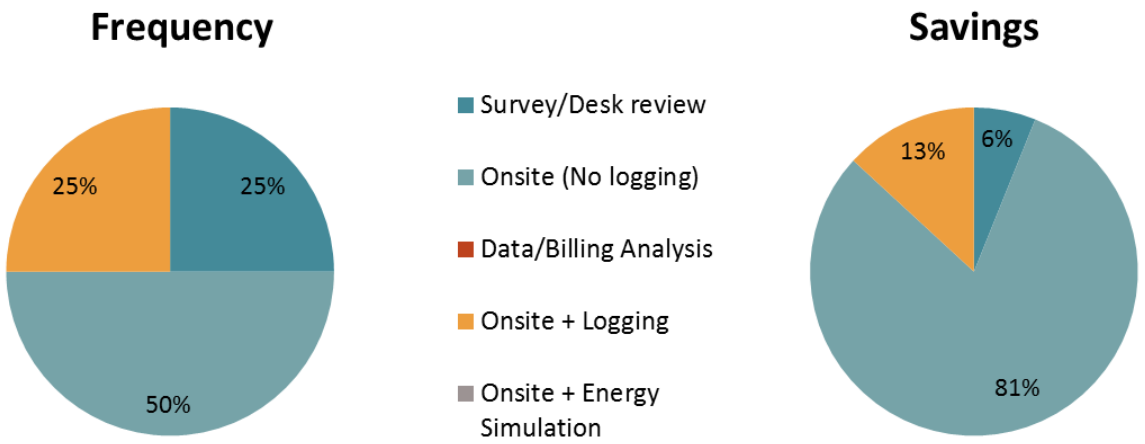


Figure 5-5 shows the frequency of each M&V method used in the Government and Institutional Program and the energy savings associated with each method. Basic rigor was used for a majority of the projects (75%), and these projects accounted for a majority of the savings (87%). There were only four projects completed in PY6 for this program, all of which accounted for less than 40,000 kWh/yr.

Figure 5-5: Frequency and Associated Savings by M&V Approach – Government and Institutional Program



5.3.3 Process Evaluation Activities and Findings

FirstEnergy implemented a common set of energy efficiency programs across its four Pennsylvania EDCs—Met-Ed, Penelec, Penn Power, and West Penn—and FirstEnergy's evaluation contractors, ADM and Tetra Tech, used the same evaluation methods and identified the same findings and recommendations for all four EDCs. The process evaluations included a review of key program documents, interviews with EDC and CSP staff and program contractors, and surveys of program participants, although not every evaluation included all of those elements. Table 5-9 provides a high-level summary of the data sources Tetra Tech used and its key findings for each program.

Table 5-9: Summary of Key Findings and Data Sources – FirstEnergy EDCs

Program	Key Findings	Data Sources
Residential		
Appliance Turn-In Program	– Bill inserts are the most common source of program information. – Program satisfaction remains high.	– Interviews with program and CSP staff – Participant survey – Program materials
Efficient Products Program	– Participants were highly satisfied with the program. – Retailers and contractors were the most common sources of information about the program. – Customers identified utility mail and web contact as the preferred approaches for hearing about programs in the future. – Participants largely reported understanding eligibility requirements. – Contractors reported slightly lower overall program satisfaction than program participants, lowest for technical support and program training. – Contractors prefer to receive program information personally, such as in one-on-one meetings or direct calls with their ICSP representative. – A minority (20%) of surveyed contractors rate the paperwork requirements as "difficult." – About half of the surveyed contractors reported receiving the contractor newsletter.	– Interviews with program and CSP staff – HVAC contractor interviews and survey – Participant survey – Program materials

Program	Key Findings	Data Sources
Home Performance Program	– Program participants were highly satisfied with the program. – Participants reported wanting to be notified about future program options via email. – Most participants were familiar with LEDs and were using them in their homes. – Auditors welcomed the opportunity for business through the program and were enthusiastic program promoters. – Auditors reported receiving inquiries about the program because of FirstEnergy EDC marketing efforts, specifically, bill inserts and HERs. – Auditors reported that "solving a problem" for the customer is more effective than focusing on the house's deficiencies or pointing out how much money the customer will save. – Auditors reported mixed satisfaction with field use of the Surveyor tool, with some reporting confusion and frustration with some characteristics of the tool. – Auditors reported that the follow-through with audit recommendations can be low because of the rebate structure for recommended upgrades. – Auditors reported that it is difficult to identify the requisite 350 kWh in savings if a home has non-electric heating and/or water heating. – Auditors were pleased with the support provided by the CSP and with their interaction with CSP staff.	– Interviews with program and CSP staff – Interviews with energy auditors – Participant survey – Program materials
Sector-level Findings	– Bill inserts are the most common source of program information. – Program satisfaction remains high.	– Interviews with program and CSP staff – Interviews with program contractors – Participant survey – Program materials
Low-Income		
Direct Install with Home Energy Audit; Kit Delivery and Giveaway	– Household and contractor satisfaction was high. – Participants in the home energy audit program components reported additional energy savings activities. – The energy specialist or auditor did not install or did not fully install direct-install measures in nearly half of households participating in the home energy audit program components.	– Interviews with program and CSP staff – Interviews with program contractors – Participant survey – Program materials
Non-Residential		
C/I Efficient Equipment; Government and Institutional Programs	– Participants were highly satisfied with the program, would likely participate again, and have recommended the program to industry colleagues. – Contractors were the leading source of program information. – Respondents would prefer receiving additional information about the program via email newsletters and direct mail. – Participants' budget and financial planning periods typically were either one year or less or five years or longer, with small C/I and GNI customers most likely to report the former and large customers most likely to report the latter.	– Interviews with program and CSP staff – Participant survey – Program materials

Program	Key Findings	Data Sources
	– The budget cycle affects project implementation for about one-quarter of participants.	

5.4 STATEWIDE EVALUATOR AUDIT ACTIVITIES AND FINDINGS

This section presents the activities and findings of the SWE Team's audits of Met-Ed's programs. It includes a summary and key findings from the SWE Team's residential, low-income, non-residential, and NTG and process evaluation audit activities.

5.4.1 Residential Program Audit Summary

5.4.1.1 Residential Lighting

For PY6, 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 the FirstEnergy EDCs 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 over 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 2014 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.

5.4.1.2 Appliance Turn-In Program

The SWE Team reviewed Met-Ed's JACO database quarterly throughout PY6, and at the end of the year reviewed its additional calculations for verified gross savings. The SWE Team confirmed that the correct EDC-specific deemed values from the 2014 TRM were used whether a unit was retired, replaced with a standard unit, or replaced with an ENERGY STAR unit. Met-Ed used surveys to determine if refrigerators and freezers were functional and if they had been replaced with a standard or an ENERGY STAR unit. These percentages were then combined with the deemed savings from the 2014 TRM to calculate an average unit of energy consumption (UEC) for each refrigerator and freezer that was recycled. The SWE Team also verified that if a refrigerator was removed and then replaced with an ENERGY STAR unit, the additional ENERGY STAR refrigerator Efficient Products Program savings was subtracted from the program savings totals in order to prevent double-counting.

5.4.1.3 Efficient Products Program

For PY6, the Efficient Products Program increased the offering by two programs to total 20 subcategories. Incentives for some measures were paid to the consumer at the point of sale or through rebates for qualified purchases or installations. This was the second program year in which consumer electronics were incorporated into the Efficient Products Program, and the first year for including room air conditioners in the upstream category, which provides incentives to retailers for selling qualified consumer electronic products at the point of sale.

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 strata. Due to the fact that some rebate applications were assigned to PY5, the evaluation contractor had to designate which year's TRM to use in the ex post analysis. FirstEnergy's evaluation contractor analyzed all of the reported program data for consistency with the 2014 TRM (or 2013 TRM as appropriate for consumer electronics) and noted and accounted for any discrepancies in reported gross savings through the verified savings analysis.

5.4.1.4 Home Performance Program

The SWE Team audited each component of the Home Performance Program: School Conservation Kits, Whole House Direct Install, Home Energy Audit Conservation Kits, New Homes, and HERs. The School Conservation Kits component provides kits of prescriptive measures to students' parents upon request after the parents review the energy efficiency curriculum. The SWE Team verified that the correct 2014 TRM savings were used for all measures and that the FirstEnergy statewide receipt rate and ISRs were correctly applied to the items. The SWE Team found that the evaluation contractor also used the correct TRM savings and ISR for the Home Energy Audit Conservation Kits.

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 SWE Team also reviewed the billing analysis performed on the more than 2 MWh/yr house stratum. The SWE Team verified that the New Homes component of the program was evaluated according to FirstEnergy's evaluation plan and that the realization rates determined by the evaluation contractor from additional REM/Rate models had been correctly applied to the ex ante savings.

The evaluation contractor did not do a full evaluation of HER savings for PY6 because the one-year measure life does not count toward compliance. However, the evaluator did recreate the analysis performed by the ICSP with similar results. The SWE reviewed the analysis performed by the evaluator and verified that it was done correctly. It is anticipated that the evaluation contractor will fully evaluate this program and that the SWE Team will audit this analysis in PY7.

5.4.2 Low-Income Program Audit Summary

The SWE Team reviewed the three distribution branches of the Low-Income Program (direct install, giveaway, and direct delivery kits) to ensure that the savings were correctly calculated using the 2014 TRM and that the realization rates were correctly determined and applied appropriately. Met-Ed's evaluator provided a complete database of direct-install measures, which the SWE Team formatted and ranked by individual measure contribution to total program 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 LILU Conservation Kits and the Giveaway Program were implemented per the 2014 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 PY6, which is 15% of the total number of measures offered across all sectors. This exceeded its goal of 8.8%.

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 performed in accordance with the applicable TRM, or by some other reasonable methodology. In general, project documentation was complete and thorough, with ample notes and explanation where necessary. Of the nine projects reviewed, only two were found to be inconclusive due to either missing or inconsistent documentation. Specific examples of deficiencies noted in the project file review are explored in Appendix A.2.1. In PY5 the SWE recommended that more thorough documentation be kept regarding changes in scopes of work, and that detailed information regarding measure type and quantity be included in project invoices. Issues encountered in

the PY6 project file review were in the same vein but occurred much less frequently. At this time, the SWE Team recommends only that custom calculators be more carefully crafted to follow governing TRM equations and requirements.

The SWE Team reviewed tracking data and quarterly reports when they were submitted to ensure consistency across tracking and reporting documents. The participant counts and energy and demand savings values in the documents were identical. However, the SWE Team found discrepancies in the number of participants and the total amount of incentives. Variances do not necessarily indicate inadequate QA/QC or incorrect reported values. Variability in the number of participants is connected to the definition of "participant" used by the SWE Team and EDC for a given program or measure. Further detail is provided in Appendix A.2.2.

The SWE Team reviewed Met-Ed's PY6 sample design to ensure its compliance with the Evaluation Framework. The results are displayed in Table 5-10, showing relative precision at the 85% confidence level (CL).

Table 5-10: Compliance across Sample Designs for Met-Ed's PY6 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	12.2%	14.8%	✓
Small C/I Buildings	14.7%	14.7%	✓
Large C/I Equipment	8.9%	9.6%	✓
Large C/I Buildings	10.2%	4.6%	✓
Government/Institutional	0.0%	0.0%	✓

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 in Appendix A.2.3.

As part of the audit process, the SWE Team performed 11 ride-along site inspections of non-residential projects to oversee Met-Ed's on-site evaluation practices. The projects included lighting upgrades, envelope upgrades, EMS projects, refrigeration upgrades, and VFD installations. The SWE Team had perfect agreement in verified gross energy savings for 10 of 11 projects, and perfect agreement in verified demand reductions in 9 of 11 projects. Overall, the ratio of SWE verified savings to ADM verified savings was 99.8%. Nonetheless, the SWE Team encountered minor discrepancies and opportunities for improvement. Details of all 11 projects and their associated findings from ride-along site inspections are presented in Appendix A.2.4.

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. The SWE Team found the level of rigor chosen by the evaluation contractor to be reasonable, based on project size and uncertainty. The analysis files performed the desired calculations appropriately but were not always well organized. The results of the verified savings analysis are explored in Appendix A.2.5.

5.4.4 Net-to-Gross and Process Evaluation Audit Summary

Table 5-11 presents a high-level summary of the results of the SWE Team's audit of Tetra Tech's NTG assessment and process evaluation of the FirstEnergy EDC programs. The following subsections present

detailed discussions and a summary of the findings, starting with the audit of NTG reporting and related files, followed by findings based on the review of process reports and supporting documents. Appendix C.2 provides detailed program-specific reviews of the process evaluation activities.

Table 5-11: Summary of SWE Team Review of FirstEnergy EDC Process and NTG Evaluations

Elements Reviewed in the Annual Report	SWE Findings
Inclusion of Required Elements per Report Template	
Description of the methods	Generally consistent with SWE guidelines but with minor exceptions noted
Summary of findings	Generally consistent with SWE guidelines but with minor exceptions noted
Summary of conclusions	Findings, but no conclusions presented
Table of recommendations and EDC's response	Consistent with SWE guidelines
Consistency with the Evaluation Plan	
Process evaluation implemented the evaluation plan	Mostly, with exceptions noted
Evidence-based Recommendations	
Recommendations supported by findings and conclusions	Mostly, with exceptions noted
Recommendations actionable	Mostly, with exceptions noted
Use of NTG Common Method or Explanation for Alternate Method	
Availability of NTG data files and documents	Mostly
NTG method used – the common method or another	Common method
NTG common method applied correctly	Yes (where possible to determine)

5.4.4.1 Net-to-Gross Audit Results

This section documents the results of the SWE Team's NTG audits of the FirstEnergy EDC programs in PY6, including a summary of the program-level NTG values that FirstEnergy's evaluation contractor reported. The results are provided for residential, low-income, and non-residential programs.

5.4.4.1.1 Residential Programs

Tetra Tech estimated NTG for three residential programs: the Appliance Turn-In Program, the Residential Energy Efficient Products Program, and the Home Performance Program. Tetra Tech reported using the SWE Team's common method for NTG estimation for all three programs as well as the method that it used in Phase I (using separate samples) for the Residential Energy Efficient Products Program. Since the SWE Team requires only the common method, this section addresses only the reporting relevant to the common method.

Tetra Tech did not describe the NTG methods in detail in either the PY6 annual report or its various process evaluation and NTG memoranda, but it did cite the relevant SWE memoranda. Tetra Tech provided Excel workbooks with the raw data from its 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 Tetra Tech used the SWE common methods. However, in its process evaluation and NTG memorandum for the Appliance Turn-In Program, Tetra Tech described some assumptions made in applying the SWE common method, which the SWE Team reviewers found hard to follow.

For the Residential Energy Efficient Products Program, the reported NTGR value reflects only the HVAC/Water Heater and Appliance components, as Tetra Tech did not evaluate the Consumer Electronics component in PY6. As such, the NTG values in Table 3-7 of the annual report pertain only to the HVAC/Water Heater and Appliance components. The evaluation consultant for FirstEnergy reports that upstream lighting NTG values should be available for reporting in PY7. The PY6 annual report includes a footnote stating that "NTG ratio at program level should be developed using stratum weight and stratum NTG ratios" but it is not clear that Tetra Tech *did* so develop and there was no explanation of the calculation of stratum-level weights. Additional details on how Tetra Tech combined stratum-level NTGR data into program-level findings would have been useful.

For the Residential Energy Efficient Products Program and the Home Performance Program, the sampling approach table shows that 16% of PY6 participants in the HVAC and Water Heating component, or 239 customers, were contacted in order to achieve the desired sample size 70. For the Appliance component, 261 participants (or 4% of the participants in that component) were contacted to yield 67 completed surveys. The survey response rates for these two components are 29% and 26% respectively.

Tetra Tech's use of its Phase I NTG estimation approach as well as the common method for the Residential Energy Efficient Products Program created some confusion in the reporting of NTGR for that program. The PY6 annual report presents total achieved sample sizes and a program-level NTGR that appear to combine the common method and the Phase I approach. Thus, for example, the annual report shows an achieved sample size of 137 and a program-level NTGR of .66, while the process evaluation and NTG memorandum show an achieved sample of 75 and a program-level NTGR of .65 for the common method (and an achieved sample of 63 and a program-level NTGR of .67 for the Phase I method).[31] The PY6 annual report refers only to using the SWE common method—only the separately submitted process evaluation and NTG memorandum refers to the additional use of the Phase I method. This may create the false impression that the NTGR result presented in the annual report is based solely on the common method. After further review and follow-up, Tetra Tech and ADM confirmed that the actual NTG values reflected in the PY6 reports for any Phase II NTG activities do correspond to the common method. However, the aforementioned sample size of 137 was intended to be 75. The NTG participant counts will be revised in the PY7 reports, but the NTG values themselves do not require revision as they are developed according to Phase II common method approach.

Table 5-12 provides a detailed summary of the SWE Team's review of the NTG activities, by program.

Table 5-12: Summary of NTG Audit of Met-Ed's Residential Programs

Program	NTG Method	Review Comments
Appliance Turn-In	Tetra Tech reported using the common method.	Tetra Tech reported used the common method for Appliance Recycling to estimate NTG, but the SWE Team could not verify that and could not follow aspects of Tetra Tech's discussion.
Efficient Products	Tetra Tech used the common method.	The program-level NTGR did not include the Consumer Electronics component as that was not included in the PY6 research. The report does not explain how it weighted stratum-level NTGR data. The PY6 annual report combines the achieved samples and NTGR values of the SWE common method and the method that Tetra Tech used in Phase I research. The report should not combine the samples and results from the two methods.

[31] Note that the total achieved sample for the two methods combined is reported as 137 in the annual report but sums to 138 in the process evaluation and NTG memorandum.

Program	NTG Method	Review Comments
Home Performance	Tetra Tech used the common method.	The program-level NTGR did not include the Home Energy Review component as the impact research provides a net savings value for that component; it also did not include the New Homes component as that was not included in the PY6 research. The report does not explain how it weighted stratum-level NTGR data.

Table 5-13 summarizes NTG findings from the PY6 Met-Ed annual report. NTGR was greatest for Home Performance and lowest for Appliance Turn-In.

Table 5-13: Summary of NTG Estimates by Program

Approach	Program	Free-Ridership	Spillover	NTGR	Sample Size[a]
Estimated	Appliance Turn-In	.43	0	.57	39
	Energy Efficient Products[b]	.51	.16	.65	75
	Home Performance[c]	.13	.02	.89	141

NOTES
[a] All sample sizes are for the NTG research using the common method. All provided at least 85/15 confidence/precision.
[b] NTG findings do not include the Consumer Electronics component as that was not included in the PY6 research.
[c] NTG findings do not include the Home Energy Review component as the impact research provides net savings for that component; they also do not include the New Homes component as that was not included in the PY6 research.

5.4.4.1.2 Low-Income Residential Programs

Tetra Tech assumed a NTGR of 1.0 for low-income programs and did not carry out NTG research for those programs. The SWE recommends that EDCs conduct NTG research on all programs, including low-income programs.

5.4.4.1.3 Non-Residential Programs

Tetra Tech estimated NTG for three non-residential programs: the Small C/I Equipment Program, the Large C/I Equipment Program, and the Government and Institutional Program. 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. Tetra Tech reported using the SWE Team's common method for NTG estimation all three programs. Tetra Tech did not describe the NTG methods in detail in either the PY6 annual report or its various process evaluation and NTG memoranda, but it did cite the relevant SWE memoranda. Tetra Tech provided Excel workbooks with the raw data from its NTG research and the SPSS syntax files used to calculate the NTGRs from the raw data. A review of selected workbooks and syntax verify that Tetra Tech used the SWE common method and applied it correctly.

The descriptions of the NTG sampling methods were not very detailed, and certain aspects were somewhat unclear. For all three programs, the report shows the population size and achieved sample for multiple measure strata, but the sampling approach table does not show the percent of sample frame contacted to achieve the target sample size. Subsequent discussion with Tetra Tech staff indicated that the numbers of customers contacted to yield the final achieved sample sizes were not available to the report authors. As the percent of sample frame contacted was a required element of the report template, the evaluation consultant should include it in future reports.

The report does not describe any methods (e.g., weighting) for combining stratum-level findings into program-level NTG values. The PY6 annual report includes a footnote stating that "NTG ratio at program level should be developed using stratum weight and stratum NTG ratios" but it does not state whether

Tetra Tech *did* so. For the large C/I and government and institutional program, the report states that the evaluation used "the complete participant dataset," but the significance of that statement is not clear. Subsequent discussion with Tetra Tech staff clarified the methods they used and the SWE Team is satisfied that the methods were sound. Future reports should provide sufficient detail to allow readers to understand the methods used. The reports may reference other documentation providing additional detail, but the report itself should explain the method.

For all three non-residential programs, the sampling approach table shows that a significant fraction of participants were contacted for NTG purposes — 73% of the population in the case of the Large C/I Equipment program and 31% of the population for the Small C/I Equipment program.[32]

The P6 annual report states that, for the Small C/I EE Equipment Program, the participant data "was first aggregated to the level of individual participants based on account number and multiple record accounts were identified. After the multiple accounts were sampled, the final random sample was selected." Having reviewed the Tetra Tech sampling plan, the SWE Team understands that this indicates that the evaluators sampled from a stratum of participating businesses with multiple accounts ("multiple-record accounts") and another stratum of participating businesses with a single account. This is explained somewhat in the separate process evaluation and NTG memorandum, but it could have been stated more clearly, with more details provided, in the annual report for readers other than the SWE Team.

Based on the Tetra Tech sampling plan, it was clear that the "multiple-record accounts" stratum would include a relatively large number of cases in which a single participant contributed multiple cases to the sample. Based on the large proportion of participants who had multiple accounts in this program, Tetra Tech's approach may have been the only way to obtain a reasonable sample size. However, the SWE Team raised concerns about this approach during the review of the sampling plan. Specifically, the approach introduces a large degree of non-independence of observations into the sample. In one respect, the multiple-record accounts stratum represents a type of clustered sampling approach. Since the stratum with one account per participant would be a simple random sample, the overall sample would be a sort of hybrid of clustered and non-clustered approaches. The SWE Team suggests that the evaluators provide more detail about the structure of the sample, including the number of sampled projects that came from each stratum, and discuss how the sampling approach affected confidence and precision.

Table 5-14 summarizes the SWE Team's review of the Met-Ed NTG methodology, by program.

Table 5-14: Summary of NTG Audit of the Met-Ed Non-Residential Programs

Program	NTG Method	Review Comments
Small C/I Equipment	Tetra Tech reported using the common method.	The description of the sampling approach was not clear, and the description of the NTGR method lacked detail. It is not clear how the evaluators combined the stratum-level data into the program-level NTGR.
Large C/I Equipment	Tetra Tech reported using the common method.	Same comments as for Small C/I Equipment Program
Government and Institutional	Tetra Tech reported using the common method.	Same comments as for Small C/I Equipment Program

Table 5-15 shows the NTG estimates reported in the annual report.

[32] Across all four EDCs, of 27 projects (or participants) for the GNI Program, 24 were contacted for NTG surveys.

Table 5-15: Summary of Met-Ed NTGR Estimates for Non-Residential Programs

Approach	Program	Free-Ridership	Spillover	NTGR	Sample Size[a]
Estimated	Small C/I Equipment	.41	.12	.71	44
	Large C/I Equipment	.32	.05	.73	54
	Government and Institutional[b]	.37	.11	.73	18

NOTES
[a] All samples provided at least 85/15 confidence/precision.
[b] NTGR = 1 – free-ridership (.37) + spillover (.11), which = .74. The SWE Team assumes the reported value of .73 is correct and the difference is due to rounding.

5.4.4.2 Process Evaluation Review Results

The SWE Team's audit included a review of the process evaluation methods, findings, conclusions, and recommendations in the Met-Ed PY6 annual report to determine whether it was 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 SWE Team's review found that the evaluations appeared to be consistent with Tetra Tech's Phase II evaluation plan, with some exceptions. The report generally provided a comprehensive overview of the process evaluation findings, conclusions, and recommendations, although as noted below, the SWE Team noted areas where additional detail on the methods and results would be valuable in program-level findings. In the following subsections, the SWE Team summarizes the review of the process evaluation sections in the Met-Ed annual report. Detailed summaries by program are in Appendix C.2.

5.4.4.2.1 Summary of Research Activities and Consistency with the Evaluation Plan

The process evaluation conducted by Tetra Tech involved review of key program documentation; interviews with program staff, CSPs, and program-affiliated contractors, retailers, and auditors; and surveys with program participants. The research issues addressed varied by program but generally included key aspects of program administration, implementation, and delivery, including program communication, program awareness, and participant and contractor satisfaction.

The process evaluations generally appeared consistent with the evaluation plan, with some exceptions. The most significant exceptions were that the Phase II evaluation plan stated that the PY5 or PY6 process evaluations for the Residential Energy Efficient Products Program and Home Performance Program would include a benchmarking review[33] and that the process evaluation for the non-residential programs would include a survey of nonparticipating trade allies, but the report mentioned neither of those activities. The evaluators should explain why those activities were not included in the PY6 evaluations.

In addition, the evaluation of the Residential Energy Efficient Products Program did not achieve the target number of surveyed contractors, which appears to have been achievable given the size of the sample frame. Although the overall achieved sample (across the four EDC territories) was large enough to meet the required confidence and precision levels for the combined sample, the respondents were not

[33] The plan stated that the process evaluation would include a benchmarking review for the Residential Energy Efficient Products Program in PY6 and for the Home Performance Program in PY5; however, FirstEnergy carried out no process evaluations in PY5.

distributed equally or proportionally across the EDC territories and one EDC in particular was represented by a small number of respondents. The report should explain why they were unable to achieve the target sample size, thereby ensuring that each EDC was represented by a fair number of respondents.

5.4.4.2.2 Summary of Sampling Strategies

The SWE Team determined that the sampling approaches for the process evaluation activities were generally 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 85/15 confidence/precision or were drawn from such small populations that achieving that standard would have required reaching a large percentage of the population. For other non-survey research activities—the in-depth interviews with program staff, implementers, or other program actors—the sampling was purposive.

5.4.4.2.3 Report Elements and Clarity of the Reporting

The SWE Team deemed the reporting to be adequate, while identifying areas that could be improved:

- Some findings for the Appliance Turn-in Program appear to be based on the total sample across the four EDCs, not just for Met-Ed. The report should clarify whether that is the case and why.
- The report presented no findings from interviews with program and implementer staff.
- The description of the Home Performance Program was somewhat confusing, leading to confusion regarding the findings.
- The SWE Team had concerns about the discussion of the LED awareness findings in the Home Performance Program and about the reliability of the results in general.
- In a few cases, some additional discussion of findings may be warranted.

As noted above, the evaluators provided process evaluation findings in the PY6 annual report supplemented by a set of process evaluation memoranda, submitted from about three months before to about the same time as the annual report. Between these documents, the report 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 other readers) to assess the methods, findings, conclusions, and recommendations, with the following exceptions:

- The discussion of the contractor survey for the Energy Efficient Products Program seems to indicate that none of the surveyed contractors worked in more than one EDC territory, which seems surprising. The report should clarify whether that is the case.
- The report generally did not indicate how many staff and implementers were interviewed.
- Some additional details regarding survey methodology would be valuable.

The SWE Team considers the above issues to be minor and easily remedied.

In addition, the presentation of recommendations was in some ways disjointed. The PY6 annual report provided a summary of methods, high-level findings, and the table of recommendations; however, the annual report did not provide a set of conclusions tying the findings to the recommendations. The memoranda usually presented more details on methods and findings and often presented a set of conclusions and an appendix table tying findings to recommendations, or presented explanations for the

recommendations in a separate section. In several cases, however, the recommendations presented in the annual report did not overlap completely with those in the memoranda, so in some cases it was not easy to determine how well a recommendation followed from findings.

5.5 STATEWIDE EVALUATOR FINAL RECOMMENDATIONS

The SWE Team has the following recommendations for Met-Ed's EE&C programs going forward.

1) The FirstEnergy evaluation contractor did an excellent job of compiling the verification data for the residential programs into a spreadsheet database and performing the necessary analysis. However, the SWE Team recommends that Met-Ed make modifications to the larger tracking system files to reduce size and improve ease of navigation.

2) The CSPs and evaluation contractors should use SWE-provided savings calculators when available. Some of the inconsistencies the SWE Team observed in PY6 were a direct result of using a lighting calculator that misaligned with the 2014 TRM algorithms and assumptions in the non-residential sector.

3) The SWE Team would like to see better organization and a more streamlined presentation of the EM&V plan and associated documentation in the C/I project files. For example, there was a document titled "M&V Plan" included in the project file for CR_PRJ-219164 that was blank and appeared to be a template that was not used. The SWE Team would like extraneous documentation like this to be completed or removed from the project file, to improve clarity and transparency.

4) The SWE Team recommends that the FirstEnergy EDCs enhance quality assurance reviews and follow-up with those contractors for whom households report measures are more frequently "left behind" for future installation.

5) The SWE Team recommends that in Phase III, FirstEnergy EDCs consider subsuming the C/I Small and Large Energy Efficient Buildings programs into the C/I Small and Large Energy Efficient Equipment Programs to reduce administrative costs and to ensure adequate budget is available in case participation levels increase significantly.

6) The SWE Team recommends that the FirstEnergy EDCs seek opportunities to provide contractors and targeted customers with additional literature and marketing materials they can use to convey benefits of the Large EE Equipment and Government and Institutional programs to management staff.

6 PENNSYLVANIA ELECTRIC COMPANY

This chapter summarizes Penelec's program performance in PY6. It includes an overview of the cumulative energy savings and demand reductions achieved by Penelec's Act 129 EE&C programs in Phase II through the end of PY6; 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.

6.1 SUMMARY OF ENERGY AND DEMAND REDUCTIONS

Table 6-1 provides an overview of Penelec's cumulative reported gross (RG) and verified gross (VG) savings impacts, and carryover (CO) savings since the EE&C programs' inception through the end of PY6.

Table 6-1: Summary of Penelec's Phase II Savings Impacts

Savings Impacts	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/yr)	Savings Achieved as % of 2016 Targets[i]
Total Energy Savings (MWh/yr)	238,075	233,186	26,805	259,991	318,813	82%
Total Demand Reduction (MW)	26.04	27.67	N/A	27.7	N/A	N/A
TRC Benefits ($1,000)[a]	N/A[g]	$104,879	N/A	$104,879	N/A	N/A
TRC Costs ($1,000)[b]	N/A[g]	$55,527	N/A	$55,527	N/A	N/A
TRC B/C Ratio [c]	N/A[g]	1.89	N/A	1.89	N/A	N/A
CO_2 Emissions Reduction (Tons)[d][e]	203,197	199,024	22,878	221,902	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 1,707 lb CO_2 per MWh according to the latest available (2014) PJM Emission Report of marginal off-peak annual CO_2 emission rate based on direction provided by Commission staff.
[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.

As Table 6-1 shows, Penelec achieved 82% of its Act 129 Phase II energy savings target by the end of PY6. The TRC B/C ratio (or TRC ratio) of Penelec's programs through PY6 was 1.89, which indicates that Penelec's portfolio of EE&C programs was cost-effective on an aggregated basis.

Table 6-2 lists Penelec's EE&C programs. Penelec reported PY6 gross energy and/or demand savings for all nine programs.

Table 6-2: Penelec EE&C PY6 Programs

Programs Reporting PY6 Gross Savings	Sector(s)
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 6-3 provides a breakdown of the contribution of the verified gross energy savings (MWh/yr) and gross demand savings (MW) for each program, and the contribution of each program's savings toward the total portfolio energy and demand savings. The Home Performance Program accounts for 32% of the total Phase II verified gross energy savings in Penelec's portfolio, making it the most impactful energy savings program in the residential sector. The Large C/I Equipment Program accounts for 17% of the total Phase II verified gross savings in Penelec's portfolio, making it the most impactful energy savings program in the non-residential sector. The Efficient Products Program contributed 24% of the total energy savings.

Table 6-3: Summary of Penelec EE&C Program Impacts on Verified Gross Portfolio Savings

Program	Phase II VG Savings (MWh/yr)	% of Portfolio Phase II VG MWh/yr Savings	Phase II VG Savings (MW)	% of Portfolio Phase II VG MW Savings
Appliance Turn-In	8,975	4%	1.34	5%
Efficient Products	56,677	24%	5.40	20%
Home Performance	75,223	32%	7.13	26%
Low-Income	7,806	3%	0.55	2%
Small C/I Equipment	30,862	13%	5.19	19%
Small C/I Buildings	5,537	2%	0.75	3%
Large C/I Equipment	38,578	17%	6.28	23%
Large C/I Buildings	8,839	4%	0.91	3%
Gov./Institutional	687	0%	0.11	0%
Total Portfolio	**233,186**	**100%**	**27.7**	**100%**

The NTG research yielded estimates of NTG ratios for the Penelec programs. Table 6-4 provides the verified net savings alongside the verified gross savings for PY6 and Phase II. The portfolio-level NTG ratio

for PY6 was 0.78. Section 6.4.4 provides findings and details on the SWE Team audit of the NTG research conducted for Penelec programs.

Table 6-4: Summary of Penelec EE&C Program Verified Net and Gross Savings by Sector

Sector	PY6 VG Savings (MWh/yr)	PY6 Verified Net Savings (MWh/yr)	Phase II VG Savings (MWh/yr)	Phase II Verified Net Savings (MWh/yr)
Residential	74,892	54,871	144,262	95,136
Commercial and Industrial	47,548	34,108	71,534	52,660
Government, Nonprofit, and Institutional	11,534	8,270	17,391	11,727
Total Portfolio	***133,973***	***97,249***	***233,186***	***159,523***

6.2 TOTAL RESOURCE COST TEST

Table 6-5 presents TRC benefits, TRC costs, present value of net benefits, and TRC ratios for Penelec's PY6 portfolio, and individual programs. The SWE found no initial inconsistencies between the TRC model outputs and the TRC results shown in the PY6 annual report.

Table 6-5: Summary of Penelec's PY6 TRC Factors and Results

Program	TRC NPV Benefits ($)	TRC NPV Costs ($)	Present Value of Net Benefits ($)	TRC Ratio
Appliance Turn-In	$1,992,316	$971,256	$1,021,060	2.05
Efficient Products	$11,016,708	$4,846,790	$6,169,919	2.27
Home Performance	$8,802,386	$5,650,456	$3,151,930	1.56
Low-Income	$1,109,022	$2,071,841	$(962,819)	0.54
Small C/I Equipment	$8,856,296	$5,695,342	$3,160,955	1.56
Small C/I Buildings	$1,488,128	$899,445	$588,683	1.65
Large C/I Equipment	$17,671,824	$6,722,862	$10,948,962	2.63
Large C/I Buildings	$6,417,610	$738,425	$5,679,185	8.69
Government/Institutional	$65,473	$197,325	$(131,852)	0.33
Total Portfolio	**$57,419,764**	**$27,793,742**	**$29,626,022**	**2.07**

In summary, seven of nine programs offered were found to be cost-effective and two were found to be 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*
- *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*
- *Government and Institutional*

6.2.1 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 to the upfront costs of installation of implementation. This value matches the EDC's EE&C Plan on file.

Different values of LLFs were used for different sectors, as shown in Table 6-6. Inconsistencies were found in the energy LLF values applied in the TRC model workbook and those specified in the Penelec PY6 annual report, specifically in the small C/I and Government and Institutional sectors. The SWE believes the values specified in the PY6 annual report to be incorrect, and have noted the energy LLF used by program in the Penelec TRC model in the table below.

Table 6-6: Penelec's PY6 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%	9.45%	9.45%
Home Performance	Residential	7.92%	9.45%	9.45%
Low-Income	Residential	7.92%	9.45%	9.45%
Small C/I Equipment	Non-residential	7.92%	7.2%[a)]	7.2%
Small C/I Buildings	Non-residential	7.92%	7.2%[a)]	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%
Government/Institutional	Non-residential	7.92%	7.2%[a]	7.2%

NOTES
a)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 Penelec PY6 annual report.

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 2014 TRM. In the non-residential sector, the TRC model applied a EUL at the stratum level rather than at the measure level.

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 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.[34] 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.

In PY6, the 2014 TRM specifically 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 PY6. 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, a measure's lifetime was separated into two parts: the first three years, and the remaining lifetime. The removed equipment was treated as the baseline for the first three years, 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.

The SWE Team reviewed and found the energy and demand impacts used in the Penelec TRC model to be generally consistent with those provided in the program tracking database, with one minor exception. Further review found a systematic error that minimally understates the kW demand savings for a small sample of projects that have zero ex ante kW savings yet some nonzero ex post kW savings. The TRC benefits reflect the full kW demand savings, but the verified kW portfolio totals in the PY6 annual report are inconsistent with the TRC model. The overall magnitude of this error is less than 0.5% of the PY6 verified demand savings.

6.2.2 Avoided Cost of Energy

The Penelec TRC model assigned a value ($/kW/year) to the avoided cost of energy for each year from 2015 through 2029 for each measure category based on the load profile of the end use and the sector in which the savings occur. The avoided costs of energy for measures were calculated by multiplying 8,760 energy costs values by 8,760 associated load shapes. The unit impacts were multiplied by the most appropriate avoided cost stream to determine the per-unit avoided energy costs for that program.

6.2.3 Avoided Cost of Capacity

The Penelec TRC model assigned a flat annual figure ($/kW-year) to the cost of adding generation capacity based on PJM forward capacity auction prices. A single value was used for the avoided cost of capacity for all programs and sectors. This value was multiplied by the ex post demand savings for each combination of program and sector to determine the benefits to the EDC of not having to expand generation capacity.

6.2.4 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 PY6 TRC

[34] The DEER 2008 incremental cost database is available for download at http://www.deeresources.com.

benefits, costs, and ratios to be reasonable and accurate. As noted above, the TRC model review did uncover a small systematic error in the evaluation process that minimally understates the verified demand savings in the Penelec summary reporting tables (< 0.5% of the overall portfolio demand savings). The SWE recommends that the evaluator correct the observed calculation error for future program years.

6.3 STATUS OF EVALUATION ACTIVITIES

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

6.3.1 Status of Evaluation, Measurement and Verification Plans

FirstEnergy submitted, and the SWE Team approved, only one EM&V Plan across all four FirstEnergy EDCs. Section 5.3.1 presents a detailed account of the status of FirstEnergy's EM&V Plan.

6.3.2 Measurement and Verification Activities and Findings

By the end of PY6, Penelec had achieved 82% of its total Phase II energy savings compliance target, based on aggregated verified savings as of May 31, 2015 from Phase II in addition to Phase I carryover. Realization rates compare gross savings reported by the EDC to the verified gross savings determined by the EDC evaluation contractor through M&V activities (see Section 4.3.2 for an overview of how realization rates are calculated and defined).

Table 6-7 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 6-7 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 PY6.

Table 6-7: Penelec Energy Efficiency Programs – Realization Rates for Energy and Demand Savings in PY6

Program	Energy Realization Rate	Relative Precision (Energy)[a]	Demand Realization Rate	Relative Precision (Demand)[a]
Appliance Turn-In	99.2%	10.2%	103.6%	9.0%
Efficient Products	109.2%	2.1%	121.0%	2.4%
Home Performance	98.4%	9.7%	99.3%	10.9%
Low-Income	94.9%	6.7%	99.2%	6.8%
Small C/I Equipment	92.6%	11.7%	98.2%	12.5%
Small C/I Buildings	108.7%	13.5%	90.4%	15.2%
Large C/I Equipment	97.1%	8.6%	117.2%	10.5%
Large C/I Buildings	94.2%	4.8%	90.6%	0.5%
Government/Institutional	62.7%	7.2%	33.7%	13.0%

NOTES
[a] Relative precision values are at the 85% confidence level.

6.3.2.1 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,

and if the refrigerators and freezers had later been replaced. The replacement option was also designated as either ENERGY STAR or standard so as to be applicable to the 2014 TRM deemed values for each scenario. The program realization rate is mostly a function of the difference between the ex ante and ex post weights of the various replacement scenarios.

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.

The evaluation contractor approached the evaluation differently for each branch of the Home Performance Program. The Home Energy Audit Kits and School Kits were evaluated using the T&R tracking 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 evaluator, producing results consistent with the ICSP's. The ICSP's results were accepted as verified for the PY6 annual report, with the understanding that the measure life is only one year and that a full evaluation will be performed for PY7.

6.3.2.2 Low-Income Programs

The energy realization rate for the Low-Income Program was the lowest among the Penelec residential programs, at 94.9%. 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 ISRs from the LILU evaluation, as actual ISRs cannot be known directly, but are likely lower than the defaults in the TRM. For the evaluation of the LILU Energy Kit portion of the Low-Income Program, the evaluation contractor employed an approach similar to that chosen for the evaluation of the Home Energy Audit and School Kits: through customer surveys and reviews of the T&R system. As with the Home Energy Audit Kits and School Kits, the 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.

6.3.2.3 Non-Residential Programs

Realization rates for Penelec's non-residential programs' energy savings ranged from 63% to 109%. Realization rates for demand reductions from these programs ranged from 34% to 117%. The Government and Institutional program was responsible for the low realization rates of 63% and 34% for energy and demand, all coming from lighting projects. 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 6-1 shows the frequency of each M&V approach performed by ADM in PY6 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 6-1: Frequency and Associated Savings by M&V Approach – Small C/I Equipment Program

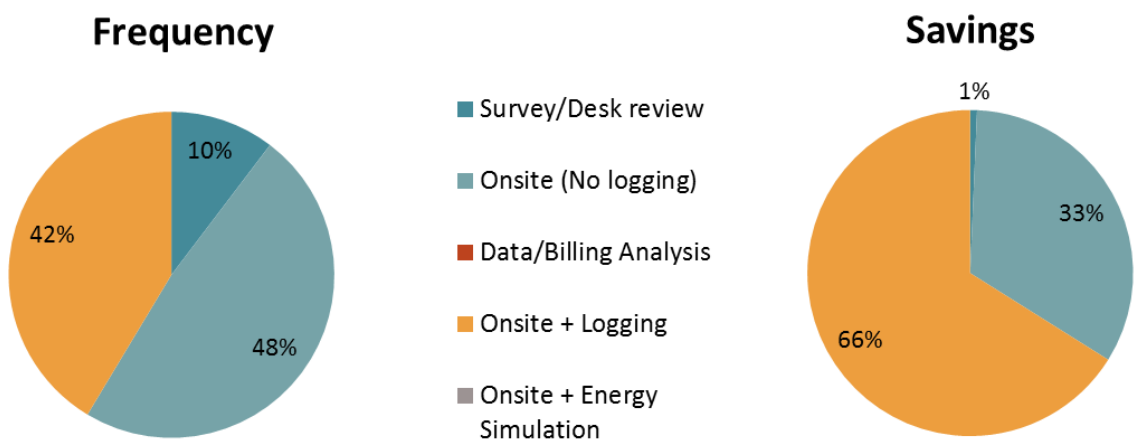


Figure 6-1 indicates that 58% of the sampled measures for the Small C/I Equipment Program were evaluated using a basic level of rigor. However, the representative savings for these measures accounted for only 34% of the energy savings. This suggests that the use of basic rigor was appropriately apportioned, 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 (66%) 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 6-2 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 and billing analysis was the only enhanced rigor approach used for this program, and associated projects accounted for 95% of savings.

Figure 6-2: Frequency and Associated Savings by M&V Approach – Small C/I Buildings Program

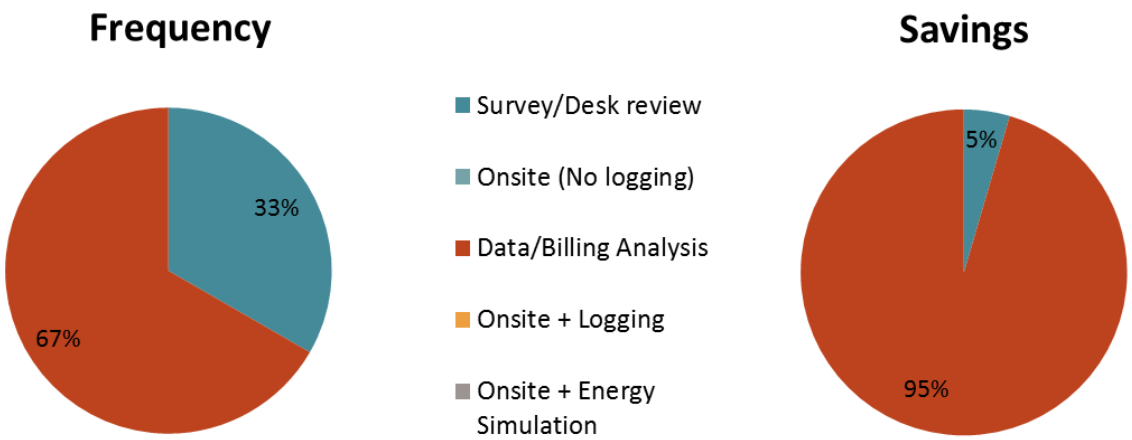
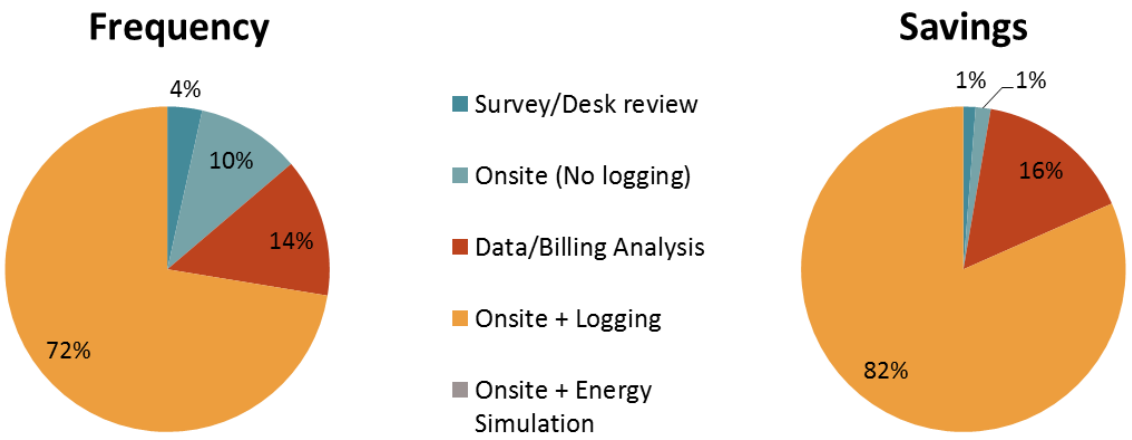


Figure 6-3 shows the frequency of each M&V method used in the Large C/I Equipment Program and the energy savings associated with each method. Enhanced rigor was used for a majority of the projects (86%), and these projects accounted for almost all the savings (98%). Basic rigor was appropriately limited to those projects with less savings.

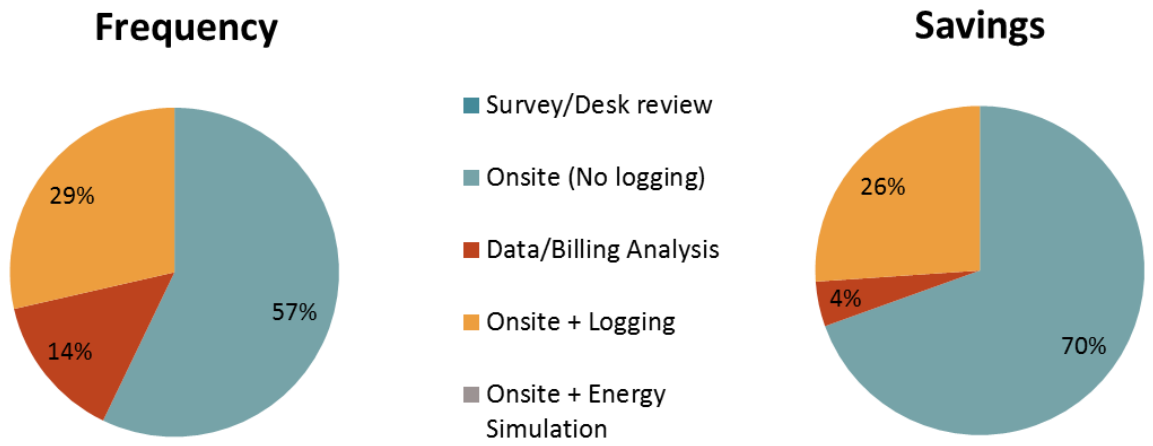
Figure 6-3: Frequency and Associated Savings by M&V Approach – Large C/I Equipment Program



The Large C/I Building Program had only six projects completed in PY6, of which three were in the evaluation sample. All three used enhanced rigor. Data and billing analysis was used to evaluate projects accounting for 93% of savings.

Figure 6-4 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 a majority of the projects (57%) and these projects accounted for a majority of the savings (70%). There were only seven projects completed in PY6 for this program, and each of these was less than 40,000 kWh/yr.

Figure 6-4: Frequency and Associated Savings by M&V Approach – Government and Institutional Program



6.3.3 Process Evaluation Activities and Findings

FirstEnergy implemented a common set of energy efficiency programs across its four Pennsylvania EDCs—Met-Ed, Penelec, Penn Power, and West Penn—and FirstEnergy's evaluation contractors, ADM and Tetra Tech, used the same evaluation methods and identified the same findings and recommendations for all four EDCs. See Section 5.3.3 for a summary of the data sources Tetra Tech used and its key findings for each program.

6.4 STATEWIDE EVALUATOR AUDIT ACTIVITIES AND FINDINGS

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

6.4.1 Residential Program Audit Summary

6.4.1.1 Residential Lighting

For PY6, 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 over 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 2014 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.

6.4.1.2 Appliance Turn-In Program

The SWE Team reviewed Penelec's JACO database quarterly throughout PY6, and at the end of the year reviewed its additional calculations for verified gross values. The SWE Team confirmed that the correct EDC-specific deemed values from the 2014 TRM were used whether a unit was retired, replaced with a standard unit, or replaced with an ENERGY STAR unit. Penelec used surveys to determine if refrigerators

and freezers were functional and if they had been replaced with a standard or an ENERGY STAR unit. These percentages were then combined with the deemed savings from the 2014 TRM to calculate an average UEC for each refrigerator and freezer that was recycled. The SWE Team also verified that if a refrigerator was removed and then replaced with an ENERGY STAR unit, the additional ENERGY STAR refrigerator Efficient Products Program savings was subtracted from the program savings totals in order to prevent double-counting.

6.4.1.3 Efficient Products Program

For PY6, the Efficient Products Program increased the offering by two programs to total 20 subcategories. Incentives for some measures were paid to the consumer at the point of sale or through rebates for qualified purchases or installations. This was the second program year in which consumer electronics were incorporated into the Efficient Products Program, and the first year for including room air conditioners in the upstream category, which provides incentives to retailers for selling qualified consumer electronic products at the point of sale.

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 strata. Due to the fact that some rebate applications were assigned to PY5, the evaluation contractor had to designate which year's TRM to use in the ex post analysis. FirstEnergy's evaluation contractor analyzed all of the reported program data for consistency with the 2014 TRM (or 2013 TRM as appropriate for consumer electronics) and noted and accounted for any discrepancies in reported gross savings through the verified savings analysis.

6.4.1.4 Home Performance Program

The SWE Team audited each component of the Home Performance Program: School Conservation Kits, Whole House Direct Install, Home Energy Audit Conservation Kits, New Homes, and HERs. The School Conservation Kits component provides kits of prescriptive measures to students' parents upon request after the parents review the energy efficiency curriculum. The SWE Team verified that the correct 2014 TRM savings were used for all measures and that the FirstEnergy EDC statewide receipt rate and ISRs were correctly applied to the items. The SWE Team found that the evaluation contractor also used the correct TRM savings and ISR for the Home Energy Audit Conservation Kits.

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 SWE Team also reviewed the billing analysis performed on the more than 2 MWh/yr house stratum. The SWE Team verified that the New Homes component was evaluated according to FirstEnergy's evaluation plan and that the realization rates determined by the evaluation contractor from additional REM/Rate models had been correctly applied to the ex ante savings.

The evaluation contractor did not do a full evaluation of HER savings for PY6 because the one-year measure life does not count toward compliance. However, the evaluator did recreate the analysis performed by the ICSP with similar results. The SWE Team reviewed the analysis performed by the evaluator and verified that it was done correctly. It is anticipated that the evaluation contractor will fully evaluate this program and that the SWE Team will audit this analysis in PY7.

6.4.2 Low-Income Program Audit Summary

The SWE Team reviewed the three distribution branches of the Low-Income Program (direct install, giveaway, and direct delivery kits) to ensure that the savings were correctly calculated using the 2014 TRM and that the realization rates were correctly determined and applied appropriately. Penelec's

evaluator provided a complete database of direct-install measures, which the SWE Team formatted and ranked by individual measure contribution to total program 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 LILU Conservation Kits and the Giveaway Program were implemented per the 2014 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 PY6, which is 15% of the total number of measures offered across all sectors. This exceeded its goal of 10.2%.

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. In general, the submitted project files provided thorough documentation for SWE review, but showed evidence of loose interpretations of the applicable TRM on many occasions. Specific examples of deficiencies noted in the project file review are explored in Appendix A.3.1. Based on the inconsistencies noted among the other FirstEnergy EDCs, the SWE Team makes the following recommendations to ensure the accuracy of reported savings presented in upcoming program years:

1) SWE-provided calculators should be used properly; if SWE-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 to the SWE in response to quarterly and annual SWE data requests.

The SWE Team reviewed tracking data and quarterly reports as they were submitted to ensure consistency across tracking and reporting documents. The total energy and demand impacts provided in the database summary match the figures reported in Penelec's PY6 quarterly reports. Minor variances were found in the number of participants because the SWE Team used a slightly different methodology to count participants in the Power Direct kit offering. Incentive amounts also differed slightly (by less than 0.5%) between the tracking data submission and quarterly report tables. Further detail is provided in Appendix A.3.2.

The SWE Team reviewed Penelec's PY6 sample design to ensure its compliance with the Evaluation Framework. The results are displayed in Table 6-8, showing relative precision at the 85% confidence level (CL).

Table 6-8: Compliance across Sample Designs for Penelec's PY6 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	11.7%	12.5%	✓
Small C/I Buildings	13.5%	15.2%	✓
Large C/I Equipment	8.6%	10.5%	✓
Large C/I Buildings	4.8%	0.5%	✓
Government/Institutional	7.2%	13.0%	✓

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 in Appendix A.3.3.

As part of the audit process, the SWE Team performed 11 ride-along site inspections of non-residential projects to oversee Penelec's on-site evaluation practices. Nine of the projects were lighting upgrades, and two were EMS projects. The SWE Team observed perfect agreement in verified kWh in ten of 11 projects. In the remaining project, ADM reported slightly lower savings and slightly higher demand reductions than SWE, primarily because ADM combined results from billing analysis and a TRM-style analysis for a lighting project. The overall realization rate of these 11 projects, defined as the ratio of SWE verified kWh to ADM verified kWh, is 100.0%. Nonetheless, SWE did find opportunities for improvement. Results from the site inspections are summarized in Appendix A.3.4.

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 the approaches used to be sufficiently rigorous. Appendix A.3.5 presents more detailed results of the verified savings analysis.

6.4.4 Net-to-Gross and Process Evaluation Audit Summary

FirstEnergy implemented a common set of energy efficiency programs across its four Pennsylvania EDCs. FirstEnergy's evaluation consultants, ADM and Tetra Tech, used the same evaluation methods for all four EDCs. See Section 5.4.4 for a description of the SWE Team's review of the FirstEnergy EDC process and NTG evaluation, which apply to all four of FirstEnergy's Pennsylvania EDCs.

Table 6-9 summarizes NTG findings from the Penelec PY6 annual report. The NTGR was greatest for the Home Performance Program and lowest for the Appliance Turn-In Program.

Table 6-9: Summary of NTG Estimates by Program

Approach	Program	Free-Ridership	Spillover	NTGR	Sample Size[a]
Residential					
Estimated	Appliance Turn-In	.51	0	.49	45
	Efficient Products	.57	.11	.54	70
	Home Performance	.15	.02	.87	127
Non-Residential					
Estimated	Small C/I Equipment	.38	.12	.75	54

Approach	Program	Free-Ridership	Spillover	NTGR	Sample Size[a]
	Large C/I Equipment	.27	.08	.80	51
	Government and Institutional	.54	.12	.57	18

NOTES
[a] The samples provided at least 85/15 precision/confidence.

6.5 STATEWIDE EVALUATOR FINAL RECOMMENDATIONS

The SWE Team has the following recommendations for Penelec's EE&C programs going forward.

1) The FirstEnergy evaluation contractor did an excellent job of compiling the verification data for the residential programs into a spreadsheet database and performing the necessary analysis. However, the SWE Team recommends that Penelec make modifications to the larger tracking system files to reduce size and improve ease of navigation.

2) The CSPs and evaluation contractors should use SWE-provided savings calculators when available. If SWE-provided calculators are unavailable for a given measure, custom calculators should be crafted carefully following the governing TRM equations and requirements.

3) The SWE Team would like to see better organization and a more streamlined presentation of the EM&V plan and associated documentation in the C/I project files. The SWE Team would like extraneous documentation to be cleaned up, in order to improve clarity and transparency.

4) The SWE Team recommends that the FirstEnergy EDCs enhance quality assurance reviews and follow-up with those contractors for whom households report measures are more frequently "left behind" for future installation.

5) The SWE Team recommends that in Phase III, the FirstEnergy EDCs consider subsuming the C/I Small and Large Energy Efficient Buildings programs into the C/I Small and Large Energy Efficient Equipment Programs to reduce administrative costs and to ensure adequate budget is available in case participation levels increase significantly.

6) The SWE Team recommends that the FirstEnergy EDCs seek opportunities to provide contractors and targeted customers with additional literature and marketing materials they can use to convey benefits of the Large EE Equipment and Government and Institutional programs to management staff.

7 PENNSYLVANIA POWER COMPANY

This chapter summarizes Penn Power's program performance in PY6. 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 through the end of PY6; 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.

7.1 SUMMARY OF ENERGY AND DEMAND REDUCTIONS

Table 7-1 provides an overview of Penn Power's cumulative reported gross (RG) and verified gross (VG) savings impacts, and carryover (CO) savings since the EE&C programs' inception through the end of PY6.

Table 7-1: Summary of Penn Power's Phase II Savings Impacts

Savings Impacts	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/yr)	Savings Achieved as % of 2016 Targets[i]
Total Energy Savings (MWh/yr)	84,826	90,633	22,580	113,213	95,502	119%
Total Demand Reduction (MW)	8.81	10.24	N/A	10.2	N/A	N/A
TRC Benefits ($1,000)[a]	N/A[g]	$36,314	N/A	$36,314	N/A	N/A
TRC Costs ($1,000)[b]	N/A[g]	$29,698	N/A	$29,698	N/A	N/A
TRC B/C Ratio[c]	N/A[g]	1.22	N/A	1.22	N/A	N/A
CO_2 Emissions Reduction (Tons) [d][e]	72,399	77,355	19,272	96,627	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 1,707 lb CO_2 per MWh according to the latest available (2014) PJM Emission Report of marginal off-peak annual CO_2 emission rate based on direction provided by Commission staff.
[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.

As Table 7-1 shows, Penn Power achieved 119% of its Act 129 Phase II energy savings target by the end of PY6. The TRC B/C ratio (or TRC ratio) of Penn Power's programs through PY6 was 1.22, which indicates that Penn Power's portfolio of EE&C programs was cost-effective on an aggregated basis.

Table 7-2 lists Penn Power's EE&C programs. Penn Power reported PY6 gross energy and/or demand savings for nine programs.

Table 7-2: Penn Power EE&C PY6 Programs

Programs Reporting PY6 Gross Savings	Sector(s)
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 7-3 provides a breakdown of the contribution of the verified gross energy savings (MWh/yr) and gross demand savings (MW) for each program, and the contribution of each program's savings toward the total portfolio energy and demand savings. The Home Performance program and the Efficient Products programs account for 25% and 22% of the total Phase II verified gross energy savings in Penn Power's portfolio, making them the most impactful energy savings programs in the residential sector. The Large C/I Equipment Program accounts for 30% of the total Phase II verified gross savings in Penn Power's portfolio, making it the most impactful energy savings programs in the non-residential sector.

Table 7-3: Summary of Penn Power EE&C Program Impacts on Verified Gross Portfolio Savings

Program	Phase II VG Savings (MWh/yr)	% of Portfolio Phase II VG MWh/yr Savings	Phase II VG Savings (MW)	% of Portfolio Phase II VG MW Savings
Appliance Turn-In	3,152	3%	0.43	4%
Efficient Products	20,324	22%	2.04	20%
Home Performance	22,931	25%	2.18	21%
Low-Income	2,178	2%	0.17	2%
Small C/I Equipment	12,099	13%	1.80	18%
Small C/I Buildings	2,592	3%	0.41	4%
Large C/I Equipment	27,196	30%	3.19	31%
Large C/I Buildings	26	0%	0.00	0%
Gov./Institutional	135	0%	0.01	0%
Total Portfolio	**90,633**	**100%**	**10.2**	**100%**

The NTG research yielded estimates of NTG ratios for the Penn Power programs. Table 7-4 provides the verified net savings alongside the verified gross savings for PY6 and Phase II. The portfolio-level NTG ratio for PY6 was 0.75. Section 7.4.4 provides findings and details on the SWE Team audit of the NTG research conducted for Penn Power programs.

Table 7-4: Summary of Penn Power EE&C Program Verified Net and Gross Savings by Sector

Sector	PY6 VG Savings (MWh/yr)	PY6 Verified Net Savings (MWh/yr)	Phase II VG Savings (MWh/yr)	Phase II Verified Net Savings (MWh/yr)
Residential	22,533	16,808	47,012	30,457
Commercial and Industrial	26,460	17,205	34,052	23,127
Government, Nonprofit, and Institutional	8,520	5,520	9,569	6,127
Total Portfolio	***57,514***	***39,534***	***90,633***	***59,711***

7.2 TOTAL RESOURCE COST TEST

Table 7-5 presents TRC NPV benefits, TRC NPV costs, present value of net benefits, and TRC ratio for Penn Power's PY6 individual programs and total portfolio. The SWE found no initial inconsistencies between the TRC model outputs and the TRC results shown in the PY6 annual report.

Table 7-5: Summary of Penn Power's PY6 TRC Factors and Results

Program	TRC NPV Benefits ($)	TRC NPV Costs ($)	Present Value of Net Benefits ($)	TRC Ratio
Appliance Turn-In	$507,873	$313,141	$194,732	1.62
Efficient Products	$2,737,370	$1,968,081	$769,288	1.39
Home Performance	$2,673,717	$2,392,574	$281,143	1.12
Low-Income	$328,391	$492,552	$(164,161)	0.67
Small C/I Equipment	$4,602,557	$3,004,508	$1,598,049	1.53
Small C/I Buildings	$932,912	$2,018,119	$(1,085,207)	0.46
Large C/I Equipment	$11,230,181	$7,560,478	$3,669,703	1.49
Large C/I Buildings	$5,986	$82,599	$(76,613)	0.07
Government/Institutional	$56,142	$104,210	$(48,068)	0.54
Total Portfolio	**$23,075,129**	**$17,936,261**	**$5,138,867**	**1.29**

In summary, 5 of Penn Power's 9 programs offered were found to be cost-effective while 4 were found to be 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*
- *C/I Small Energy Efficient Equipment*
- *C/I Large Energy Efficient Equipment*

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

- *Residential Low-Income*
- *C/I Small Energy Efficient Buildings*
- *C/I Large Energy Efficient Buildings*
- *Government and Institutional*

As for the other FirstEnergy EDCs, the SWE notes that the programs with large amounts of energy and demand savings generally had high TRC ratios. This signifies that the programs garnering the most savings also were the most cost-effective programs in PY6.

7.2.1 Assumptions and Inputs

One TRC model template was shared across all four FirstEnergy EDCs. 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 upfront costs of installation of implementation. This value matches the EDC's EE&C Plan on file.

Different values for LLFs were used for different sectors (Table 7-6). Inconsistencies were found in the energy LLF values applied in the TRC model workbook and those specified in the Penn Power PY6 annual report, specifically in the small C/I and Government and Institutional sectors. The SWE believes the values specified in the PY6 annual report to be incorrect, and have noted the energy LLF used by program in the Penn Power TRC model in Table 7-6.

Table 7-6: Penn Power's PY6 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%[a]	5.45%
Small C/I Buildings	Non-residential	11.14%	5.45%[a]	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%
Government/Institutional	Non-residential	11.14%	5.45%[a]	5.45%

NOTES
[a] 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 Penn Power PY6 annual report.

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 2014 TRM. In the non-residential sector, the TRC model applied a EUL at the stratum level rather than at the measure level.

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 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. 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.

In PY6, the 2014 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 PY6. 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, a measure's lifetime was separated into two parts: the first three years, and the remaining lifetime. The removed equipment was treated as the baseline for the first three years, 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.

7.2.2 Avoided Cost of Energy

The Penn Power TRC model assigned a value ($/kWh/year) to the avoided cost of energy for each year from 2015 through 2029 for each measure category, based on the load profile of the end use and the sector in which the savings occur. The avoided costs of energy for measures were calculated by multiplying 8,760 energy costs values by 8,760 associated load shapes. The model then multiplied these unit impacts by the most appropriate avoided cost stream to determine the per-unit avoided energy costs for that program.

7.2.3 Avoided Cost of Capacity

The Penn Power TRC model assigned a flat annual figure ($/kW-year) to the cost of adding generation capacity based on PJM forward capacity auction prices. The model used a single value for the avoided cost of capacity for all programs and sectors. This value was multiplied by the ex post demand savings for each combination of program and sector to determine the benefits incurred by the EDC from not having to expand generation capacity.

7.2.4 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 PY6 TRC benefits, costs, and ratios to be reasonable and accurate.

7.3 STATUS OF EVALUATION ACTIVITIES

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

7.3.1 Status of Evaluation, Measurement, and Verification Plans

The FirstEnergy EDCs submitted, and the SWE Team approved, only one EM&V Plan across all four FirstEnergy EDCs. Section 5.3.1 presents a detailed account of the status of First Energy's EM&V Plan.

7.3.2 Measurement and Verification Activities and Findings

By the end of PY6, Penn Power achieved 119% of its total Phase II energy savings compliance target, based on aggregated verified savings as of May 31, 2015 from Phase II in addition to Phase I carryover. Realization rates compare gross savings reported by the EDC to the verified gross savings determined by the EDC evaluation contractor through M&V activities (see Section 4.3.2 for an overview of how realization rates are calculated and defined).

Table 7-7 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 7-7 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 PY6.

Table 7-7: Penn Power Energy Efficiency Programs – Realization Rates for Energy and Demand Savings in PY6

Program	Energy Realization Rate	Relative Precision (Energy)[a]	Demand Realization Rate	Relative Precision (Demand)[a]
Appliance Turn-In	97.4%	10.8%	105.5%	11.8%
Efficient Products	115.9%	2.1%	138.8%	4.6%
Home Performance	97.9%	9.3%	98.6%	9.3%
Low-Income	96.4%	4.7%	98.8%	4.5%
Small C/I Equipment	99.2%	8.5%	115.8%	10.3%
Small C/I Buildings	96.0%	10.8%	95.3%	12.4%
Large C/I Equipment	122.2%	9.5%	119.4%	8.3%
Large C/I Buildings	96.3%	0.0%	92.9%	0.0%
Government/Institutional	99.1%	0.0%	30.9%	0.0%

NOTES
[a]Relative precision values are at the 85% confidence level.

7.3.2.1 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, and if the refrigerators and freezers had later been replaced. The replacement option was also designated as either ENERGY STAR or standard so as to be applicable to the 2014 TRM deemed values for each scenario. The program realization rate is mostly a function of the difference between the ex ante and ex post weights of the various replacement scenarios.

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.

The evaluation contractor approached the evaluation differently for each branch of the Home Performance Program. The Home Energy Audit Kits and School Kits were evaluated using the T&R tracking 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 evaluator, producing results consistent with the ICSP's. The ICSP's results were accepted as verified for the PY6 annual report, with the understanding that the measure life is only one year and that a full evaluation will be performed for PY7.

7.3.2.2 Low-Income Programs

The energy realization rate for the Low-Income Program was the lowest among the Penn Power residential programs, at 96.4%. 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 ISRs from the LILU evaluation, as actual ISRs cannot be known directly, but are likely lower than the defaults in the TRM. For the evaluation of the LILU Energy Kit portion of the Low-Income Program, the evaluation contractor employed an approach similar to that chosen for the evaluation of the Home Energy Audit and School Kits: through customer surveys and reviews of the T&R system. As with the Home Energy Audit Kits and School Kits, the 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.

7.3.2.3 Non-Residential Programs

Realization rates for Penn Power's non-residential programs' energy savings ranged from 96% to 122%. Realization rates for demand reductions from these programs ranged from 31% to 119%. The Government and Institutional program was responsible for the low realization rate of 31% for demand, however only one project was completed in PY6. 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 7-1 shows the frequency of each M&V approach performed by ADM in PY6 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 7-1: Frequency and Associated Savings by M&V Approach – Small C/I Equipment Program

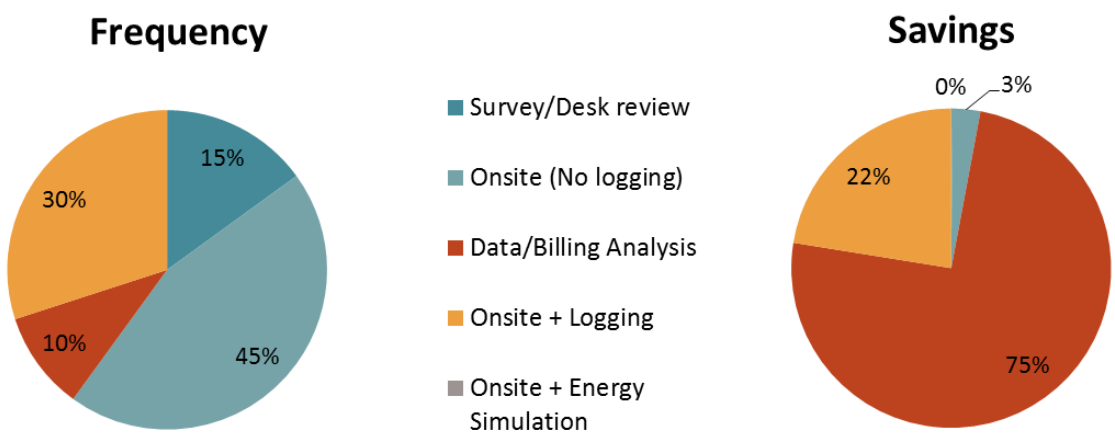


Figure 7-1 indicates that 60% of the sampled measures for the Small C/I Equipment Program were evaluated using a basic level of rigor. However, the representative savings for these measures accounted for only 3% of the energy savings. This suggests that the use of basic rigor was appropriately apportioned, 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 (97%) 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 7-2 shows the frequency of each M&V method used in the Small C/I Buildings Program and the energy savings associated with each method. Outside of CFL kits, only three projects were completed in PY6. Projects evaluated by enhanced rigor approaches accounted for 68% of evaluation sample savings.

Figure 7-2: Frequency and Associated Savings by M&V Approach – Small C/I Buildings Program

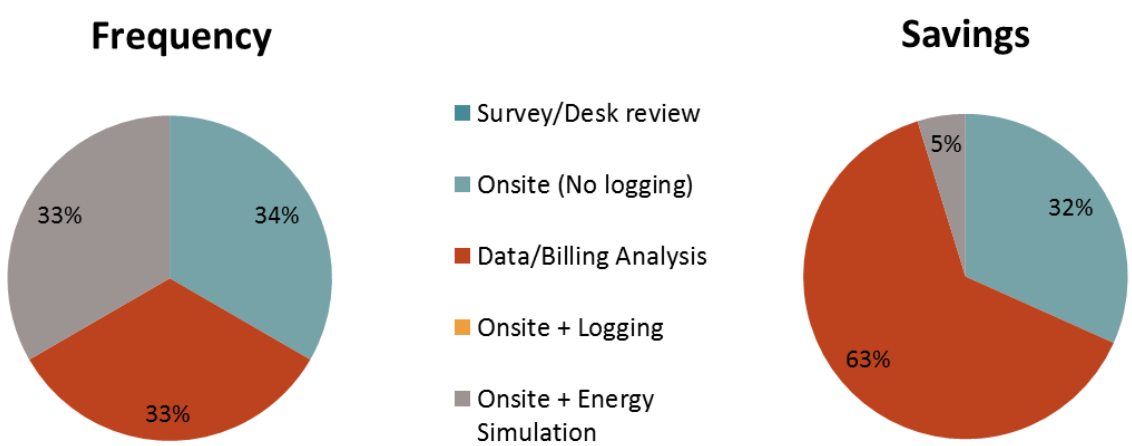
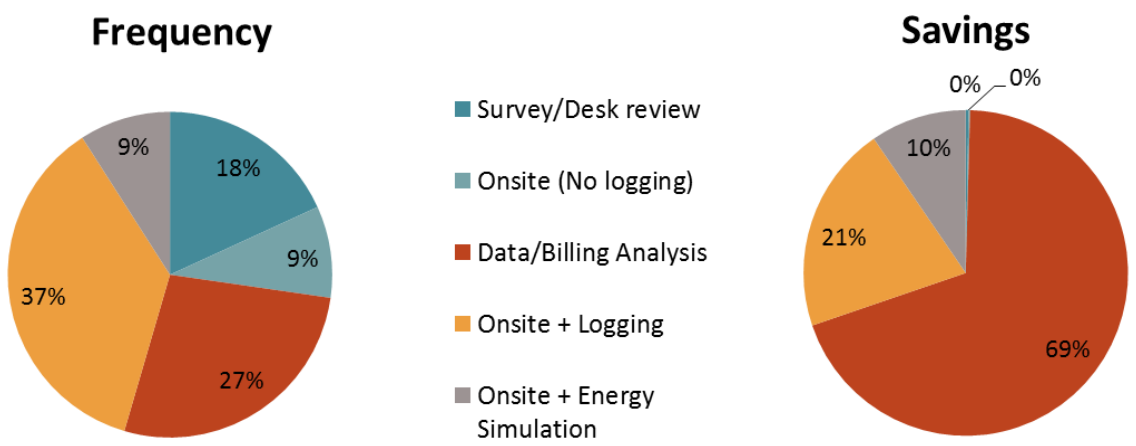


Figure 7-3 shows the frequency of each M&V method used in the Large C/I Equipment Program and the energy savings associated with each method. Enhanced rigor was used for a majority of the projects (73%),

and these projects accounted for almost all the savings (over 99%). Basic rigor was appropriately limited to those projects with less savings.

Figure 7-3: Frequency and Associated Savings by M&V Approach – Large C/I Equipment Program



Outside of CFL kits, no projects were completed in PY6 for Penn Power's Large C/I Buildings Program. The Government and Institutional Program had only one project completed in PY6, and it received a basic level of rigor in the form of an on-site inspection.

7.3.3 Process Evaluation Activities and Findings

FirstEnergy implemented a common set of energy efficiency programs across its four Pennsylvania EDCs—Met-Ed, Penelec, Penn Power, and West Penn—and FirstEnergy's evaluation consultants, ADM and Tetra Tech, used the same evaluation methods and identified the same findings and recommendations for all four EDCs. See Section 5.3.3 for a summary of the data sources Tetra Tech used and its key findings for each program.

7.4 STATEWIDE EVALUATOR AUDIT ACTIVITIES AND FINDINGS

This section presents the activities and findings of the SWE Team's audits of Penn Power's programs. It includes a summary and key findings from the SWE Team's residential, low-income, non-residential, and NTG and process evaluation audit activities.

7.4.1 Residential Program Audit Summary

7.4.1.1 Residential Lighting Program

For PY6, residential upstream lighting accounted for a majority 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 over 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 2014 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.

7.4.1.2 Appliance Turn-In Program

The SWE Team reviewed Penn Power's JACO database quarterly throughout PY6, and at the end of the year reviewed its additional calculations for verified gross values. The SWE Team confirmed that the correct EDC-specific deemed values from the 2014 TRM were used whether a unit was retired, replaced with a standard unit, or replaced with an ENERGY STAR unit. Penn Power used surveys to determine if refrigerators and freezers were functional and if they had been replaced with a standard or an ENERGY STAR unit. These percentages were then combined with the deemed savings from the 2014 TRM to calculate an average UEC for each refrigerator and freezer that was recycled. The SWE Team also verified that if a refrigerator was removed and then replaced with an ENERGY STAR unit, the additional ENERGY STAR refrigerator Efficient Products Program savings was subtracted from the program savings totals in order to prevent double-counting.

7.4.1.3 Efficient Products Program

For PY6, the Efficient Products Program increased the offering by two programs to total 20 subcategories. Incentives for some measures were paid to the consumer at the point of sale or through rebates for qualified purchases or installations. This was the second program year in which consumer electronics were incorporated into the Efficient Products Program, and the first year for including room air conditioners in the upstream category, which provides incentives to retailers for selling qualified consumer electronic products at the point of sale.

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 strata. Due to the fact that some rebate applications were assigned to PY5, the evaluation contractor had to designate which year's TRM to use in the ex post analysis. FirstEnergy's evaluation contractor analyzed all of the reported program data for consistency with the 2014 TRM (or 2013 TRM as appropriate for consumer electronics) and noted and accounted for any discrepancies in reported gross savings through the verified savings analysis.

7.4.1.4 Home Performance Program

The SWE Team audited each component of the Home Performance Program: School Conservation Kits, Whole House Direct Install, Home Energy Audit Conservation Kits, New Homes, and HERs. The School Conservation Kits component of the program provides kits of prescriptive measures to students' parents upon request after the parents review the energy efficiency curriculum. The SWE Team verified that the correct 2014 TRM savings were used for all measures and that the FirstEnergy EDC statewide receipt rate and ISRs were correctly applied to the items. The SWE Team found that the evaluation contractor also used the correct TRM savings and ISR for the Home Energy Audit Conservation Kits.

For the Whole House Direct Install component of the program, the SWE Team verified that the five highest contributing prescriptive measures and five randomly selected measures were calculated properly per the TRM protocols. The SWE Team also reviewed the billing analysis performed on the more than 2 MWh/yr house stratum. The SWE Team verified that the New Homes component of the program was evaluated according to FirstEnergy's evaluation plan and that the realization rates determined by the evaluation contractor from additional REM/Rate models had been correctly applied to the ex ante savings.

The evaluation contractor did not do a full evaluation of HER savings for PY6 because the one-year measure life does not count toward compliance. However, the evaluator did recreate the analysis performed by the ICSP with similar results. The SWE Team reviewed the analysis performed by the

evaluator and verified that it was done correctly. It is anticipated that the evaluation contractor will fully evaluate this program and that the SWE Team will audit this analysis in PY7.

7.4.2 Low-Income Program Audit Summary

The SWE Team reviewed the three distribution branches of the Low-Income Program (direct install, giveaway, and direct delivery kits) to ensure that the savings were correctly calculated using the 2014 TRM and that the realization rates were correctly determined and applied appropriately. Penn Power's evaluator provided a complete database of direct-install measures, which the SWE Team formatted and ranked by individual measure contribution to total program 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 LILU Conservation Kits and the Giveaway Program were implemented per the 2014 TRM.

Finally, 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 PY6, which is 15% of the total number of measures offered across all sectors. This exceeded its goal of 10.6%.

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 another appropriate methodology. In general, the submitted project files provided thorough documentation for SWE review, with only minor deficiencies unique to particular projects. Specific examples of deficiencies noted in the project file review are explored in Appendix A.4.1. The SWE Team provides the following recommendations to ensure the accuracy of the reported savings presented in upcoming program years:

1) SWE-provided calculators should be used properly; if SWE-provided calculators 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.

The SWE Team reviewed tracking data and quarterly reports upon their submission to ensure consistency across tracking and reporting documents. The SWE Team found the documents' participant counts and energy and demand savings values to be fully aligned. The only differences observed related to the participant counts and the incentive amounts provided for each program. Based on its audit findings, the SWE Team recommends that Penn Power and its evaluation contractor memorialize and consistently apply the definition of "participant" for measures such as Power Direct kits. Although the observed differences are minimal, reported incentive payments should also be carefully compared to those listed in tracking-data extracts to ensure consistency. The SWE Team understands that program tracking is a continuous process and encourages historical corrections. Further detail is provided in Appendix A.4.2.

The SWE Team reviewed Penn Power's PY6 sample design to ensure its compliance with the Evaluation Framework. The results are displayed in
Table 7-8, showing relative precision at the 85% confidence level (CL).

Table 7-8: Compliance across Sample Designs for Penn Power's PY6 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	8.5%	10.3%	✓
Small C/I Buildings	10.8%	12.4%	✓
Large C/I Equipment	9.5%	8.3%	✓
Large C/I Buildings	0.0%	0.0%	✓
Government/Institutional	0.0%	0.0%	✓

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 in Appendix A.4.3.

As part of the audit process, the SWE Team performed two ride-along site inspections of non-residential projects—both of which were lighting projects—to oversee Penn Power's on-site evaluation practices. The SWE Team found good agreement with ADM, but also noted areas where ADM's clarity could be enhanced with regards to selecting a baseline. The SWE noted that for nonresidential projects involving screw-based lamps affected by the EISA 2007 regulation, ADM used the post-EISA wattages instead of as-found baseline wattages. Details of all reviewed projects and associated findings are presented in Appendix A.4.4.

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. Appendix A.4.5 presents more detailed results of the verified savings analysis.

7.4.4 Net-to-Gross and Process Evaluation Audit Summary

FirstEnergy implemented a common set of energy efficiency programs across its four Pennsylvania EDCs. FirstEnergy's evaluation consultants, ADM and Tetra Tech, used the same evaluation methods for all four EDCs. See Section 5.4.4 for a description of the SWE Team's review of the FirstEnergy EDC process and NTG evaluation, which apply to all four of FirstEnergy's Pennsylvania EDCs.

Table 7-9 summarizes NTG findings from the Penn Power PY6 annual report. The NTGR was greatest for the Home Performance Program and lowest for the Small C/I Equipment program.

Table 7-9: Summary of NTG Estimates by Program

Approach	Program	Free-Ridership	Spillover	NTGR	Sample Size[a]
Residential					
Estimated	Appliance Turn-In	.47	0	.53	37
	Efficient Products	.55	.13	.57	65
	Home Performance	.18	.06	.88	116
Non-Residential					
Estimated	Small C/I Equipment	.74	.13	.39	44
	Large C/I Equipment	.36	.11	.75	12
	Government and Institutional	.54	.12	.57	18

NOTES
[a] The samples provided at least 85/15 precision/confidence.

7.5 STATEWIDE EVALUATOR FINAL RECOMMENDATIONS

The SWE Team has the following recommendations for Penn Power's EE&C programs going forward.

1) The FirstEnergy evaluation contractor did an excellent job of compiling the verification data for the residential programs into a spreadsheet database and performing the necessary analysis. However, the SWE Team recommends that Penn Power make modifications to the larger tracking-system files to reduce size and improve ease of navigation.

2) The implementation and evaluation contractors should use SWE-provided savings calculators when available. Many of the inconsistencies the SWE Team observed in PY6 were a direct result of using a lighting calculator that misaligned with the 2014 TRM algorithms and assumptions.

3) The SWE Team would like to see better organization and a more streamlined presentation of the EM&V plan and associated documentation in the C/I project files. The SWE Team would like extraneous documentation to be cleaned up, in order to improve clarity and transparency.

4) The SWE Team recommends that Penn Power enhance quality assurance reviews and follow-up with those contractors for whom households report measures are more frequently "left behind" for future installation.

5) The SWE Team recommends that in Phase III, Penn Power consider subsuming the C/I Small and Large Energy Efficient Buildings programs into the C/I Small and Large Energy Efficient Equipment Programs to reduce administrative costs and to ensure adequate budget is available in case participation levels increase significantly.

6) The SWE Team recommends that Penn Power seek opportunities to provide contractors and targeted customers with additional literature and marketing materials they can use to convey benefits of the Large EE Equipment and Government and Institutional programs to management staff.

8 WEST PENN POWER COMPANY

This chapter summarizes West Penn's program performance in PY6. 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 through the end of PY6; 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.

8.1 SUMMARY OF ENERGY AND DEMAND REDUCTIONS

Table 8-1 provides an overview of West Penn's cumulative reported gross (RG) and verified gross (VG) savings impacts, and carryover (CO) savings since the EE&C programs' inception through the end of PY6.

Table 8-1: Summary of West Penn's Phase II Savings Impacts

Savings Impacts	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/yr)	Savings Achieved as % of 2016 Targets[i]
Total Energy Savings (MWh/yr)	242,824	245,859	59,929	305,788	337,533	91%
Total Demand Reduction (MW)	28.69	30.20	N/A	30.2	N/A	N/A
TRC Benefits ($1,000)[a]	N/A[g]	$73,699	N/A	$73,699	N/A	N/A
TRC Costs ($1,000)[b]	N/A[g]	$56,458	N/A	$56,458	N/A	N/A
TRC B/C Ratio[c]	N/A[g]	1.31	N/A	1.31	N/A	N/A
CO_2 Emissions Reduction (Tons)[d][e]	207,250	209,841	51,149	260,990	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 1,707 lb CO_2 per MWh according to the latest available (2014) PJM Emission Report of marginal off-peak annual CO_2 emission rate based on direction provided by Commission staff.
[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.

As Table 8-1 shows, West Penn achieved 91% of its Act 129 Phase II energy savings target by the end of PY6. The TRC B/C ratio (or TRC ratio) of West Penn's programs through PY6 was 1.31, which indicates that West Penn's portfolio of EE&C programs was cost-effective on an aggregated basis.

Table 8-2 lists West Penn's EE&C programs. West Penn reported PY6 gross energy and/or demand savings for all nine programs.

Table 8-2: West Penn EE&C PY6 Programs

Programs Reporting PY6 Gross Savings	Sector(s)
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 8-3 provides a breakdown of the contribution of the verified gross energy savings (MWh/yr) and gross demand savings (MW) for each program, and the contribution of each program's savings toward the total portfolio energy and demand savings. The Efficient Products Program accounts for 27% of the total Phase II verified gross energy savings in West Penn's portfolio, making it the most impactful energy savings program in the residential sector. The Large C/I Equipment Program accounts for 26% of the total Phase II verified gross savings in West Penn's portfolio, making it the most impactful energy savings program in the non-residential sector. The Home Performance Program contributed 25% of the total energy savings.

Table 8-3: Summary of West Penn EE&C Program Impacts on Verified Gross Portfolio Savings

Program	Phase II VG Savings (MWh/yr)	% of Portfolio Phase II VG MWh/yr Savings	Phase II VG Savings (MW)	% of Portfolio Phase II VG MW Savings
Appliance Turn-In	12,199	5%	1.78	6%
Efficient Products	66,362	27%	7.41	25%
Home Performance	62,002	25%	7.58	25%
Low-Income	3,465	1%	0.30	1%
Small C/I Equipment	30,337	12%	4.70	16%
Small C/I Buildings	4,409	2%	0.72	2%
Large C/I Equipment	64,515	26%	7.35	24%
Large C/I Buildings	1,706	1%	0.27	1%
Gov./Institutional	865	0%	0.08	0%
Total Portfolio	**245,859**	**100%**	**30.2**	**100%**

The NTG research yielded estimates of NTG ratios for the West Penn programs. Table 8-4 provides the verified net savings alongside the verified gross savings for PY6 and Phase II. The portfolio-level NTG ratio for PY6 was 0.73. Section 8.4.4 provides findings and details on the SWE Team audit of the NTG research conducted for West Penn programs.

Table 8-4: Summary of West Penn EE&C Program Verified Net and Gross Savings by Sector

Sector	PY6 VG Savings (MWh/yr)	PY6 Verified Net Savings (MWh/yr)	Phase II VG Savings (MWh/yr)	Phase II Verified Net Savings (MWh/yr)
Residential	81,971	55,854	138,984	84,742
Commercial and Industrial	60,997	43,352	87,575	63,702
Government, Nonprofit, and Institutional	12,059	8,593	19,301	12,976
Total Portfolio	***155,026***	***107,799***	***245,859***	***161,420***

8.2 TOTAL RESOURCE COST TEST

Table 8-5 presents TRC NPV benefits, TRC NPV costs, present value of net benefits, and TRC ratio for West Penn's PY6 individual programs and total portfolio. The SWE found no initial inconsistencies between the TRC model outputs and the TRC results shown in the PY6 annual report.

Table 8-5: Summary of West Penn's PY6 TRC Factors and Results

Program	TRC NPV Benefits ($)	TRC NPV Costs ($)	Present Value of Net Benefits ($)	TRC Ratio
Appliance Turn-In	$2,387,265	$1,123,467	$1,263,798	2.12
Efficient Products	$12,742,379	$8,092,823	$4,649,556	1.57
Home Performance	$4,660,634	$4,826,181	$(165,548)	0.97
Low-Income	$664,382	$2,123,751	$(1,459,369)	0.31
Small C/I Equipment	$9,355,771	$8,864,630	$491,141	1.06
Small C/I Buildings	$839,869	$1,223,860	$(383,991)	0.69
Large C/I Equipment	$28,530,502	$6,648,706	$21,881,796	4.29
Large C/I Buildings	$1,154,099	$1,262,651	$(108,552)	0.91
Government/Institutional	$124,532	$521,640	$(397,108)	0.24
Total Portfolio	**$60,459,434**	**$34,687,709**	**$25,771,725**	**1.74**

In summary, four of West Penn's nine programs offered were cost-effective and five 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*
- *Small C/I Energy Efficient Equipment*
- *Large C/I Energy Efficient Equipment*

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

- *Residential Home Performance*
- *Residential Low-Income*
- *Small C/I Energy Efficient Buildings*
- *Large C/I Energy Efficient Buildings*
- *Government and Institutional*

As was noted in the analyses of the other FirstEnergy companies' programs, the 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 PY6.

8.2.1 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 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 upfront costs of installation or implementation. This value matches the EDC's EE&C Plan on file.

The LLFs used varied by sector (see Table 8-6). Inconsistencies were found in the energy LLF values applied in the TRC model workbook and those specified in the West Penn PY6 annual report, specifically in the small C/I and Government and Institutional sectors. The SWE Team believes the values specified in the PY6 annual report to be incorrect, and has noted the energy LLF used by program in the West Penn TRC model in Table 8-6.

Table 8-6: West Penn's 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%[1]	7.90%
Small C/I Buildings	Non-residential	9.15%	7.90%[1]	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%
Government/Institutional	Non-residential	9.15%	7.90%[a]	7.90%

NOTES
[a] 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 West Penn PY6 annual report.

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 2014 TRM. In the non-residential sector, the TRC model applied a EUL at the stratum level rather than at the measure level.

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 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. 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.

In PY6, the 2014 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 PY6. 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, a measure's lifetime was separated into two parts: the first three years, and the remaining lifetime. The removed equipment was treated as the baseline for the first three years, 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.

The SWE Team reviewed and found the energy and demand impacts used in the West Penn TRC model to be generally consistent with those provided in the program tracking database, with one minor exception. Further review found a systematic error that minimally understates the kW demand savings for a small sample of projects that have zero ex ante kW savings yet some nonzero ex post kW savings. The TRC benefits reflect the full kW demand savings, but the verified kW portfolio totals in the PY6 annual report are inconsistent with the TRC model. The overall magnitude of this error is less than 0.2% of the PY6 verified demand savings.

8.2.2 Avoided Cost of Energy

The West Penn TRC model assigned a value ($/kWh) to the avoided cost of energy for each year from 2015 through 2029 for each measure category based on the load profile of the end use and the sector in which the savings occur. The avoided costs of energy for measures were calculated by multiplying 8,760 energy costs values by 8,760 associated load shapes. The model then multiplied these unit impacts by the most appropriate avoided-cost stream to determine the per-unit avoided energy costs for that program.

8.2.3 Avoided Cost of Capacity

The West Penn TRC model assigned a flat annual figure ($/kW-year) to the cost of adding generation capacity based on PJM forward capacity auction prices. The model used a single value for the avoided cost of capacity for all programs and sectors. This value was multiplied by the ex post demand savings for each combination of program and sector to determine the benefits incurred by the EDC from not having to expand generation capacity.

8.2.4 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 PY6 TRC

benefits, costs, and ratios to be reasonable and accurate. As noted above, the TRC model review did uncover a small systematic error in the evaluation process that minimally understates the verified demand savings in the West Penn summary reporting tables (< 0.2% of the overall portfolio demand savings). The SWE recommends that the evaluator correct the observed calculation error for future program years.

8.3 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.

8.3.1 Status of Evaluation, Measurement, and Verification Plans

FirstEnergy submitted, and the SWE Team approved, only one EM&V Plan across all four FirstEnergy EDCs. Section 5.3.1 presents a detailed account of the status of FirstEnergy's EM&V Plan.

8.3.2 Measurement and Verification Activities and Findings

By the end of PY6, West Penn achieved 91% of its total Phase II energy savings compliance target, based on aggregated verified savings as of May 31, 2015 from Phase II, in addition to Phase I carryover. Realization rates compare gross savings reported by the EDC to the verified gross savings determined by the EDC evaluation contractor through M&V activities (see Section 4.3.2 for an overview of how realization rates are calculated and defined).

Table 8-7 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 8-7 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 PY6.

Table 8-7: West Penn Energy Efficiency Programs – Realization Rates for Energy and Demand Savings in PY6

Program	Energy Realization Rate	Relative Precision (Energy)[a]	Demand Realization Rate	Relative Precision (Demand)[a]
Appliance Turn-In	105.6%	10.8%	111.8%	9.4%
Efficient Products	114.5%	2.1%	121.2%	2.6%
Home Performance	99.9%	14.2%	99.5%	14.0%
Low-Income	94.2%	6.4%	99.0%	6.1%
Small C/I Equipment	101.6%	12.4%	115.4%	11.8%
Small C/I Buildings	81.1%	12.7%	62.6%	13.8%
Large C/I Equipment	100.7%	4.4%	99.4%	4.3%
Large C/I Buildings	89.2%	4.2%	99.2%	3.4%
Government/Institutional	52.3%	10.2%	12.5%	17.1%

NOTES
[a] Relative precision values are at the 85% confidence level.

8.3.2.1 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, and if the refrigerators and freezers had later been replaced. The replacement option was also designated

as either ENERGY STAR or standard so as to be applicable to the 2014 TRM deemed values for each scenario. The program realization rate is mostly a function of the difference between the ex ante and ex post weights of the various replacement scenarios.

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.

The evaluation contractor approached the evaluation differently for each branch of the Home Performance Program. The Home Energy Audit Kits and School Kits were evaluated using the T&R tracking 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 evaluator, producing results consistent with the ICSP's. The ICSP's results were accepted as verified for the PY6 annual report, with the understanding that the measure life is only one year and that a full evaluation will be performed for PY7.

8.3.2.2 Low-Income Programs

The energy realization rate for the Low-Income Program was the lowest among the West Penn residential programs, at 94.2%. 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 ISRs from the LILU evaluation, as actual ISRs cannot be known directly, but are likely lower than the defaults in the TRM. For the evaluation of the LILU Energy Kit portion of the Low-Income Program, the evaluation contractor employed an approach similar to that chosen for the evaluation of the Home Energy Audit and School Kits: through customer surveys and reviews of the T&R system. As with the Home Energy Audit Kits and School Kits, the 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.

8.3.2.3 Non-Residential Programs

Realization rates for West Penn's non-residential programs' energy savings ranged from 52% to 102%. Realization rates for demand reductions from these programs ranged from 13% to 115%. The Government and Institutional program was responsible for the low realization rates of 52% for energy and 13% for demand. The largest Government and Institutional project completed had only a 14% kWh realization rate. Only two Government and Institutional projects had reported demand savings, and both had less than a 20% kW realization rate. West Penn achieved the 15% precision requirement for kWh in all of its non-residential programs. It did not achieve 15% precision for demand savings, having a precision of 17% for the Government and Institutional Program, but this is not a requirement for Phase II of Act 129.

Figure 8-1 shows the frequency of each M&V approach performed by ADM in PY6 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 8-1: Frequency and Associated Savings by M&V Approach – Small C/I Equipment Program

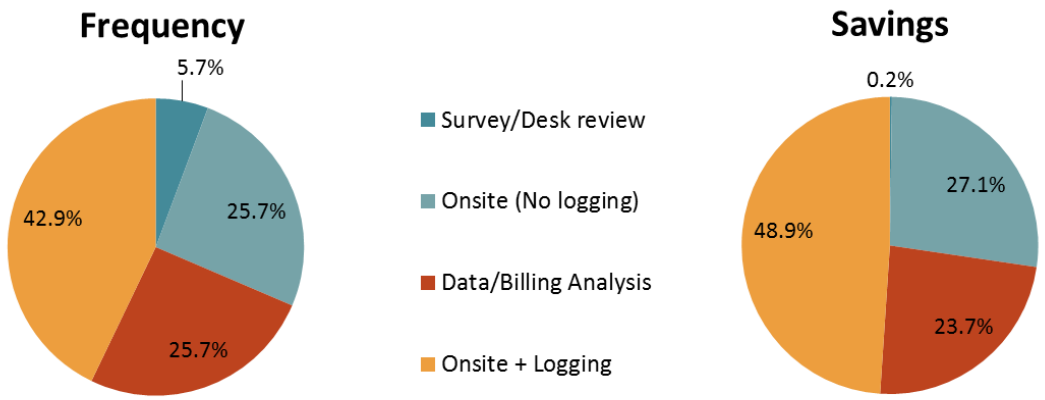


Figure 8-1 indicates that 31% of the sampled measures for the Small C/I Equipment Program were evaluated using a basic level of rigor. However, the representative savings for these measures accounted for 27% of the energy savings. This suggests that the use of basic rigor was appropriately apportioned, 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 (73%) 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 8-2 shows the frequency of each M&V method used in the Small C/I Buildings Program and the energy savings associated with each method. Outside of CFL kits, seven projects were completed in PY6, and three were selected for evaluation. The entire sample was evaluated through an enhanced level of rigor.

Figure 8-2: Frequency and Associated Savings by M&V Approach – Small C/I Buildings Program

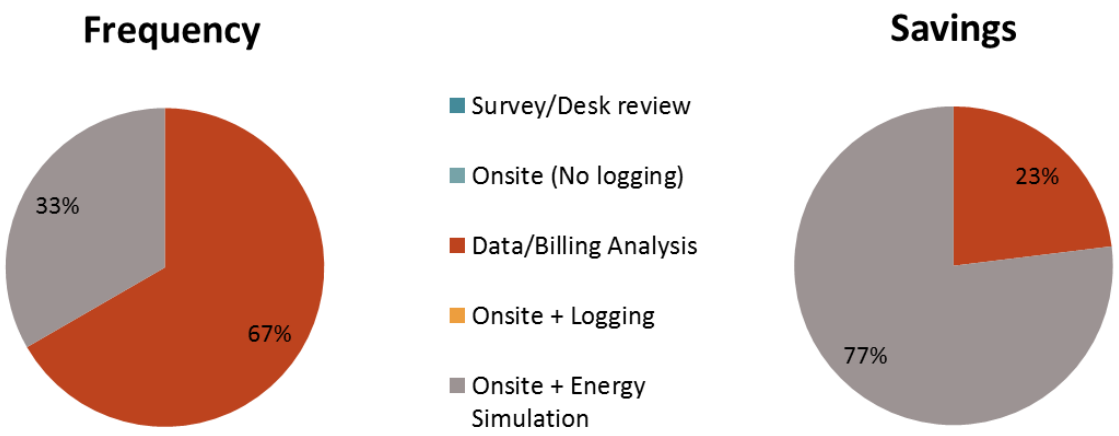
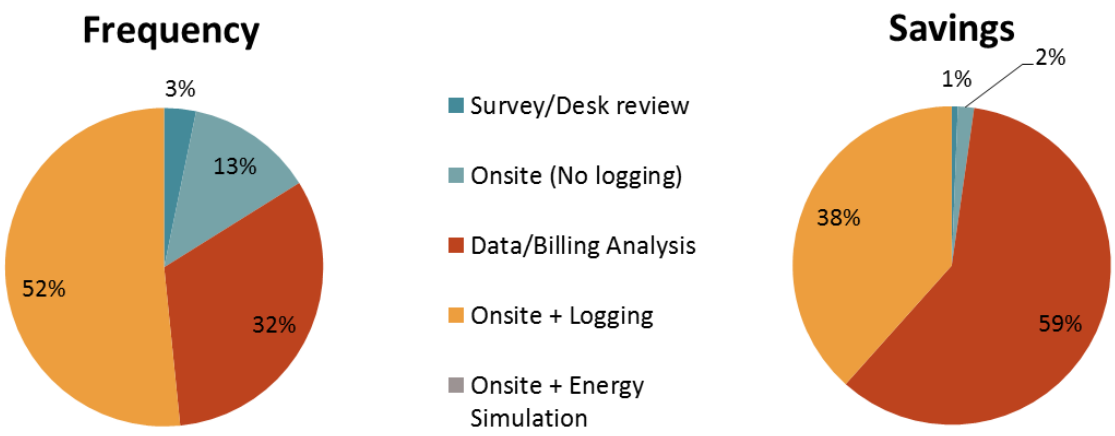


Figure 8-3 shows the frequency of each M&V method used in the Large C/I Equipment Program and the energy savings associated with each method. Enhanced rigor was used for a majority of the projects (84%), and these projects accounted for a vast majority of the savings (over 97%). Basic rigor was appropriately limited to those projects with less savings.

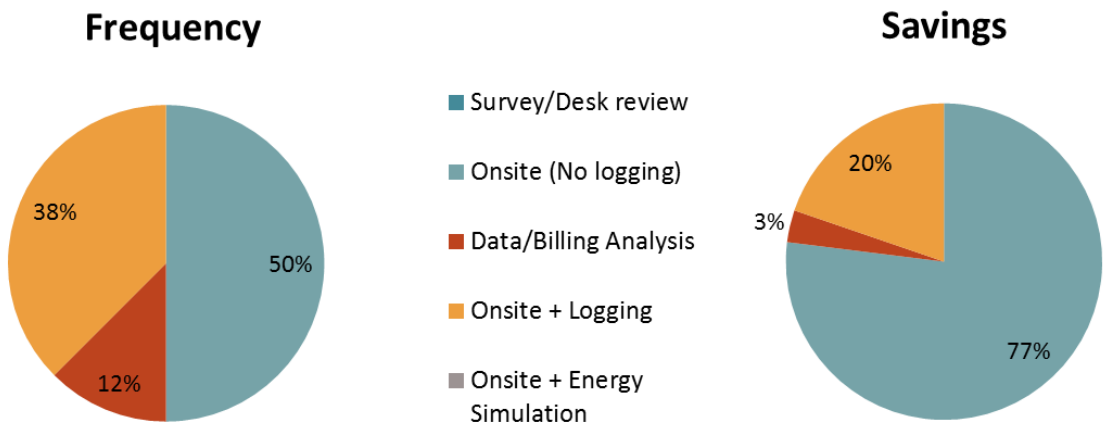
Figure 8-3: Frequency and Associated Savings by M&V Approach – Large Equipment Program



Outside of CFL kits, four projects were completed in the Large C/I Buildings Program for PY6. Three of these projects were selected for evaluation, and all of them received an enhanced level of rigor in the form of a data and billing analysis.

Figure 8-4 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 50% of the projects, but these projects accounted for 77% of the savings.

Figure 8-4: Frequency and Associated Savings by M&V Approach – Government and Institutional Program



8.3.3 Process Evaluation Activities and Findings

FirstEnergy implemented a common set of energy efficiency programs across its four Pennsylvania EDCs—Met-Ed, Penelec, Penn Power, and West Penn—and FirstEnergy's evaluation consultants, ADM and Tetra Tech, used the same evaluation methods and identified the same findings and recommendations for all four EDCs. See Section 5.3.3 for a summary of the data sources Tetra Tech used and its key findings for each program.

8.4 STATEWIDE EVALUATOR AUDIT ACTIVITIES AND FINDINGS

This section presents the activities and findings of the SWE Team's audits of West Penn's programs. It includes a summary and key findings from the SWE Team's residential, low-income, non-residential, and NTG and process evaluation audit activities

8.4.1 Residential Program Audit Summary

8.4.1.1 Residential Lighting

For PY6, 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 over 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 2014 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.

8.4.1.2 Appliance Turn-In Program

The SWE Team reviewed West Penn's JACO database quarterly throughout PY6, and at the end of the year reviewed its additional calculations for verified gross values. The SWE Team confirmed that the correct EDC-specific deemed values from the 2014 TRM were used whether a unit was retired, replaced with a standard unit, or replaced with an ENERGY STAR unit. West Penn used surveys to determine if refrigerators and freezers were functional and if they had been replaced with a standard or an ENERGY STAR unit. These percentages were then combined with the deemed savings from the 2014 TRM to

calculate an average UEC for each refrigerator and freezer that was recycled. The SWE Team also verified that if a refrigerator was removed and then replaced with an ENERGY STAR unit, the additional ENERGY STAR refrigerator Efficient Products Program savings was subtracted from the program savings totals in order to prevent double-counting.

8.4.1.3 Efficient Products Program

For PY6, the Efficient Products Program increased the offering by two programs to total 20 subcategories. Incentives for some measures were paid to the consumer at the point of sale or through rebates for qualified purchases or installations. This was the second program year in which consumer electronics were incorporated into the Efficient Products Program, and the first year for including room air conditioners in the upstream category, which provides incentives to retailers for selling qualified consumer electronic products at the point of sale.

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 strata. Due to the fact that some rebate applications were assigned to PY5, the evaluation contractor had to designate which year's TRM to use in the ex post analysis. FirstEnergy's evaluation contractor analyzed all of the reported program data for consistency with the 2014 TRM (or 2013 TRM as appropriate for consumer electronics) and noted and accounted for any discrepancies in reported gross savings through the verified savings analysis.

8.4.1.4 Home Performance

The SWE Team audited each component of the Home Performance Program: School Conservation Kits, Whole House Direct Install, Home Energy Audit Conservation Kits, New Homes, and HERs. The School Conservation Kits component of the program provides kits of prescriptive measures to students' parents upon request after the parents review the energy efficiency curriculum. The SWE Team verified that the correct 2014 TRM savings were used for all measures and that the FirstEnergy EDC statewide receipt rate and ISRs were correctly applied to the items. The SWE Team found that the evaluation contractor also used the correct TRM savings and ISR for the Home Energy Audit Conservation Kits.

For the Whole House Direct Install component of the program, the SWE Team verified that the five highest contributing prescriptive measures and five randomly selected measures were calculated properly per the TRM protocols. The SWE also reviewed the billing analysis performed on the more than 2 MWh/yr house stratum. The SWE Team verified that the New Homes component of the program was evaluated according to FirstEnergy's evaluation plan and that the realization rates determined by the evaluation contractor from additional REM/Rate models had been correctly applied to the ex ante savings.

The evaluation contractor did not do a full evaluation of HER savings for PY6 because the one-year measure life does not count toward compliance. However, the evaluator did recreate the analysis performed by the ICSP with similar results. The SWE Team reviewed the analysis performed by the evaluator and verified that it was done correctly. It is anticipated that the evaluation contractor will fully evaluate this program and that the SWE Team will audit this analysis in PY7.

8.4.2 Low-Income Program Audit Summary

The SWE Team reviewed the three distribution branches of the Low-Income Program (direct install, giveaway, and direct delivery kits) to ensure that the savings were correctly calculated using the 2014 TRM and that the realization rates were correctly determined and applied appropriately. West Penn's evaluator provided a complete database of direct-install measures, which the SWE Team formatted and ranked by individual measure contribution to total program 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 LILU Conservation Kits and the Giveaway Program were implemented per the 2014 TRM.

Finally, 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 PY6, which is 15% of the total number of measures offered across all sectors. This exceeded its goal of 8.8%.

8.4.3 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. In general, the submitted project files provided thorough documentation for SWE Team review, and showed early involvement by the evaluation contractor. Of the nine reviewed projects, only two were found to be insufficiently documented. Specific examples of deficiencies noted in the project file review are explored in Appendix A.5.1. At this time, the SWE Team recommends only that greater care be taken to ensure that each project file properly captures the project's full scope of work, particularly in the case of aggregated projects.

The SWE Team reviewed tracking data and quarterly reports upon their submission to ensure consistent tracking and reporting documents. The documents aligned well with participant counts and energy and demand savings values. The SWE Team observed minor variances in the number of participants and in incentive amounts. Offsetting differences in energy and demand impacts were noted among programs, likely due to reclassification of completed projects. Therefore the SWE Team recommends that West Penn and its evaluation contractor conduct a thorough review of the tracking database to ensure that filed projects are accurately represented—especially projects that contribute toward the GNI compliance target. These variances do not necessarily indicate inadequate QA/QC or incorrect reported savings. It is likely that they are due to CSPs or the evaluation contractor discovering mistakes or obtaining additional information about a project after the close of the quarter and modifying the records accordingly. The SWE Team understands that program tracking is a continuous process and encourages historical corrections. Further detail is provided in Appendix A.5.2.

The SWE Team reviewed West Penn's PY6 sample design to ensure its compliance with the Evaluation Framework. The results are displayed in Table 8-8, showing relative precision at the 85% confidence level (CL).

Table 8-8: Compliance across Sample Designs for West Penn's PY6 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	12.4%	11.8%	✓
Small C/I Buildings	12.7%	13.8%	✓
Large C/I Equipment	4.4%	4.3%	✓
Large C/I Buildings	4.2%	3.4%	✓
Government/Institutional	10.2%	17.1%	✓

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 can be found in Appendix A.5.3.

As part of the audit process, the SWE Team performed 14 ride-along site inspections of non-residential projects to oversee West Penn's on-site evaluation practices. All of these projects were lighting upgrades. Concerns arose at only four sites, primarily surrounding as-built conditions and missing or incomplete details about key parameters, such as fixture quantities, space-conditioning patterns, and HOUs. The ratio of SWE's verified impacts to ADM's verified impacts, was 100.8%. Appendix A.5.4 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, the 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. The analysis files provided performed the desired calculations appropriately but could have been better organized. Appendix A.5.5 presents more detailed results of the verified savings analysis.

8.4.4 Net-to-Gross and Process Evaluation Audit Summary

FirstEnergy implemented a common set of energy efficiency programs across its four Pennsylvania EDCs. FirstEnergy's evaluation consultants, ADM and Tetra Tech, used the same evaluation methods for all four EDCs. See Section 5.4.4 for a description of the SWE Team's review of the FirstEnergy process and NTG evaluation, which apply to all four of FirstEnergy's Pennsylvania EDCs.

Table 8-4 summarizes NTG findings from the West Penn PY6 annual report. The NTGR was greatest for the Home Performance Program and lowest for the Appliance Turn-In Program.

Table 8-9: Summary of NTG Estimates by Program

Approach	Program	Free-Ridership	Spillover	NTGR	Sample Size[a]
Residential					
Estimated	Appliance Turn-In	.68	0	.32	51
	Efficient Products	.52	.05	.52	65
	Home Performance	.02	.01	.99	159
Non-Residential					
Estimated	Small C/I Equipment	.39	.10	.71	63
	Large C/I Equipment	.34	.08	.73	43
	Government and Institutional	.54	.12	.57	18

NOTES
[a] The samples provided at least 85/15 precision/confidence.

8.5 STATEWIDE EVALUATOR FINAL RECOMMENDATIONS

The SWE Team has the following recommendations for West Penn's EE&C programs going forward.

1) The FirstEnergy evaluation contractor did an excellent job of compiling the verification data for the residential programs into a spreadsheet database and performing the necessary analysis. However, the SWE Team recommends that West Penn make modifications to the larger tracking-system files to reduce size and improve ease of navigation.

2) The implementation and evaluation contractors should use SWE-provided savings calculators when available. Many of the inconsistencies the SWE Team observed in PY6 were directly related to using a lighting calculator that was misaligned with the 2014 TRM algorithms and assumptions.

3) The SWE Team would like to see better organization and a more streamlined presentation of the EM&V plan and associated documentation in the C/I project files. The SWE Team would like extraneous documentation to be cleaned up, in order to improve clarity and transparency.

4) The SWE Team recommends that West Penn enhance quality assurance reviews and follow-up with those contractors for whom households report measures are more frequently "left behind" for future installation.

5) The SWE Team recommends that in Phase III, the FirstEnergy EDCs consider subsuming the C/I Small and Large Energy Efficient Buildings programs into the C/I Small and Large Energy Efficient Equipment Programs to reduce administrative costs and to ensure adequate budget is available in case participation levels increase significantly.

6) The SWE Team recommends that West Penn seek opportunities to provide contractors and targeted customers with additional literature and marketing materials they can use to convey benefits of the Large EE Equipment and Government and Institutional programs to management staff.

9 PECO ENERGY COMPANY

This chapter summarizes PECO's program performance in PY6. It includes an overview of the cumulative energy savings and demand reductions achieved by PECO's Act 129 EE&C programs in Phase II through the end of PY6; 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.

9.1 SUMMARY OF ENERGY AND DEMAND REDUCTIONS

Table 9-1 provides an overview of PECO's cumulative reported gross (RG) and verified gross (VG) savings impacts, and carryover (CO) savings since the EE&C programs' inception through the end of PY6.

Table 9-1: Summary of PECO's Phase II Savings Impacts

Savings Impacts	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/yr)	Savings Achieved as % of 2016 Targets[i]
Total Energy Savings (MWh/yr)	494,558	593,953	242,793	836,746	1,125,851	74%
Total Demand Reduction (MW)	197.1	214.7	N/A	214.7	N/A	N/A
TRC Benefits ($1,000)[a]	N/A[g]	$454,342	N/A	$454,342	N/A	N/A
TRC Costs ($1,000)[b]	N/A[g]	$289,381	N/A	$289,381	N/A	N/A
TRC B/C Ratio[c]	N/A[g]	1.57	N/A	1.57	N/A	N/A
CO_2 Emissions Reduction (Tons)[d][e]	422,105	506,939	207,224	714,163	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 1,707 lb CO_2 per MWh according to the latest available (2014) PJM Emission Report of marginal off-peak annual CO_2 emission rate based on direction provided by Commission staff.
[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 Savings 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 Gross Savings 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.

As Table 9-1 shows, PECO achieved 74% of its Act 129 Phase II energy savings target by the end of PY6. The TRC B/C ratio (or TRC ratio) of PECO's programs through PY6 was 1.57, which indicates that PECO's portfolio of EE&C programs was cost-effective on an aggregated basis.

Table 9-2 lists the 16 programs for which PECO reported PY6 gross energy and/or demand.

Table 9-2: PECO EE&C Programs with Reported Gross Savings in PY6

Programs Reporting PY6 Gross Savings	Sector(s)
Smart AC Saver - Residential	Residential
Low-Income Energy Efficiency Program	Low-Income
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
Smart AC Saver Program - Commercial	C/I
Smart Business Solutions	C/I
Smart Equipment Incentives - Commercial and Industrial	C/I
Smart Construction Incentives	C/I
Smart Multi-Family Solutions - Non-residential	C/I
Smart On-Site	C/I
Smart Equipment Incentives - Government, Nonprofit and Institutional	GNI

Table 9-3 provides a breakdown of the contribution of the verified gross energy savings (MWh/yr) and gross demand savings (MW) for each program, and the contribution of each program's savings toward the total portfolio's energy and demand savings. The residential portion of the Smart Home Rebates (SHR) Program accounts for 28% of the total Phase II verified gross energy savings in PECO's portfolio, making it the most impactful energy savings program in the residential sector. The Smart Equipment Incentives – C/I program accounts for 20% of the total Phase II verified gross savings in PECO's portfolio, making it the most impactful energy savings program in the non-residential sector. Collectively, the programs yielded nearly 594,000 MWh/yr of verified gross energy savings and nearly 215 MW of verified gross demand savings for Phase II through PY6.

Table 9-3: Summary of PECO EE&C Program Impacts on Verified Gross Portfolio Savings

Program[a]	Phase II VG Savings (MWh/yr)	% of Portfolio Phase II VG MWh/yr Savings	Phase II VG Savings (MW)[b]	% of Portfolio Phase II VG MW Savings
Low-Income Energy Efficiency Program	35,480	6%	3.9	2%
Smart AC Saver - Residential	0	0%	126.1	59%
Smart Appliance Recycling - Residential	15,250	3%	2.2	1%
Smart Builder Rebates	229	0%	0.1	0%
Smart Energy Saver	4,459	1%	0.3	0%

Program[a]	Phase II VG Savings (MWh/yr)	% of Portfolio Phase II VG MWh/yr Savings	Phase II VG Savings (MW)[b]	% of Portfolio Phase II VG MW Savings
Smart Home Rebates - Residential	168,963	28%	28.2	13%
Smart House Call	3,926	1%	0.6	0%
Smart Multi-Family Solutions - Residential	5,569	1%	0.6	0%
Smart Usage Profile	0	0%	0	0%
Smart AC Saver - Commercial	0	0%	4	2%
Smart Appliance Recycling - Small C/I	109	0%	0	0%
Smart Business Solutions - Small C/I	23,211	4%	6.3	3%
Smart Construction Incentives - C/I	15,058	3%	2.2	1%
Smart Equipment Incentives - C/I	118,939	20%	19.4	9%
Smart Home Rebates - Small C/I	32,873	6%	0.7	0%
Smart Home Rebates - Large C/I	61,281	10%	6.7	3%
Smart Multi-Family Solutions - C/I	5,970	1%	0.6	0%
Smart On-Site C/I	0	0%	0	0%
Smart Appliance Recycling - GNI	9	0%	0	0%
Smart Business Solutions - GNI	821	0%	0.2	0%
Smart Construction Incentives - GNI	5,295	1%	0.7	0%
Smart Equipment Incentives - GNI	35,773	6%	4	2%
Smart Home Rebates - GNI	1	0%	0	0%
Smart Multi-Family Solutions - GNI	258	0%	0	0%
Smart On-Site GNI	60,427	10%	7.7	4%
Total Portfolio	**593,905**	**100%**	**214.7**	**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 a LLF.

The NTG research yielded estimates of NTG ratios for the PECO programs. Table 9-4 provides the verified net savings alongside the verified gross savings for PY6 and Phase II. The portfolio-level NTG ratio for PY6 was 0.68. Section 9.4.4 provides findings and details on the SWE Team audit of the NTG research conducted for PECO programs.

Table 9-4: Summary of PECO EE&C Program Verified Net and Gross Savings by Sector

Sector	PY6 VG Savings (MWh/yr)	PY6 Verified Net Savings (MWh/yr)	Phase II VG Savings (MWh/yr)	Phase II Verified Net Savings (MWh/yr)
Residential	134,143	87,208	233,925	137,797

Sector	PY6 VG Savings (MWh/yr)	PY6 Verified Net Savings (MWh/yr)	Phase II VG Savings (MWh/yr)	Phase II Verified Net Savings (MWh/yr)
Commercial and Industrial	143,414	113,868	257,443	202,276
Government, nonprofit, and institutional	30,118	13,132	102,584	79,105
Total Portfolio	***307,626***	***214,208***	***593,953***	***419,175***

9.2 TOTAL RESOURCE COST TEST

Table 9-5 presents TRC NPV benefits, TRC NPV costs, present value of net benefits, and TRC ratio for PECO's PY6 individual programs and total portfolio. The SWE found no initial inconsistencies between the TRC model outputs and the TRC results shown in the PY6 annual report.

Table 9-5: 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)	$14,825,038	$6,921,237	$7,903,802	2.14
Smart Appliance Recycling	$6,362,474	$1,773,487	$4,588,987	3.59
Smart Builder Rebates	$258,390	$606,661	$(348,271)	0.43
Smart Energy Saver	$2,008,881	$483,324	$1,525,556	4.16
Smart Home Rebates	$91,141,427	$55,108,106	$36,033,322	1.65
Smart House Call	$2,852,860	$5,043,575	$(2,190,715)	0.57
Smart Multi-Family Solutions (Residential)	$2,168,196	$1,460,965	$707,231	1.48
Smart Usage Profile	$1,771,568	$1,779,394	$(7,826)	1.00
Low-Income Energy Efficiency Program	$11,954,951	$9,393,724	$2,561,227	1.27
Smart AC Saver (Commercial)	$169,957	$305,200	$(135,243)	0.56
Smart Business Solutions	$10,233,749	$6,259,935	$3,973,814	1.63
Smart Equipment Incentives (C/I)	$66,310,767	$26,867,373	$39,443,395	2.47
Smart Construction Incentives	$16,743,009	$7,943,415	$8,799,593	2.11
Smart Multi-Family Solutions (Nonresidential)	$1,339,832	$1,184,970	$154,862	1.13
Smart On-Site	-	$422,654	$(422,654)	0.00
Smart Equipment Incentives (GNI)	$18,675,247	$11,051,671	$7,623,576	1.69
Common Costs	-	*$12,172,705*	-	-
Total Portfolio	**$246,816,346**	**$148,778,397**	**$98,037,948**	**1.66**

In summary, 12 of the 16 programs offered were found to be cost-effective, three were found to be non-cost-effective, and one claimed no savings in PY6. The breakout of cost-effective, non-cost-effective, and no-participant 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)*

No Savings Claimed
(TRC Ratio = 1.0)

- *Smart On-Site*

9.2.1 Assumptions and Inputs

PECO used the same discount rate (7.6%) in its PY6 TRC model to discount program benefits and costs for all programs, as was done in PY5. This rate was used to compare the NPV of program benefits that will occur later in a measure's lifetime to the upfront 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 PY5, the SWE requests that PECO's subsequent Phase II reports rely on the discount rate that was approved in its latest EE&C Plan.[35]

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 9-6 shows details about the discount rates and the energy and demand LLF values PECO used for each program.

Table 9-6: 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%

[35] As an alternative, PECO could file a request to the Commission to revise their Phase II EE&C plan to reflect their 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.

Program	Sector	Discount Rate	Energy LLF[a]	Demand LLF[a]
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 a 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 and identified only one inconsistency. "Refrigeration – Floating Head Pressure Controls" is included in Section 3.5 of the 2014 TRM with a deemed EUL of 15 years. The TRC model applies a 10-year EUL for the same measure. Although the TRC model cites the TRM, the values appear inconsistent. The SWE recommends that PECO continue to update the TRC model annually to accurately align with the appropriate TRM, 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 PY6 annual report provided the cost and source for instances where the measure costs were not derived from the SWE incremental cost database of 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 PY6 annual report. There were small differences between verified savings in the PECO TRC and the verified savings from program tracking databases in several portfolio programs, most notably Smart Home Rebates and Smart Construction Incentives. Overall, the modeled portfolio energy and demand savings in the TRC model were approximately 17,600 MWh/yr and 3.9 MW less than the PY6 verified energy and demand savings from program tracking databases and the annual report. These differences are more than 1% of the total portfolio verified savings. The SWE coordinated with Navigant to resolve the inconsistency between the verified and modeled savings, and found a unit reporting error in the TRC model. Navigant corrected the error and submitted a new model to the SWE. This revised model has energy and demand savings that align closely with the PECO PY6 report.[36] As a result of these changes, the TRC Ratio improves from 1.66 to 1.84 in PY6. The SWE recommends that PECO utilize the corrected TRC model and update any affected tables to the PY6 report in a subsequent memo to the Commission.

In PY6, the 2014 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 PY6. 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 2014 PA TRM guidance on the issue of dual baselines.

9.2.2 Avoided Cost of Energy

PECO's PY6 TRC model assigned a value ($/kWh) to the avoided cost of energy for each year from 2014 through 2028[37] under four different load conditions: summer on-peak, summer off-peak, winter on-peak, and winter off-peak. The model assigned each measure to an end-use load shape that was the most relevant to the affected equipment. The model then divided the energy impacts of a given measure across the four load conditions based on the associated load profile. The model multiplied the impacts under a given load condition by the avoided cost of energy for that condition and summed them across the effective lifetime of the measure to calculate the avoided energy benefits produced by the measure. The SWE Team supports the use of specific end-use load shapes to feed the TRC model, because energy savings achieved during on-peak periods with high energy costs are more cost-effective per kWh saved than measures producing savings during off-peak periods.

PECO's TRC model also assigned a value ($/kWh) to the avoided cost of T&D for each year from 2014 through 2028. Avoided costs of T&D were applied for three sectors: residential, small C/I, and large C/I. Navigant calculated a weighted average for the small C/I and large C/I sectors based on the estimated sales from the 2012 SWE Market Potential Study. Avoided T&D costs were greatest for the residential sector and lowest for the C/I sector. Navigant adjusted the measure-level ex post savings impacts for line

[36] Due to differences in significant differences across databases and models and rounding errors, there are still minor differences between select programs. The portfolio energy savings in the revised TRC model match the verified energy savings to 99.9%.

[37] The SWE verified that PECO's 2014–2028 avoided cost stream accurately aligns with PY6. However, the SWE issued a guidance memo (GM-019, February 2013) to suggest that each EDC's program year avoided cost stream begin with the calendar year at the close of the program year. For example, for a measure installed in PY6 (June 1, 2014–May 31, 2015) with a 15-year measure life, the avoided cost stream should be referred to as 2015 through 2029. This would not result in a change to the TRC outputs.

losses and then multiplied by the appropriate avoided energy cost stream to calculate avoided energy benefits.

9.2.3 Avoided Cost of Capacity

The PECO TRC model assigned a flat annual amount ($/kW-year) to the cost of adding generation capacity, which was used for the avoided cost of capacity for all programs and sectors. Ex post demand savings were adjusted for line losses and multiplied by the avoided cost of capacity estimates to determine the financial benefit of peak-demand impacts.

9.2.4 Conclusions and Recommendations

The PECO TRC model was transparent, and the SWE observed no significant changes in the TRC model operation since PY4. The SWE Team determined that the PECO TRC model provided adequate details regarding the determination of financial benefits from energy and demand impacts. The SWE review determined that there were significant differences (greater than 1%)) between the modeled energy and demand savings and the verified energy and demand savings in the PY6 report. The SWE recommends that PECO correct their TRC model and any affected tables in the PY6 report in a subsequent memo to the Commission.

Regarding the minor issue of sources for measure lives, the SWE Team recommends that PECO and its evaluation contractor use measure life values in the TRM as the default values, and justify any departures from the TRM. The SWE Team also requests that PECO use the discount rate approved in its Phase II EE&C Plan until an updated factor is 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 PY6 offerings by approximately $2.7 million.

9.3 STATUS OF EVALUATION ACTIVITIES

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

9.3.1 Status of Evaluation, Measurement, and Verification Plans

The SWE Phase II Evaluation Framework completed in June 2013 is the framework that applied to EDC evaluation planning for PY6. This framework provided for the standardization of evaluation protocols across EDCs. The 2013 Evaluation Framework required each EDC to complete an initial evaluation plan for each program in its portfolio to address several objectives. (See Section 4.3.1 for a summary of these objectives). Table 9-7 displays key milestones completed.

Table 9-7: 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 PY5 Annual Report to the PUC.

The SWE Team reviewed 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 several 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 will 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 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 (C/I and GNI) program. They were 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 did field 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 which 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.

9.3.2 Measurement and Verification Activities and Findings

PECO achieved 74%[38] of its total Phase II energy savings compliance target, based on aggregated verified savings as of May 31, 2015 from Phase II in addition to Phase I carryover. Realization rates compare gross savings reported by the EDC to the verified gross savings determined by Navigant through M&V activities (see Section 4.3.2 for an overview of how realization rates are calculated and defined.)

Table 9-8 provides a summary of M&V findings based on activities conducted by Navigant. The summary is based on details provided in PECO's PY6 annual report and on information obtained from the SWE Team's data requests and audits. Table 9-8 presents realization rates and relative precision values for verified energy and demand savings for each of PECO's residential and non-residential EE programs for PY6.

Table 9-8: Realization Rates and Relative Precisions for PECO's Programs in PY6

Program	Energy Realization Rate	Relative Precision (Energy)[a]	Demand Realization Rate	Relative Precision (Demand)[a]
Low-Income Energy Efficiency Program	99%	4.0%	99%	3.9%
Smart Appliance Recycling	89%	2.4%	89%	2.4%
Smart Builder Rebates	102%	3.1%	92%	13.9%
Smart Energy Saver	135%	1.0%	152%	1.2%
Smart Home Rebates	125%	0.6%	148%	2.5%
Smart House Call	102%	6.9%	96%	4.6%
Smart Multi-Family Solutions - Residential	91%	5.7%	91%	5.8%
Smart Usage Profile	N/A	0.0%	N/A	0.0%
Smart Business Solutions	86%	8.7%	133%	7.2%
Smart Equipment Incentives - Commercial and Industrial	108%	6.6%	120%	14.8%
Smart Construction Incentives	110%	4.4%	102%	9.3%
Smart Multi-Family Solutions - Non-residential	98%	2.1%	98%	2.2%
Smart On-Site	N/A	N/A	N/A	N/A
Smart Equipment Incentives - Government, Nonprofit and Institutional	104%	2.7%	96%	8.8%
Total	110%	N/A	110%	N/A

[38]The PECO PY6 annual report indicates this value is 86%. The SWE determined that the value of 86% was based on dividing the Phase II verified savings by the compliance target.

Program	Energy Realization Rate	Relative Precision (Energy)[a]	Demand Realization Rate	Relative Precision (Demand)[a]

NOTES
[a] Relative precision values shown are at the 85% confidence level.

9.3.2.1 Residential Energy Efficiency Programs

Realization rates for PECO's residential programs' energy savings ranged from 89% to 135%. Realization rates for demand reductions from these programs ranged from 89% to 152%. All residential programs met the relative precision requirement established in the Evaluation Framework.

During PY6, Navigant performed impact M&V activities in accordance with PECO's EM&V Plan to verify the EDC's reported savings. The EM&V Plan describes verification activities intended for deemed and partially deemed measures using the 2014 TRM as the basis for verifying annual electric energy and demand savings wherever 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 building energy simulation modeling or billing analyses to evaluate measure energy savings. With the exception of the Smart Multi-Family Solutions program, no on-site assessments were conducted for the impact evaluation of residential programs.

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 PY6, PECO maintained the program to meet the company's portfolio MW reduction target of 78.0 MW. Navigant used a deemed savings value that was based on the PY4 verification of the direct load control program evaluation and compared it to the CSP's calculated value from PY6 to check for accuracy.

For the Smart Appliance Recycling program, Navigant first completed a census review of the program tracking database to verify that the reported savings used the correct 2014 TRM deemed savings for recycled refrigerators and freezers. For verified savings, Navigant conducted a second census review and applied the set of regression equations for refrigerators and freezers specified in the 2014 TRM, using the recorded appliance characteristics collected by PECO's program database in PY6, in order to estimate more specific program year savings. Navigant then conducted a telephone survey to form a stratified random sample of the program population to determine whether the existing unit was retired, replaced with an ENERGY STAR unit, or replaced with a non–ENERGY STAR unit, as well as the part-use factor. Navigant's evaluation sample found a higher proportion of replaced units than the tracking system, leading to an overall realization rate below 100%.

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 2014 PA TRM. Through the whole-building modeling, Navigant independently calculated energy and demand savings for project homes. Navigant's evaluation activities found that the reported domestic hot water savings were being calculated using an algorithm that is different than the 2014 PA TRM protocol. The verified savings were adjusted to be consistent with the 2014 TRM, leading to a realization rate slightly greater than 100%.

The Smart Home Rebates program, which represents 70% of the gross verified savings in the residential sector, consists of both efficient products and upstream lighting.[39] 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 used the result of the completed PY5 intercept surveys to develop estimates of cross-sector sales. Navigant's verified savings for this program in the residential sector are less than the reported savings as a result of a cross-sector sales adjustment for bulbs installed in non-residential sockets and changing federal standards for refrigerators and room air conditioners. Conversely, Navigant found higher than reported savings across the pool pump measure by confirming the installed pool pump horsepower and refining the baseline unit consumption estimate to correspond to the pump power of the rebated pump. The overall realization rates for the program (across all sectors) were 125% for energy savings and 148% 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 2014 TRM, conducted phone surveys to verify measure installations, and conducted desk audits of a sample of participants to verify the accuracy of the program tracking system. The impact evaluation found and attempted to correct small calculation errors in the tracking system associated with air sealing and insulation measures. The adjusted savings, coupled with installation verification telephone surveys, yielded overall program realization rates of 102% for energy and 96% 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 2014 TRM. As a result of the impact evaluation, Navigant adjusted the ISR for distributed lightbulbs to be consistent with the 2014 PA TRM in lieu of the student survey installation rates, lowered the baseline wattage used in the energy savings calculation for LED nightlights, and used EDC- and program-specific data regarding number of people per household for the low-flow showerhead and faucet aerator measures. Navigant only updated TRM-defined variables based on installation survey data where permitted by the 2014 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 2014 TRM guidance. Navigant verified slight differences in installed measure quantities from the sample of telephone surveys, resulting in overall program energy and demand realization rates of 91%.

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.[40] PECO reports year-to-date savings for PY6 but does not include SUP savings in PY6 as contributing to Phase II compliance goals. This is because the SUP program has a one-year EUL. Savings from the SUP program in PY7 will count toward the Phase II compliance goals. PECO reports PY6 energy savings of 16,891 MWh/yr attributed to 44,982 participants, an average of approximately 375 kWh per participant. 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.

[39] Savings attributable to the non-residential sector were excluded from the SHR total. Similarly, savings from the low-income sector were excluded from the total residential savings total.
[40] As a check on the robustness of savings estimates, Navigant also modeled program savings utilizing a post program regression model.

9.3.2.2 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. No on-site inspections to confirm measure installations were performed for the low-income impact evaluation, nor were they indicated in the PECO EM&V Plan.[41] Navigant found only minor differences between reported and verified installed quantities and general agreement with the 2014 TRM, resulting in overall program energy and demand realization rates of 99%.

9.3.2.3 Non-Residential Energy Efficiency Programs

Realization rates for PECO's non-residential programs' energy savings ranged from 86% to 110%. Realization rates for demand reductions from these programs ranged from 96% to 133%. PECO achieved better than 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.

Figure 9-1 shows the frequency of each M&V approach performed by Navigant in PY6 for PECO's Smart Equipment Incentives (SEI) 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. IPMVP Option D involves modeling energy performance of a facility before and after the efficiency measure is installed. The frequencies and savings presented in Figure 9-1 include C/I and GNI measures within the SEI Program.

[41] Navigant did complete ride-along observations with the CSP, as part of the process evaluation, of 24 homes receiving Component 1 audit / education visits.

Figure 9-1: Frequency and Associated Savings of M&V Approaches for SEI Program

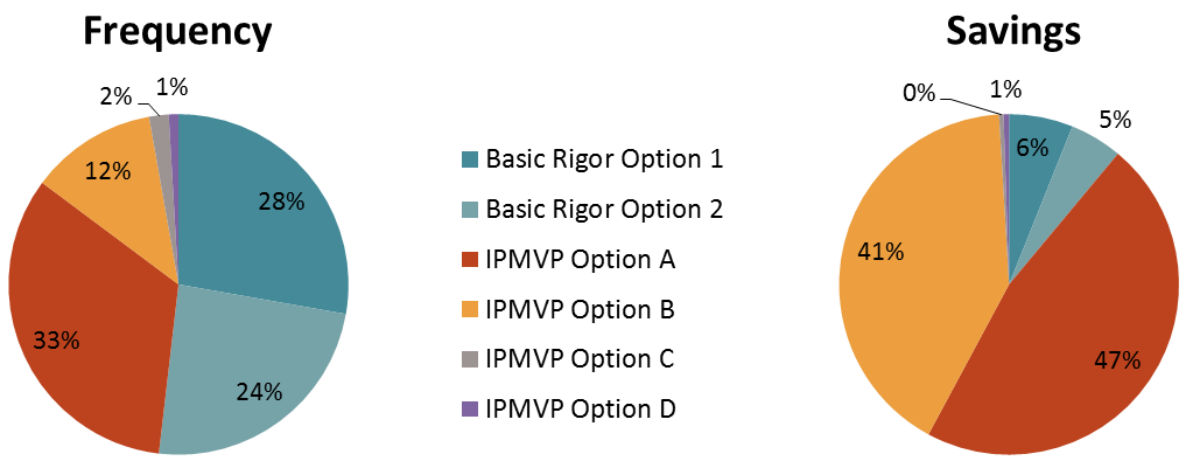


Figure 9-1 indicates that 52% of the sampled measures for the SEI Program were evaluated using a basic level of rigor. However, the representative savings for these measures accounted for only 11% of the energy savings. This suggests that the use of basic rigor was appropriately used, predominately for measures with smaller savings. Likewise, the more expensive methods (i.e., Options A, B, C, and D) were reserved for a smaller number of projects, but these projects contributed a large majority (89%) 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 9-2: Frequency and Associated Savings of M&V Approaches for SCI Program

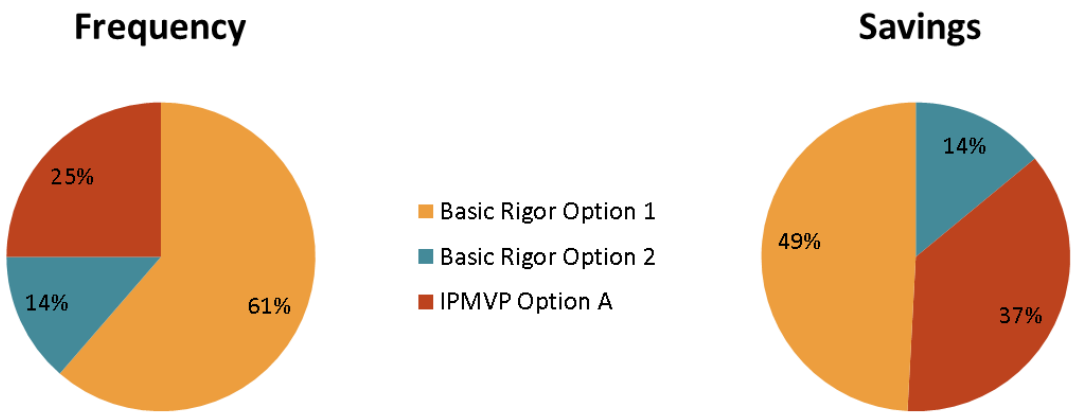


Figure (cross reference) shows the frequency of each M&V method used in the Smart Construction Incentives (SCI) Program and the energy savings associated with each method. Basic rigor was used for a majority of the projects (61%), but these projects accounted for only 14% of the savings. Enhanced rigor was appropriately used for fewer projects, but these accounted for 86% 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.

Navigant performed verification on a stratified sample of 16 projects from PECO's SBS Program in PY6. Impact evaluation used a basic level of rigor, including file reviews of all sampled projects and telephone interviews of 14 of the 16 sampled participants. Verification was performed in accordance with the EM&V

Plan. As shown in Table 9-8, Navigant's analysis resulted in an energy realization rate of 86% and a demand realization rate of 133%. The high realization rate for demand resulted from survey respondents indicating that their equipment was in operation for much or all of the peak demand period, whereas the ex ante savings calculations were based on a default CF value well below 1.0.

The Smart On-Site (SOS) Program had no projects completed in PY6. As of the close of PY6, the SOS program had nine CHP projects scheduled to be completed within Phase II.

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. In PY5, in compliance with the approved EM&V Plan, Navigant did not perform an independent verification of the claimed installations. In PY6, the evaluator conducted on-site visits for a subset of telephone survey participants for enhanced verification.

9.3.3 Process Evaluation Activities and Findings

The process evaluation that Navigant conducted included a review of key program documents; interviews with EDC staff, a third-party implementation staff, and program-affiliated market actors; and surveys of program participants and nonparticipants—although not every evaluation included all of these elements. Table 9-9 provides a high-level summary of the data sources Navigant used and its key findings for each program.

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

Program	Key Findings	Data Sources
Residential		
Smart Home Rebates (SHR)	– Customers exhibited high awareness of LED and CFL measures. – Overall adoption of CFLs and LEDs was low. – Manufacturers and retailers stated that price of LEDs is ceasing to be a barrier, but that availability of ENERGY STAR or efficient lighting products could still be a barrier. – Delphi panelists predicted that less than 50% of the market has adopted high-efficiency HVAC equipment; surveyed HVAC installers estimated an even lower penetration of this equipment among low-income segments. – Mystery shopping trips documented the erosion of enthusiasm and knowledge among sales staff for selling energy efficient appliances.	– Interviews with PECO staff, implementer, 8 lighting manufacturers, and 11 HVAC installers – General population survey (n=602) – Conjoint web panel survey (n=898) – Participant survey (n=200) – Mystery shopping at 150 participating retail store locations – Delphi panel with 16 HVAC installers – Focus group with 17 PECO participants – Program materials
Smart House Call (SHC)	– PECO implemented a considerable marketing effort in PY6 and experienced success from this effort. Marketing materials, in particular, helped program staff build relationships with participating contractors. – About 25% of participants also participated in the Smart A/C Saver Program, and 5%–10% also participated in the SHR Program. – Both energy advisors and contractors stated that they were not well oriented to the additional Smart Ideas programs for which SHC participants may be eligible. Energy advisors	– Interviews with PECO staff, implementer, 6 contractors, and 6 energy advisors – Program materials

Program	Key Findings	Data Sources
	also noted being discouraged to adequately follow up with audit customers. – Energy advisors reported nearly half of participants express an intention to pursue additional measures that go beyond what is incentivized under the program.	
Smart Appliance Recycling (SAR)	– Appliance dealers stated that the program has had a limited effect on the secondary retail market. – The program has had an effect on the disposal market for refrigerator and freezers. Junk-hauling services reported that the number of refrigerators they had picked up decreased over the past year, which is when PECO increased the rebate and program marketing. – Satisfaction with all aspects of program delivery to participants remained high.	– Interviews with PECO staff, implementer, and 5 used appliance dealers and junk-removal service firms – Participant survey (n=125)
Smart Usage Profile (SUP)	– The majority (89%, n=472) of treatment households recalled receiving the HERs, and Navigant found statistically significant savings among treatment households, confirming that the program is being implemented, that treatment households are regularly receiving HERs, and that they are, on average, taking energy saving actions as a result. – Less than two-thirds (62%) of respondents who rated program satisfaction were satisfied with mailed HERs. Compared with other HER program evaluations, participant satisfaction with the mailed reports was lower than the typical range of 68%–70%. – The majority (73%) of email recipients did not recall receiving the email reports from PECO. – About 56% of participants, compared with 75% of nonparticipants, reported visiting the portal (a statistically significant difference). This finding suggests that participants are getting what they need from the printed reports and do not need the portal for additional information, which goes against the current understanding of program logic.	– Interviews with PECO staff and implementer – Participant and nonparticipant survey (n=200) – Program materials
Smart Energy Saver (SES)	– Multiple teachers indicated that many of their students have parents with low levels of English comprehension. Teachers struggle to get any homework assignment and installation survey back from these students. – Among the 15 surveyed teachers, two required some type of parental consent before the students were sent home with the kits. Teachers who had kits left over at the end of the program had concerns over sending the kits back to the program because they felt it may reflect poorly on them and their schools and may limit their ability to receive kits in the future. – One teacher asked all students to fill out the student installation surveys, even those who had not taken kits home. A few teachers indicated they had their students complete the installation surveys in the classroom rather than at home with their parents. These findings indicate that the evaluators should explore whether the program functions differently in practice than the assumed design.	– Interviews with PECO staff and implementer – Analysis of returned program surveys – Participating teacher survey (n=15) – Program materials

Program	Key Findings	Data Sources
	– The program saw low levels of participant engagement, measured by the returned program surveys. Navigant found a 32% return rate on student surveys, a 25% return rate on teacher satisfaction surveys, and a 2% return rate on parent satisfaction surveys.	
Smart Builder Rebates (SBR)	– Current incentive levels are insufficient to attract new builders to the program. The largest participant in the program decided to stop building ENERGY STAR homes because the incentives were insufficient.	– Interviews with PECO staff and implementer – Program materials
Residential Smart A/C Saver (SACS)	– Since the incentive reduction at the end of Phase I, the program did not experience the 19% drop in participation as predicted by the Willingness-to-Accept (WTA) survey, conducted in PY4. Rather, the program has seen a consistent but much smaller drop in participation of approximately 1.4% per year since the end of PY4.	– Interviews with PECO staff – Program materials
Smart Multi-Family (SMF) Solutions	– About 10% of surveyed tenants reported that they were not informed of the program prior to installation. Some of them cited this as a reason for dissatisfaction with the program overall. – About 12% of surveyed tenants reported dissatisfaction with the equipment, with the majority citing CFLs as the source of dissatisfaction. – Through discussions with the evaluation team during on-site visits, landlords requested information on the installed equipment's make and model in order to replace in kind. – There has been zero participation in the prescriptive channel to date. There have been, however, multiple repeat landlord participants in the program. – Only 40% of landlords recalled receiving a list of incentivized energy efficiency equipment recommended through the program.	– Interviews with PECO staff and implementer – Participant survey (n=85; both tenants and landlords surveyed)
Sector-level Findings	– Program satisfaction is moderate to high across residential programs. – Low levels of participant engagement in SES, SBR, SHR appliance aspect of the program, and SMF Solutions prescriptive component of the program. High levels of participant engagement in SACS and possibly SAR. – Barriers to participant engagement vary by program. For example, insufficient incentives are a barrier in recruiting SBR participants, while parents with a low level of English comprehension are difficult to engage through the SES school kit program.	– Interviews with PECO staff, implementers, and program-affiliated market actors – Participant and nonparticipant surveys (surveyed over 400 participants and 1,500 nonparticipants across programs) – Mystery shopping at retail locations – Focus group with participants – Program materials
Low-Income		

Program	Key Findings	Data Sources
Low-Income Energy Efficiency Program (LEEP)	– About 26% of LEEP survey participants reported they had undertaken additional no- or low-cost actions that were not recommended by a program representative after participating in the LEEP. – Of homes visited during the ride-along surveys, 75% had unfinished basements with no floor insulation and up to 25% had windows that did not shut properly or were broken. Lack of floor insulation and properly functioning windows can result in heat loss or increased heating use. – Of participants' homes visited during the ride-along surveys, 13% declined the offered CFLs.	– Interviews with PECO staff and implementer – Participant survey (n=125) – Ride-along observations of 24 homes
Non-Residential		
Commercial Smart A/C Saver (SACS)	– Because there is not a separate line for capacity payments in the program finances tracking spreadsheet, it is difficult to easily verify program costs.	– Interviews with PECO staff – Program materials
Smart Equipment Incentives (SEI)	– Contractors and PECO account managers stated that rebates for non-lighting and custom projects are not enough to change decision-making because it is too costly and labor-intensive to verify savings unless the size of the project is significantly large. Participants confirmed this perspective. – The majority (60%) of participants stated that the program did affect the type of energy efficient equipment their organizations decided to buy and that PECO can be more influential during the planning phase of the project cycle. – Contractors and participants noted the wait time after submitting a pre-application is a barrier to completing projects within the planned project timeline. – Customer satisfaction with the program continues to be high (96% of C/I participants were satisfied or very satisfied with the program). – Participants and contractors offered these suggestions for program improvement: (1) provide assistance on engineering requirements to establish a project baseline; (2) improve the application process because PECO's paperwork requirements are more burdensome than requirements from other utility programs; (3) update marketing because contractors find it boring and outdated.	– Interviews with PECO staff, including account managers, implementer, 5 distributors, 4 industry groups, and 3 non-lighting contractors – Participant survey (n=45) – Program materials
Smart Construction Incentives (SCI)	– Participant survey respondents stated that the incentive amount they receive from the program is only enough to cover the additional cost they have to incur to be eligible to participate, such as building energy modeling requirements, and two major challenges to implementing projects are budget and the difficulty of measuring energy savings. – About 55% of participants said the program did not affect what energy efficient equipment their organization decided to purchase. About 47% of respondents stated they would have done the project if the program were not available. – Project building cycles determine the potential pool of participants, not the SCI program. The evaluation team found that the timeline of new construction projects does not always align well with project application timeline	– Interviews with 6 architectural, engineering, construction, or energy management firms – Participant survey (n=21) – Program materials – Interviews with three PECO program management staff – Interviews with two CSP staff

Program	Key Findings	Data Sources
	requirements. For example, a project application may be due before the building design is finalized, limiting program participation. – Most participants (70%) stated their organization is considering installing additional energy efficient equipment in the next 12 months, such as lighting, chillers, VFD controls, refrigeration, and HVAC. – The majority (75%) of participants are very satisfied or somewhat satisfied with the program. This satisfaction level is lower than that found in other PECO programs. The main reasons for dissatisfaction, when mentioned, were that the respondents anticipated a higher rate of return and that the application requirements were cumbersome and of little value to them.	
Smart Multi-Family (SMF) Solutions	– Same process evaluation findings as those noted in this table under SMF Solutions residential program (see above). – *Note: Since energy savings from the SMF Solutions program come from residential and non-residential sectors, this program is discussed in both residential and non-residential sections of this report.*	– Interviews with PECO staff and implementer – Participant survey (n=85; both tenants and residential and non-residential landlords surveyed)
Smart On-Site (SOS)	– PECO has reported that there have been delays in CHP project completion, over which PECO currently has little or no control. Furthermore, there are numerous factors beyond PECO's control that can delay the completion of CHP projects. One factor that PECO does have control over is the interconnection process. – Many customers with viable applications for CHP are unaware of the opportunity.	– Interviews with PECO staff and 5 project developers
Smart Business Solutions (SBS)	– Program implementation diverged significantly from the EE&C Plan from the beginning of Phase II because PECO's contract with the implementer was based on the program funding level and saving goal in the original EE&C Plan and was not updated to align with the revised plan that was filed in March 2014. – Implementer's administrative fee is determined as a fixed multiplier of the estimated annualized savings from each project, which could create an incentive for the implementer to inflate savings. – From the installers' perspectives, the program is operating well. The only recommendations installers offered to improve the program were to offer additional measures and to provide installation crews with a small inventory of the most common bulbs and ballasts to replace units that malfunction upon installation.	– Interviews with PECO staff and implementation staff overseeing delivery of the program and installing equipment at participating locations

9.4 STATEWIDE EVALUATOR AUDIT ACTIVITIES AND FINDINGS

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

9.4.1 Residential Program Audit Summary

9.4.1.1 Smart AC Saver (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 PY6 is an accurate representation of verified savings for the program.

9.4.1.2 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 2014 PA TRM deemed savings estimates for the reported savings as well accurate use of the regression coefficients and tracking system data fields in the derivation of verified gross savings. The SWE also confirmed the calculated results of a telephone survey to verify whether units were retired, replaced with non–ENERGY STAR units, or replaced with ENERGY STAR units. The results of the telephone survey verification effort and the PY6 database tracking system are shown in Table 9-10.

Table 9-10: Appliance Recycling Program Telephone Survey Verification Results

Measure Category	Database Tracking System	Telephone Survey	Difference (Tracking – Survey)
Refrigerator retired	49%	28%	22%
Refrigerator replaced with standard efficiency unit	12%	5%	6%
Refrigerator replaced with ENERGY STAR unit	39%	67%	-28%
Freezer retired	76%	68%	8%
Freezer replaced with standard efficiency unit	7%	2%	5%
Freezer replaced with ENERGY STAR unit	16%	30%	-14%

The SWE was able to use the tracking system and phone survey data to replicate the verified savings calculations performed by Navigant. However, this method is not optimal in the SWE's judgement and recommends an alternate approach. Navigant calculated unique regression model average UEC for each equipment/replacement type. Given the unreliable nature of the tracking system data on replacement status, and the eventual reweighting based on the results of the telephone survey, the SWE believes a single UEC should have been developed for refrigerators and a single UEC for freezers. Examples of Navigant's calculation and the proposed SWE calculation are provided in Table 9-11 and Table 9-12.
Table 9-12

Table 9-11: PY6 Evaluation Verified Refrigerator Savings – Navigant

Savings Parameter	RF-Retired	RF Replaced – Standard	RF Replaced – ES	RF -Total
Number of Units – Tracking System	5,120	1,204	4,032	10,356
Replacement Type % - Phone Survey	28%	5%	67%	100%
Survey Adjusted Units	2,862	545	6,949	---
Regression Model UEC per unit	988	1,163	1,110	---

Savings Parameter	RF-Retired	RF Replaced – Standard	RF Replaced – ES	RF -Total
Part-Use Factor from Survey	97%	97%	97%	---
Avg. UEC adjusted for part-use	961	1,132	1,080	---
New Standard/ENERGY STAR consumption (adjusted for part use)	---	523	406	---
kWh savings per unit	961	609	674	---
Verified Gross MWh/yr	**2,751**	**332**	**4,685**	**7,769**

Table 9-12: PY6 Evaluation Verified Refrigerator Savings – SWE Recommended

Savings Parameter	RF-Retired	RF Replaced – Standard	RF Replaced – ES	RF -Total
Number of Units – Tracking System	5,120	1,204	4,032	10,356
Replacement Type % - Phone Survey	28%	5%	67%	100%
Survey Adjusted Units	2,862	545	6,949	---
Regression Model UEC per unit	1,056	1,056	1,056	---
Part-Use Factor from Survey	97%	97%	97%	---
Avg. UEC adjusted for part-use	1,027	1,027	1,027	---
New Standard/ENERGY STAR consumption (adjusted for part use)	---	523	406	---
kWh savings per unit	1,027	505	622	---
Verified Gross MWh/yr	**2,940**	**275**	**4,320**	**7,535**

The difference between the two approaches is approximately 234 MWh/yr, less than 1% of PECO's PY6 verified energy savings. A similar correction to the verified freezer savings should also be performed, but the expected impact on total savings is small. The SWE recommends Navigant refine its methodology and savings estimates in the PY7 report.

9.4.1.3 Smart Builder Rebates

The SWE Team reviewed Navigant's use of the 2014 PA 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 coincidence factor that are inconsistent with those in the 2014 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 PA 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.

9.4.1.4 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 Team observed that Navigant had assigned an incorrect ISR for the 18W and 23W CFL bulbs that was inconsistent with the 2014 TRM value of 97%. The SWE Team was able to estimate that the correct application of the 2014 TRM would increase the program's energy savings by 347 MWh/yr and 0.4 MW, or less than 0.1% of the verified energy and demand savings of the PY6 portfolio.

The SWE believes Navigant's approach to estimating verified energy and demand savings to be reasonable. The overall impact of the incorrect application of the 2014 TRM CFL ISR on the program's verified energy and demand savings is small and is not expected to change the portfolio verified savings by more than 1%. However, PECO should attempt to correct this error in its PY7 report.

9.4.1.5 Smart Home Rebates

PECO's Smart Home Rebates 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 2014 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 2014 TRM guidance tables. The SWE also confirmed the appropriate use of 2014 PA TRM algorithms for both residential and cross-sector sales bulbs. The PA 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.[42]

[42] PECO applied its EDC-specific interactive effects adjustments in lieu of the 2014 TRM deemed value for all lighting measures across all programs. The interactive effect variable for lighting allows for EDC data gathering.

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 PA 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 PA 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 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.

9.4.1.6 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 PY6, the SWE Team confirmed that each unique measure in the program tracking database used the correct 2014 TRM algorithm or approved IMP, with the exception of one measure. The evaluator omitted a single data field for the insulation measure in homes with room air conditioning. However, the overall impact of this omission is extremely small and would likely not alter the verified savings total in PY6.

During the review, the SWE noted that the tracking system database had, for the air source heat pump 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 Smart House Call program, the SWE recommends 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 2014 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 .412 MW, respectively. These corrections change the PY6 portfolio verified gross energy savings by < 1%.

The SWE Team agrees with the calculation of gross verified savings for this program. The SWE Team recommends that PECO correct the lone TRM algorithm error going forward, but does believe a correction is necessary for the program's verified savings total. The evaluator has already submitted revised verified

energy and demand savings to the SWE, and we recommend that these updated values be reflected in the Phase II totals of the PY7 report.

9.4.1.7 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 2014 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.

9.4.1.8 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 PY6 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.

9.4.2 Low-Income Program Audit Summary

The SWE Team confirmed that all four components of PECO's LEEP were evaluated consistent with the approaches in PECO's Phase II Evaluation Plan and subsequent memos. The SWE Team reviewed the calculated savings for each measure type in the LEEP to ensure accuracy and consistency with the 2014 PA TRM. The SWE Team found that the tracking database had accurate data fields and that the algorithms were in general agreement with the PA TRM, with a few small exceptions. These exceptions included an incorrect application of the air sealing IMP that overstated energy and demand savings for this measure and minor data field entry errors.[43]

Navigant provided the SWE Team with a sample of project supporting data as well as the raw data and data results from the sample of telephone surveys used to verify installation quantities and ISRs. The SWE Team reviewed these files and found no inconsistencies with their application in the determination of gross savings.

[43] Data field entry errors include unlikely heating capacity values for air source heat pump savings calculations and inaccurate HSPF values for the insulation measure algorithm.

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 20 measures to the low-income sector in PY6, which was 16.4% 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. The observed data field inaccuracies and TRM algorithm inconsistencies are small and are not expected to change the portfolio verified savings by more than 1%, and PECO should attempt to correct these inconsistencies in its PY7 report.

9.4.3 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. In general, documentation provided by PECO was well organized and allowed for a comprehensive review of projects, with most off-TRM values being well documented. Only a few projects were missing some requested documentation; in most cases, this was not detrimental to the SWE Team's review. Specific examples of deficiencies noted in the project file review are explored in Appendix A.6.1. Based on the minor issues documented, the SWE Team is confident in the accuracy of the energy and demand savings values claimed by PECO. Based on the deficiencies documented, the SWE Team provides the following recommendation to ensure the accuracy of the reported savings presented in upcoming program years:

1) To improve the quality and accuracy of the project files, the SWE Team recommends using electronic forms to collect data.

The SWE Team reviewed tracking data and quarterly reports upon their submission to ensure consistency across tracking and reporting documents. Overall, there are no major discrepancies between program savings and incentives presented in the quarterly reports and the values in the database extracts. However, the SWE Team recommends that information be reported in a consistent manner across all programs. For example, sector-level data (number of participants, energy and demand savings, and incentives) should be provided for all non-residential programs. Further details are provided in Appendix A.6.2.

The SWE Team reviewed PECO's PY6 sample design to ensure its compliance with the Evaluation Framework. The results are displayed in Table 9-13, showing relative precision at the 85% confidence level (CL).

Table 9-13: Compliance across Sample Designs for PECO's PY6 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)	6.6%	14.8%	✓
Smart Construction Incentives	4.4%	9.3%	✓
Small Business Solutions	8.7%	7.2%	✓
Smart Multi-Family Solutions – Non-residential	2.1%	2.2%	✓

Program	Relative Precision at 85% CL for Energy	Relative Precision at 85% CL for Demand	Compliance with Evaluation Framework
Smart Equipment Incentives (GNI)	2.7%	8.8%	✓

The goal of 15% precision at the 85% confidence level for energy was reached for all non-residential program groups in PY6. Navigant followed the SWE's request to design the SEI (C/I) 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 for all non-residential programs. The SEI (C/I) Program had missed precision targets in previous years despite the evaluation contractor's attempts to improve the precision by using additional sample points and conservative coefficient of variation (Cv) assumptions. The SWE Team applauds PECO and its evaluator for achieving the required precision level for this program. Details about each program evaluation sample are provided in Appendix A.6.3.

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 upgrades, VFD installations, energy management system (EMS) projects, motor upgrades, and refrigeration projects. The SWE Team provided recommendations for 6 of the 10 sampled projects. While no immediate corrective actions were taken, Navigant agreed to take recommendations into consideration for future site inspections. Details of all 10 projects and their associated findings are presented in Appendix A.6.4.

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 as well as the level of rigor used in the evaluations. The results of the verified savings analysis are provided in Appendix A.6.5.

9.4.4 Net-to-Gross and Process Evaluation Audit Summary

Table 9-14 presents a high-level summary of the results of the SWE Team's audit of Navigant's NTG assessment and process evaluation of the PECO programs. The following subsections present detailed discussions and a summary of the findings, starting with the audit of NTG reporting and related files, followed by findings based on the review of process reports and supporting documents. Appendix C.3 provides detailed program-specific reviews of the process evaluation activities.

Table 9-14: Summary of SWE Team's Review of PECO Process and NTG Evaluations

Elements Reviewed in the Annual Report	Findings
Inclusion of Required Elements per Report Template	
Description of the methods	Generally consistent with SWE guidelines but with minor exceptions noted
Summary of findings	Generally consistent with SWE guidelines but with minor exceptions noted
Summary of conclusions	Findings, but no conclusions presented
Table of recommendations and EDC's response	Consistent with SWE guidelines
Consistency with the Evaluation Plan	
Process evaluation implemented the evaluation plan	Mostly, with exceptions noted

Elements Reviewed in the Annual Report	Findings
Evidence-based Recommendations	
Recommendations supported by findings and conclusions	Yes, but many recommendations were inferred from findings and not conclusions
Recommendations actionable	Yes
Use of NTG Common Method or Explanation for Alternate Method	
Availability of NTG data files and documents	Yes
NTG method used – the common method or another	Common method
NTG common method applied correctly	Mostly, with exceptions noted

9.4.4.1 Net-to-Gross Audit Results

This section documents the results of the SWE Team's NTG audits of PECO's programs in PY6, including a summary of the program-level NTG values that PECO's evaluation consultant reported. The results are provided for residential, low-income, and non-residential programs.

9.4.4.1.1 Residential Programs

Navigant estimated NTGR for Smart Home Rebates (SHR), Smart Appliance Recycling (SAR), and Smart Multifamily (SMF) Solutions programs and assumed NTGR to be 1.0 for the residential Smart A/C Saver (SACS) Program. (A NTGR of 1.0 implies that net savings equal gross savings.) One residential program (Smart Usage Profile, SUP) used a RCT design, which is the optimal approach for estimating net savings or impacts. For another residential program (Smart House Call, SHC), Navigant estimated spillover in PY6 and used the prior free-ridership estimation from PY5. For the remaining programs—Smart Energy Saver (SES) and Smart Builder Rebates (SBR)—Navigant did not estimate NTG impacts in PY6 because it either estimated or attempted to estimate NTGR in PY5 or plans to estimate NTGR in PY7.

For SES in particular, Navigant attempted to estimate NTGR in PY5; however, the low number of NTG survey responses (12) was not sufficient to develop a net savings estimate. Navigant's evaluation plan for SES indicates that there were no plans to estimate the NTGR in PY6 or PY7. Additionally, PECO plans to terminate this program at the end of Phase II. Since NTG is mainly used for planning purposes, the SWE Team concurs with Navigant's decision to not spend resources in PY7 to estimate NTG for SES. If the program is revived in the future, however, then the SWE Team suggests Navigant, at minimum, should use the NTG estimation of a similar program of a neighboring EDC such as PPL's Student and Parent Energy-Efficiency Education Program.

One of the residential programs with estimated NTGRs (SHR) had an upstream lighting and a downstream non-lighting program component. The other two programs with estimated NTGRs (SAR and SMF) were downstream programs solely. The SWE Team did not provide specific guidelines for upstream NTG estimates. Since the SWE requires only the common method for downstream programs, this section addresses only the reporting relevant to the common method for the downstream programs.

Although Navigant cited using the SWE Team's common approach for estimating NTGR, the PECO PY6 annual report and supporting memoranda lacked detailed descriptions of the common method. Assessment of Navigant's NTG Excel files confirmed that Navigant used the SWE Team's common approach for NTGR estimation, with one deviation. The SMF Solutions spillover calculation deviated from the common method. The SMF Solutions participant instrument included the "program influence" question that the common method uses, but also a counterfactual question (i.e., how likely is it that

participants would have installed a spillover measure if they had not participated in the program). The spillover method calculation computes spillover only for those measures that show high program influence *and* pass the counterfactual test, so it is more stringent than the common method.

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.

Table 9-15 provides a detailed summary of the SWE Team's review of the NTG activities by program.

Table 9-15: Summary of NTG Audit of PECO's Residential Programs

Program	NTG Method	Review Comments
Smart Home Rebates (SHR)	Common method for downstream non-lighting program component and alternative methods for upstream lighting program component	Navigant used the common approach for the non-lighting measures. The workbook contained free-ridership and spillover values and calculations. Calculations followed the SWE common method—except that for some measures, spillover was not calculated due to insufficient information or measures reported were not eligible (i.e., not efficient). Navigant used five NTG methods for upstream lighting program component. The SWE Team did not evaluate these approaches.
Smart Appliance Recycling (SAR)	Common method	Net savings for various appliance recycling counterfactual scenarios were estimated. The workbook contained net savings values and calculations.
Smart House Call (SHC)	No NTGR estimation in PY6; NTGR estimated in PY5	The common method was used to estimate NTG in PY5. There was no NTG estimation in PY6.
Smart Usage Profile (SUP)	Experimental design addresses NTG	This program used an RCT program design, which addressed NTG.
Smart Energy Saver (SES)	No NTGR estimation in PY6; NTGR estimated in PY5	NTG research was conducted in PY5. However, the low number of PY5 NTG survey responses (12) was not sufficient to develop net savings estimates. There is no need to attempt to estimate NTG in PY7 since this program is being terminated at the end of PY7 or Phase II.
Smart Builder Rebates (SBR)	No NTGR estimation in PY5 or PY6	Navigant will conduct an NTG evaluation in PY7.
Smart A/C Saver – Residential	NTGR assumed to be 1.0 in both PY5 and PY6	Navigant did not conduct NTG research to determine free-ridership for this program. Navigant assumed that none of the program participants would have curtailed load at the times PECO dispatched the program without the incentives the CSP paid to them for their load curtailment. This reasonable assumption also was stated in the evaluation plan.
Smart Multi-Family (SMF) Solutions Program	Common method	Navigant estimated free-ridership and spillover values and provided a workbook with calculations. Navigant used the common method for free-ridership estimation and a more stringent method than the common method for spillover estimation. Spillover relied on responses from "program influence" question that the common method uses and a counterfactual question (i.e., how likely is it that participants would have installed a spillover measure if they had not participated in the program). The spillover was calculated only

Program	NTG Method	Review Comments
		for those measures that show high program influence and pass the counterfactual test.

Table 9-16 summarizes NTG values from the PECO PY6 annual report. Among those programs for which NTGR was estimated and not assumed in PY6, SAR had the lowest NTGR and the SMF Solutions Program the highest.

Table 9-16: Summary of PECO NTG Estimates by Program

Approach	Program	Free-Ridership	Spillover	NTGR	Sample Size[a]
Estimated	Smart Home Rebates (SHR) – lighting measures[b]	Not reported	Not reported	0.42	602
	Smart Home Rebates (SHR) – non-lighting measures	0.71	0.08	0.37	200
	Smart Appliance Recycling (SAR)	0.65	N/A	0.35	100
	Smart Multi-Family (SMF) Solutions Program	0.25	0.00	0.75	44
Assumed	Smart A/C Saver – Residential	–	–	1.0	–

NOTES
[a] All samples provided at least 85/15 precision/confidence.
[b] Navigant used five approaches to estimate NTGR for upstream lighting SHR Program. Navigant recommended NTGR from only one of the five NTG approaches: the general population NTG survey. The SWE Team reports NTGR from the general population survey in this table.

9.4.4.1.2 Low-Income Residential Programs

Navigant assumed a NTGR of 1.0 for the Low-Income Energy Efficiency Program and did not estimate NTG for this program.

9.4.4.1.3 Non-Residential Programs

Navigant estimated a NTGR for SEI, SCI, and the commercial component of the SMF Solutions Program and assumed NTGR to be 1.0 for the commercial SACS. (A NTGR of 1.0 implies that net savings equal gross savings.) One commercial program (Smart On-site, SOS) had no participants in PY6. For the remaining program—Smart Business Solution (SBS)—Navigant did not estimate NTG impacts in PY6 because it estimated NTGR in PY5 and with the intention of using these results for PY6 and PY7.

The SWE Team found Navigant's description of the NTG methods to be detailed and clear except for the NTG method for SMF Solutions. Navigant cited using the SWE Team's common approach for estimating SMF Solutions NTGR; however, the PY6 annual report and supporting memoranda lacked detailed descriptions of the common method. 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 nearly all NTG Excel calculations were correct and followed the SWE Team's common method. The only deviation from the common method occurred when estimating the SMF Solutions program spillover. Navigant used a more stringent method than the common method for SMF Solutions spillover estimation.

Table 9-17 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 9-17: Summary of NTG Audit of PECO's Non-Residential Programs

Program	NTG Method	Review Comments
Smart Equipment Incentives (SEI) – C/I and GNI	Common method	Navigant used the common approach. The workbook contained free-ridership and spillover values and calculations. Calculations followed the SWE common method.
Smart Construction Incentives (SCI)	Common method	Navigant used the common approach. The workbook contained free-ridership and spillover values and calculations. Calculations followed the SWE common method.
Smart On-Site (SOS)	N/A	No projects completed in PY6.
Smart A/C Saver – Commercial	NTGR assumed to be 1.0 in both PY5 and PY6	Navigant did not conduct NTG research to determine free-ridership for this program. Navigant assumed that none of the program participants would have curtailed load at the times PECO dispatched the program without the incentives the CSP paid to them for their load curtailment. This reasonable assumption also was stated in the evaluation plan.
Smart Multi-Family (SMF) Solutions Program	Common method	Navigant estimated free-ridership and spillover values and provided a workbook with calculations. Navigant used the common method for free-ridership estimation and a more stringent method than the common method for spillover estimation. Spillover relied on responses from "program influence" question that the common method uses and a counterfactual question (i.e., how likely is it that participants would have installed a spillover measure if they had not participated in the program). The spillover was calculated only for those measures that show high program influence and pass the counterfactual test.
Smart Business Solutions (SBS)	No NTGR estimation in PY6; NTGR estimated in PY5	The common method was used to estimate the NTGR in PY5. There was no NTG estimation in PY6.

Table 9-18 shows the NTG values reported in the annual report. Among those programs for which NTGR was estimated and not assumed in PY6, the SEI-GNI Program had the lowest NTGR and the SMF Solutions Program the highest.

Table 9-18: Summary of PECO NTGR Estimates by Program

Approach	Program	Free-Ridership	Spillover	NTGR	Sample Size[a]
Estimated	Smart Equipment Incentives (SEI) – C/I	0.34	0.11	0.77	23
	Smart Equipment Incentives (SEI) – GNI	0.60	0.02	0.42	19
	Smart Construction Incentives (SCI)	0.48	0.00	0.52	19
	Smart Multi-Family (SMF) Solutions Program	0.17	0.00	0.83	40
Assumed	Smart A/C Saver – Commercial	–	–	1.0	–

Approach	Program	Free-Ridership	Spillover	NTGR	Sample Size[a]

[a] All samples provided at least 85/15 precision/confidence.

9.4.4.2 Process Evaluation Review Results

The SWE Team's audit included a review of the process evaluation methods, findings, conclusions, and recommendations in the PECO PY6 annual report and supporting documentation to determine whether it was consistent with the reporting template provided by the SWE Team. 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's review found that the evaluations appeared to be consistent with Navigant's Phase II evaluation plan, with some exceptions. The report generally provided a comprehensive overview of the process evaluation key findings and recommendations. Many recommendations were drawn 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. In the following subsections, the SWE Team summarizes the review of the process evaluation sections in the PECO PY6 annual report. Detailed summaries by program are in Appendix C.3.

9.4.4.2.1 Summary of Research Activities and Consistency with the Evaluation Plan

The process evaluation conducted by Navigant involved review of key program documentation; interviews with program staff, implementers, and program-affiliated market actors; and surveys with program participants and nonparticipants. The research issues addressed varied by program but generally included key aspects of program administration, implementation, and delivery and customer, contractor, or market-actor program satisfaction, engagement, challenges, and recommendations. Overall, the process evaluations appeared consistent with the evaluation plan.

9.4.4.2.2 Summary of Sampling Strategies

The SWE Team determined that the sampling approaches for the process evaluation activities were appropriate. The participant or nonparticipant surveys either attempted a census or used a simple or stratified random sampling approach. All survey samples had enough cases to achieve at least 85/15 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.

9.4.4.2.3 Report Elements and Clarity of the Reporting

The SWE Team deemed the reporting to be adequate, while identifying areas that could be improved:

- There was no detail associated with the SAR participant survey findings; the report included only a high-level summary of participant survey responses. For example, there were no statistics in the report or supporting documentation showing the percentage of participants who were satisfied with the program sign-up, appliance pickup, or any other aspect of the program.
- For the SHR, SES, SEI, and SCI programs, the report presented limited results from interviews with market actors and/or program and implementer staff.
- There were no references to the statistical test(s) used to evaluate the strength of differences reported between PY5 and PY6 SHR process results. Thus, it is difficult to know whether observed differences are real or noise.

As noted above, the evaluators provided key process evaluation findings in the PY6 annual report supplemented by a few process evaluation memoranda, submitted before the PY6 annual report. Between these documents, the report 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 other readers) to assess the methods, findings, conclusions (when present), and recommendations.

9.5 STATEWIDE EVALUATOR FINAL RECOMMENDATIONS

The SWE Team has the following recommendations for PECO's EE&C programs going forward.

1) Navigant followed the SWE's request from PY5 to design the SEI (C/I) sample to exceed 90/10 and included extra sites in the analysis. The SEI (C/I) Program had missed precision targets in previous years despite the evaluation contractor's attempts to improve the precision by using additional sample points and conservative Cv assumptions. The SWE recommends that a similar approach be used in future program years to ensure achievement of the required 85/15 confidence and precision targets.

2) The SWE Team recommends that PECO should get involved during the project planning cycle of the SEI program in order to have a greater influence in the type and amount of measures implemented. The SWE Team acknowledges that PECO is in the process of implementing this recommendation, which was originally made by PECO's evaluation contractor.

3) The SWE Team recommends that to minimize project delays in the SOS program, PECO should consider an incentive structure that reduces incentives steeply as the end of a phase approaches; offer customers a CHP system design incentive; develop a pool of pre-qualified CHP project developers; and identify opportunities to streamline the interconnection process (process which often results in project delays).

4) The SWE Team recommends including LEDs in the LEEP, in addition to CFLs, for Phase III. Including LEDs in the program plan will give the program staff the ability to adapt the program to the rapidly changing lighting market.

10 PPL ELECTRIC UTILITIES

This chapter summarizes PPL's program performance in PY6. It includes an overview of the cumulative energy savings and demand reductions achieved by PPL's Act 129 EE&C programs in Phase II through the end of PY6; 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.

10.1 SUMMARY OF ENERGY AND DEMAND REDUCTIONS

Table 10-1 provides an overview of PPL's cumulative reported gross (RG) and verified gross (VG) savings impacts, and carryover (CO) savings since the EE&C programs' inception through the end of PY6.

Table 10-1: Summary of PPL's Phase II Savings Impacts

Savings Impacts	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/yr)	Savings Achieved as % of 2016 Targets[i]
Total Energy Savings (MWh/yr)	399,440	417,068	495,636	912,704	821,072	111%
Total Demand Reduction (MW)	52.01	56.50	N/A	56.5	N/A	N/A
TRC Benefits ($1,000)[a]	N/A[g]	$296,243	N/A	$296,243	N/A	N/A
TRC Costs ($1,000)[b]	N/A[g]	$166,084	N/A	$166,084	N/A	N/A
TRC B/C Ratio[c]	N/A[g]	1.78	N/A	1.78	N/A	N/A
CO_2 Emissions Reduction (Tons)[d][e]	340,922	355,968	423,025	778,993	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 1,707 lb CO_2 per MWh according to the latest available (2014) PJM Emission Report of marginal off-peak annual CO_2 emission rate based on direction provided by Commission staff.
[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 Savings 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 Gross Savings 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.

As Table 10-1 shows, PPL achieved 111% of its Act 129 Phase II energy savings target by the end of PY6. The TRC B/C ratio (or TRC ratio) of PPL's programs through PY6 was 1.78, which indicates that PPL's portfolio of EE&C programs was cost-effective on an aggregated basis.

Table 10-2 lists PPL's EE&C programs. The list is divided into programs that yielded reported savings in PY6 and programs that did not.

Table 10-2: PPL EE&C Programs

Programs Reporting PY6 Gross Savings	Sector(s)
Appliance Recycling	Residential
Continuous Energy Improvement	GNI
Custom Incentive	C/I
E-Power Wise	Low-Income
Low-Income WRAP	Low-Income
Master Metered Multifamily Housing	GNI
Prescriptive Equipment	C/I
Residential Energy-Efficiency Behavior and Education	Residential
Residential Home Comfort	Residential
Residential Retail	Residential
Student & Parent Education	Residential
Programs to be Implemented or with No Reported PY6 Savings	
Low-Income Energy-Efficiency Behavior and Education	Low-Income
School Benchmarking	GNI

PPL reported PY6 gross energy and/or demand savings for 11 programs. Table 10-3 provides a breakdown of the contribution of the verified gross energy savings (MWh/yr) and gross demand savings (MW) for each program, and the contribution of each program's savings toward the total portfolio energy and demand savings. The Residential Retail Program accounts for 34% of the total Phase II verified gross energy savings in PPL's portfolio, making it the most impactful energy savings program in the residential sector. The Prescriptive Equipment Program accounts for 41% of the total Phase II verified gross savings in PPL's portfolio, making it the most impactful energy savings program in the non-residential sector. The Residential Energy-Efficiency Behavior and Education Program and the Custom Incentive Program each accounted for 7% of the verified gross savings. Collectively, the 11 programs yielded more than 417,000 MWh/yr of verified gross energy savings and more than 56 MW of verified gross demand savings for Phase II through PY6.

Table 10-3: Summary of PPL EE&C Program Impacts on Verified Gross Portfolio Savings

Program	Phase II VG Savings (MWh/yr)	% of Portfolio Phase II VG MWh/yr Savings	Phase II VG Savings (MW)	% of Portfolio Phase II VG MW Savings
Appliance Recycling	15,692	4%	3.15	6%
Continuous Energy Improvement	1,159	0%	0.72	1%
Custom Incentive	27,288	7%	3.05	5%
E-Power Wise	3,241	1%	0.55	1%

Program	Phase II VG Savings (MWh/yr)	% of Portfolio Phase II VG MWh/yr Savings	Phase II VG Savings (MW)	% of Portfolio Phase II VG MW Savings
Low-Income Energy-Efficiency Behavior and Education	0	0%	0	0%
Low-Income WRAP	7,335	2%	0.89	2%
Master Metered Multifamily Housing	3,586	1%	0.32	1%
Prescriptive Equipment	170,418	41%	27.58	49%
Residential Energy-Efficiency Behavior and Education	29,568	7%	0	0%
Residential Home Comfort	6,493	2%	2.74	5%
Residential Retail	141,777	34%	16.68	30%
School Benchmarking	0	0%	0	0%
Student & Parent Education	10,523	3%	0.81	1%
Total Portfolio	**417,081**	**100%**	**56.5**	**100%**

The NTG research yielded estimates of NTG ratios for the PPL programs. Table 10-4 provides the verified net savings alongside the verified gross savings for PY6 and Phase II. The portfolio-level NTG ratio for PY6 was 0.71. Section 10.4.4 provides findings and details on the SWE Team audit of the NTG research conducted for PPL programs.

Table 10-4: Summary of PPL EE&C Program Verified Net and Gross Savings by Sector

Sector	PY6 VG Savings (MWh/yr)	PY6 Verified Net Savings (MWh/yr)	Phase II VG Savings (MWh/yr)	Phase II Verified Net Savings (MWh/yr)
Residential	81,084	61,601	165,681	131,362
Low-Income	6,596	6,596	10,576	10,576
Large Commercial and Industrial	46,818	29,538	61,937	40,363
Small Commercial and Industrial	56,378	37,529	131,535	95,899
Government, nonprofit, and institutional	26,497	19,720	47,352	35,377
Total Portfolio	***217,360***	***154,972***	***417,068***	***313,564***

10.2 TOTAL RESOURCE COST TEST

Table 10-5 presents TRC NPV benefits, TRC NPV costs, present value of net benefits, and TRC ratio for PPL's PY6 individual programs and total portfolio. The SWE found no initial inconsistencies between the TRC model outputs and the TRC results shown in the PY6 Annual Report.

Table 10-5: Summary of PPL's PY6 TRC Factors and Results

Program	TRC NPV Benefits ($)	TRC NPV Costs ($)	Present Value of Net Benefits ($)	TRC Ratio
Appliance Recycling	$3,908,942	$1,109,211	$2,799,731	3.52
Residential EE Behavior and Education	$2,611,913	$1,251,010	$1,360,903	2.09
Residential Home Comfort	$4,245,076	$6,341,761	$(2,096,685)	0.67
Residential Retail	$54,596,305	$21,990,505	$32,605,800	2.48
Student and Parent Education	$4,871,833	$1,966,577	$2,905,256	2.48
E-Power Wise	$1,387,449	$376,220	$1,011,229	3.69
Low-Income EE Behavior and Education	-[a]	$869,791	$(869,791)	0.00
Low-Income WRAP	$4,742,520	$6,480,999	$(1,738,479)	0.73
Continuous Energy Improvement	$314,552	$444,524	$(129,973)	0.71
Custom Incentive	$15,307,854	$11,640,386	$3,667,468	1.32
Master Metered Multifamily Housing	$1,087,204	$726,887	$360,317	1.50
Prescriptive Equipment	$75,522,439	$47,058,608	$28,463,831	1.60
School Benchmarking[b]	-	$126,129	$(126,129)	0.00
Common Costs	-	*$10,248,184*	-	-
Total Portfolio	**$168,596,087**	**$110,630,791**	**$57,965,296**	**1.52**

[a] Savings will be claimed in PY7.
[b] 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 summary, 8 of PPL's 13 programs were found to be cost-effective, 3 were found to be non-cost-effective, and 2 claimed no savings and therefore a TRC ratio of 0. 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*
- *Residential Retail*
- *Student and Parent Education*
- *E-Power Wise*
- *Custom Incentive*
- *Master Metered Multifamily Housing*
- *Prescriptive Equipment*

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

- *Residential Home Comfort*
- *Low-Income Wrap*
- *Continuous Energy Improvement*

No Savings claimed
(TRC Ratio = 0)

- *Low-Income EE Behavior and Education*
- *School Benchmarking*

10.2.1 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 10-6. Inconsistencies were found in the energy LLF values applied in the TRC model workbook and those specified in the PPL PY6 annual report, specifically in the School Benchmarking and Student and Parent Education Programs. The SWE believes the values specified in the PY6 annual report to be incorrect, and has noted the energy LLF used by program in the PPL TRC model in Table 10-6. These inconsistencies do not materially impact the TRC calculations.

Table 10-6: PPL's PY6 Discount Rates and LLFs

Program	Sector	Discount Rate	Energy LLF	Demand LLF
Appliance Recycling	Residential	8.14%	8.33%[a]	8.33%[a]
Residential EE Behavior and Education	Residential	8.14%	8.33%	8.33%
Residential Home Comfort	Residential	8.14%	8.33%[a]	8.33%[a]
Residential Retail	Residential	8.14%	8.33%[a]	8.33%[a]
Student and Parent Education	Residential	8.14%	8.33%[b]	8.33%[b]
E-Power Wise	Residential	8.14%	8.33%	8.33%
Low-Income EE Behavior and Education	Residential	8.14%	8.33%	8.33%
Low-Income WRAP	Residential	8.14%	8.33%	8.33%
Continuous Energy Improvement	GNI	8.14%	6.23%	6.23%
Custom Incentive	C/I	8.14%	4.12%[b]	4.12%[b]
Master Metered Multifamily Housing	GNI	8.14%	6.23%	6.23%
Prescriptive Equipment	C/I	8.14%	8.33%[a]	8.33%[a]
School Benchmarking	GNI	8.14%	6.23%[b]	6.23%[b]

NOTES
[a]Program includes savings across multiple sectors. Additional sector LLFs may include commercial (8.33%), industrial (4.12%), and GNI (6.23%).
[b] 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.[44] 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 sourced from the SWE incremental cost database; the only exceptions were those measures that are not included in the SWE Team's database. 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 and controls were determined through an analysis of the project files. Appendix B in PPL's annual report provided detailed information about the incremental costs used for the non-included measures and the source of the incremental costs.

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. Further review found that the savings from two fuel-switching measures in the Residential Home Comfort Program were omitted from the TRC model. Although the discrepancy was 0.1% of the total TRC results, PPL provided the SWE with an updated TRC model and plans to prepare a memo that will update the affected tables in the PY6 annual report.

In PY6, the 2014 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 PY6. 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 2014 TRM.

10.2.2 Avoided Cost of Energy

PPL forecasts energy avoided costs for each hour of each year from 2015 through 2029 for each sector—residential, small commercial, large commercial, and GNI—in PY6. These hourly avoided energy costs are used in combination with a library of 8,760 load shapes to determine the annual avoided cost for each combination of end use and sector. Each measure in PPL's EE&C portfolio was assigned to the end-use load shape that is the most correlated with the affected equipment and the associated avoided cost value.

10.2.3 Avoided Cost of Capacity

PPL's TRC model assigned annual costs ($/kW-year) to the cost of generation capacity for each year from 2015 through 2029. The model multiplied these values by the gross demand savings of each measure to

[44] The SWE observed only one variance from the 2014 TRM. 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.

estimate the avoided cost of capacity. The details of the annual costs were listed in the database extracts that PPL provided to the SWE Team for review.

10.2.4 Conclusions and Recommendations

PPL's EE&C programs are designed to produce impacts across sectors. However, avoided-cost estimates, load profiles, and LLFs vary significantly among the residential, C/I, and GNI sectors. This variation was handled appropriately in the TRC calculation workbooks, and TRC ratios were calculated for each sector and for each program (across multiple sectors).

As noted above, the program totals for PY6 energy savings (gross verified) in the TRC model and the annual report did not match for the Residential Home Comfort Program. The difference between the TRC model and the annual report was 220 MWh/yr, or 0.1% of the PY6 portfolio savings. Although the magnitude of the omission is extremely small, PPL and Cadmus submitted a corrected TRC model to the SWE and plans to update the affected tables in the PY6 annual report in a subsequent memo.

10.3 STATUS OF EVALUATION ACTIVITIES

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

10.3.1 Status of Evaluation, Measurement, and Verification Plans

The SWE Phase II Evaluation Framework outlined the standardization of evaluation protocols across EDCs. The 2013 Evaluation Framework, which was finalized on June 28, 2013, required each EDC to complete an initial evaluation plan for each program in its portfolio to address several objectives (see Section 4.3.1 for a summary of these objectives). Table 10-7 displays key milestones completed during Phase II with respect to the PPL Phase II EM&V Plan. The SWE is presenting information on all revisions to this EM&V Plan that have occurred in PY5 and PY6 in order to provide a complete picture of the evolution of this plan during Phase II to date.

Table 10-7: 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 EM&V Plan to the PUC and SWE
January 31, 2014	SWE approves the revised PPL EM&V Plan
June 1, 2014	PY6 starts
May 27, 2015	PPL submits revisions to PPL PY6 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 have now been 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

PPL submitted 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 will 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 are no longer included as an evaluation activity for the E-Power Wise program.

4) Secondary research and calculation of demand savings (MW) impacts are 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 are no longer included as evaluation activities for the Residential Energy-Efficiency Behavior and Education Program.

6) The Residential Home Comfort Program no longer includes the trade ally training component and now includes 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 are no longer offered as an evaluation activity for the Student and Parent Energy-Efficiency Education Program.

8) Trade ally interviews are no longer an evaluation activity for the Custom Incentive Program.

10.3.2 Measurement and Verification Activities and Findings

PPL achieved 111% of its total Phase II energy savings compliance target, based on aggregated verified savings as of May 31, 2015 from Phase II in addition to Phase I carryover. Realization rates compare gross savings to the verified gross savings determined by the EDC evaluation contractor through M&V activities (refer to Section 4.3.2 for an overview of how realization rates are calculated and defined).

Table 10-8 provides a summary of M&V findings based on activities conducted by Cadmus. The summary is based on details provided in PPL's PY6 annual report and on information obtained from the SWE Team's data requests and audits. Table 10-8 presents realization rates and relative precision values for verified energy and demand savings for each of PPL's residential and non-residential EE programs for PY6.

Table 10-8: Realization Rates and Relative Precisions for PPL's Programs in PY6

Program	Energy Realization Rate	Relative Precision (Energy)[a]	Demand Realization Rate	Relative Precision (Demand)[a]
Appliance Recycling	95.0%	2.2%	97.0%	1.5%
Continuous Energy Improvement	83.4%	26.4%	425.4%	28.3%
Custom Incentive	94.5%	4.9%	94.6%	6.5%
E-Power Wise	73.8%	3.6%	98.0%	4.3%
Low-Income WRAP	99.2%	6.4%	99.1%	6.6%
Master Metered Multifamily Housing	101.5%	5.8%	91.1%	6.1%
Prescriptive Equipment	94.3%	2.4%	118.7%	6.1%
Residential Energy-Efficiency Behavior and Education	97.2%	7.5%	N/A	N/A
Residential Home Comfort	106.5%	1.3%	102.3%	1.2%
Residential Retail	97.1%	11.6%	%	98%
Low-Income Energy-Efficiency Behavior and Education	N/A	N/A	N/A	N/A
Student & Parent Education	80.3%	0.2%	47.8%	0.3%
School Benchmarking	N/A	N/A	N/A	N/A
Total	**95.0%**	**3.2%**	**107.2%**	**4.3%**

NOTES
[a] Relative precision values shown are at the 85% confidence level.

10.3.2.1 Residential Energy Efficiency Programs

Realization rates for PPL's residential programs' energy savings ranged from 73.8% to 106.5%. Realization rates for demand reductions from these programs ranged 47.8% to 102.3%. All residential programs met the relative precision requirement established in the Evaluation Framework.

During PY6, 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 2014 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. No on-site assessments were conducted for the impact evaluation of residential programs.

For PPL's Appliance Recycling program, Cadmus inspected a census of PY6 participant records to verify that all units (refrigerator, freezer, and room air conditioners) reported as recycled were consistently recorded in both the EDC tracking system and the implementer database. Cadmus also conducted a telephone survey with a sample of program participants (refrigerator and freezers only) to verify the quantity and types of units collected, as well as whether the units had been replaced. The PY6 phone surveys found minor differences between replacement rates in PY5 that had been used in the reported values and replacement rates reported by PY6 survey respondents. The per-unit verified gross savings were adjusted based on the PY6 replacement rates for recycled equipment. For recycled room air conditioner units, Cadmus made ex ante adjustments to the per-unit reported savings by mapping each zip code to the specified climate zone city specified in the 2014 TRM. Overall the program realization rates for energy and demand were 95% and 97%, 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 PY6, there were three treatment groups, each receiving monthly reports for a different length of time. The evaluation methodology is based on IPMVP Option C or annual energy and demand reduction and employs a regression of customer average daily electricity consumption using a statistical approach detailed by Allcott and Rogers.[45] PPL reports PY6 program net savings of 29,568 MWh/yr attributed to 152,068 participating homes, or an overall average savings of 194 kWh per home. Overall the verified savings were slightly lower than the reported energy savings, resulting in a realization rate of 97%. 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 the EDC tracking system and the input parameters necessary to calculate savings using the 2014 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 eight strata. The evaluator targeted a census review of pool pumps, fuel-switching equipment, new homes and manufactured homes. A records review of a sample of program participants, typically 10 projects per stratum per quarter, was reviewed for the audit stratum, the air source heat pump stratum, the ductless heat pump stratum, and the weatherization stratum. The energy realization rates in the eight strata ranged from 100% to 403%, with the overall program realization rate for energy being 106%. The demand realization rates ranged from 100% to 288% across the strata, resulting in an overall program realization rate for demand of 102.3%.

PPL's Residential Retail program offers upstream incentives for energy efficient lighting and rebates for energy efficient equipment sold through retailers. In PY6, PPL no longer offered midstream incentives for efficient televisions as part of the Residential Retail program and also eliminated free smart strips to end-use customers once the PY5 inventory was depleted. For rebated energy efficient equipment, Cadmus looked up specific model numbers for rebated equipment and verified that the appropriate 2014 PA TRM deemed values or algorithms had been used in order to develop ex ante savings adjustments. Cadmus

[45] 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.

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. Cadmus found and corrected minor inconsistencies or errors in bulb pack quantities.

A cross-sector sales adjustment was made to account for bulbs that were installed in commercial facilities. Although Cadmus conducted a cross-sector sales study during PY6, the resulting point estimate's confidence interval (20% ±9%) was observed to overlap with the cross-sector sales estimate used in PY4 and PY5. As a result, Cadmus and PPL opted to continue to use the previous cross-sector sales estimate (12%) in PY6. Overall the energy realization rate for the upstream lighting component and the Residential Retail program as a whole was 97%. The demand realization rate was 98% for the upstream lighting component and the program as a whole.

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, and a review of phone, email, and Internet survey results to verify installation rates and TRM open variables. Reported savings first were adjusted to align program planning assumptions with 2014 PA TRM values, and survey data were used to adjust equipment ISRs and installation quantities in order to calculate verified energy and demand savings.

10.3.2.2 Low-Income Energy Efficiency Programs

PPL offered two low-income programs during PY6: the E-Power Wise Program and the Residential WRAP. A third low-income program, the Low-Income EE Behavior and Education Program, launched in late PY6 but has no reported savings and will be evaluated in PY7.

PPL's E-Power Wise Program provides low-income customers with energy efficiency measures in free take-home and direct-mail energy efficiency kits and educates homeowners regarding behaviorally based activities that could reduce energy use. Cadmus conducted a census review of the EDC tracking system to verify that kit component savings were calculated consistently with the 2014 PA TRM. Each kit distributed included a participant survey designed to collect the necessary data to calculate installation rates and to determine participant actions taken as a result of the program. Program participants returned a total of 605 surveys (approximately 17% of participants). The kit item and energy education savings were modified to reflect the installation rates determined through the participants' returned surveys. The program realization rates were found to be 74% for energy and 98% for demand. The demand realization rate is closer to 100% than the energy realization rate because of PY6 calculation adjustments for the energy education savings custom measure protocol algorithms.

In PY6, PPL's WRAP included three types of services: (1) baseload jobs that addressed customers without electric heat or water heating; (2) low-cost jobs that included customers without electric heat but with electric water heaters; and (3) full-cost jobs that addressed customers with electric heat and electric water heating. In addition, customers with electric water heating received heat pump water heaters (HPWHs) where suitable. For baseline, low-cost, and full-cost jobs, Cadmus conducted a customer billing analysis of prior-year WRAP participants, using a monthly fixed-effects model to calculate and verify savings. This analysis estimated annual savings, varying by job type and installation year, from 911 kWh to 1,776 kWh. PPL applied the PY6 savings per job prospectively, so the reported gross savings, adjusted ex ante, and

verified gross savings were the same. Reported savings for HPWHs were verified against the 2013 or 2014 PA TRM, depending on the installation time frame. Cadmus also conducted a record review of 218 (out of 296) HPWH units with differences in observed tank sizes and installed energy factors resulting in verified savings approximately 2% higher than the adjusted ex ante energy savings. The overall energy and demand realization rates for the WRAP were 99%.

10.3.2.3 Non-Residential Energy Efficiency Programs

Realization rates for PPL's C/I program energy savings ranged from 83% to 101%. Realization rates for demand reductions from these programs ranged from 91% to 425%. Relative precisions for these programs ranged from 2.4% to 26.4% for energy savings and from 6.1% to 28.3% for demand reduction at the 85% confidence level. The 425% demand value is from the Continuous Energy Improvement (CEI) Program, which is a pilot program and is reporting savings for the first time in PY6. This program is also responsible for the 26.4% energy realization rate and the 28.3% demand realization rate, but there were limitations with the evaluation sample, which are further discussed in Appendix A. Outside this pilot program, all of PPL's programs achieved the 15% precision requirement for kWh. They also achieved better than 15% precision for demand savings, although this is not a requirement for Phase II.

Figure 10-1 displays the frequency of each M&V approach performed by Cadmus in PY6 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. IPMVP Option D involves modeling energy performance of a facility before and after the efficiency measure is installed.

Figure 10-1: Frequency and Associated Savings of M&V Approaches for Custom Program

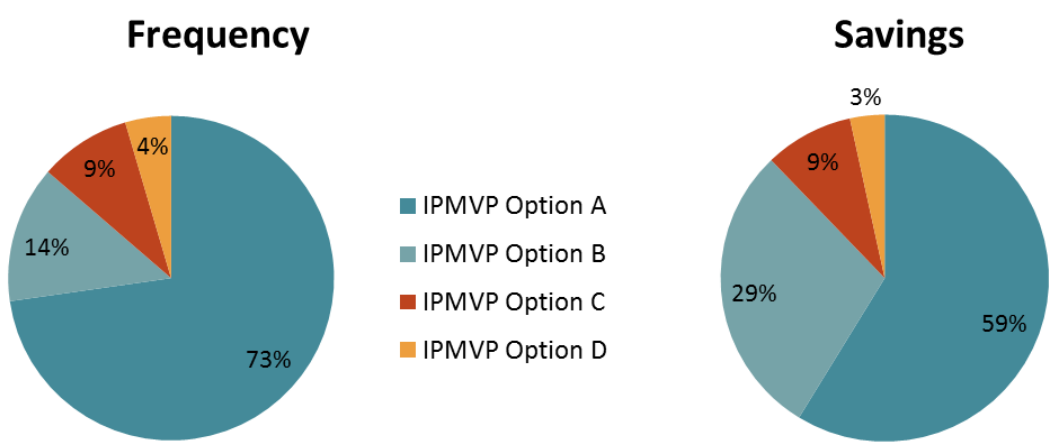


Figure 10-1 indicates that Cadmus used IPMVP Option A for 73% of the projects selected for sampling. However, these projects accounted for 59% of the sample's energy savings. Option B was used for only 14% of projects, but they accounted for 29% of the savings. Options C and D were only used on 9% and 4% of projects, respectively, and these projects accounted for similar proportions of the program's savings.

During PY6, 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. These plans specified program objectives, data collection methods, impact evaluation approaches, and reporting deliverables. The MMMF and Prescriptive Equipment Non-Lighting programs used only a basic level of rigor in their evaluation efforts; they used desk reviews or simple verification methods for their entire samples. The Prescriptive Equipment Lighting Program used site visits or desk reviews for approximately 13% of the total savings, while a vast majority (87%) used IPMVP Option A. Included in the Option A group were all projects with energy savings greater than 500,000 kWh/yr, in compliance with the requirement for PY6. The CEI Program used IPMVP Option C for its entire evaluation sample.

10.3.3 Process Evaluation Activities and Findings

The process evaluation that Cadmus conducted included a review of key program documents and databases; benchmarking and literature reviews; process map development; interviews with EDC staff, a third-party implementer, and program-affiliated market actors; and surveys of program participants, partial participants, and nonparticipants. Not every evaluation included all of these elements. Table 10-9 provides a high-level summary of the data sources Cadmus used and its key findings for each program.

Table 10-9: Summary of Key Findings and Data Sources – PPL

Program	Key Findings	Data Sources
Residential		
Appliance Recycling Program (ARP)	– The program did not achieve its savings and participation goals; there was a 32% drop in the number of appliance units recycled in PY6. This is attributed to a scaled-back approach to marketing which may have yielded fewer customer touches and ultimately fewer customers participating in the program. – Demographic data from the participant surveys suggest that a sizeable proportion of participants may be parents with children who have recently gone off to college.	– Participant and nonparticipant surveys – Interviews with program staff – Secondary research
Residential Energy-Efficiency Behavior & Education Program	– Program exceeded its PY6 planned savings. – For 12 of the 13 energy savings improvements or behaviors investigated with the surveys, no significant differences existed between treatment and control group respondents. – The HERs indicated gradual influence over time in customers' decision to make energy savings improvements. – HERs provided a small uplift in participation in other PPL programs. – The paper HERs showed higher customer engagement than the email reports.	– Participant surveys (treatment group and control group) – Program staff interviews – Program database review – Uplift analysis – Double counting analysis
Residential Home Comfort Program	– Overall, program is meeting goals for energy savings and demand reductions. – The cost of an audit is a barrier to participation for some customers. – Ductless heat pumps are popular with customers, with a majority opting for SEER 18 or higher. – The limited time offer of increased rebate for air source heat pumps was very successful in increasing installation of systems with an efficiency rating of SEER 16 or higher. – The manufactured home component is struggling to generate interest.	– Participant surveys – Program staff and implementer interviews – Trade ally interviews – Program database review – Secondary research

Program	Key Findings	Data Sources
	– Builders need more rebate options and continuing education to support the new construction component.	
Residential Retail Program (Residential Lighting and Efficient Equipment)	– PY6 rebate-processing times have not improved over PY5. Participant reporting of processing times was sometimes inconsistent with tracking data for receipt and invoice dates. The Implementation Conservation Services Provider (ICSP) replaced its rebate processing contractor in PY7 and will monitor processing times. – General population surveys indicate potential for increased adoption of LEDs by residential customers. Conversely, more small business customers are purchasing LEDs, and fewer appear to be purchasing halogen or incandescent bulbs. – Customers are still sensitive to LED price. Most customers indicated a willingness to pay $5–$7 for an LED. – CFL disposal behavior remains relatively unchanged from prior years, with over half of customers disposing of CFLs in the trash, in spite of more recycling bins in diverse locations.	– Program staff and implementer interviews – Participant surveys – General population customer surveys (residential and small business) – Cross-participant surveys – Interviews with licensed plumbers or contractors and lighting manufacturers
Low-Income		
Low-Income Winter Relief Assistance Program (WRAP)	– Overall, the program offers a comprehensive and customized weatherization service to its low-income customers. – Customers are satisfied with the program and are acting on energy savings strategies recommended by the program's energy educators. – As both WRAP and PPL's Universal Service Program (part of the state's package of low-income programs) continue to run in tandem, it will take increased initiative, creativity, and teamwork to identify and reach the remaining income-eligible population and maintain current participation levels. – The new tracking system provides improved data collection and program tracking.	– Interviews with program staff – Participant surveys – Program database review – WRAP intake form review
Student & Parent Energy-Efficiency Education Program	– The program exceeded its PY6 savings and participation goals but did not reach its planned demand savings. The program ran very smoothly in PY6, with no reported issues in delivery. – The ICSP's targeted marketing and personalized outreach efforts increased program awareness and helped increase participation. – Lower installation rates for water products were observed than for lighting products. The benchmarking study investigated this finding and found that partnering with another utility in the same region to reach customers who were serviced by two different utilities may increase installation rates for water products. – The PY6 program did not meet its KPI for workshop and classroom participation as measured by the number of Home Energy Worksheets (HEWs) returned. Respondents suggested reducing the paperwork involved with the HEWs or switching to an online survey.	– Program staff and implementer interview – Participant surveys (teacher, parent) – Student HEWs – Benchmarking research – Program database review – Records review

Program	Key Findings	Data Sources
Master Metered Low-Income Multifamily Housing (MMMF) Program	– Overall, the program is working smoothly and customers are satisfied with the quality of the work performed by the ICSP and the equipment. – Respondents reported low levels of satisfaction with the program's water-saving measures. – Cadmus cannot conclude if dissatisfaction is tied to the showerheads or restriction valves (or both). A future survey in PY7 will investigate this issue.	– Program staff and implementer interviews – Leave-behind tenant surveys – Participant surveys – Database review – QA/QC review of records
E-Power Wise Program	– The ICSP and PPL continue to provide a well-managed program. – Installation rates for water-saving devices continue to struggle. – Agency staff who interact with low-income populations may not have a clear understanding of program offerings available. – Some agencies expressed concerns about the saturation of energy savings kits. – Confusion about how to use the furnace whistle and incompatible heating types has resulted in low installation rates.	– Participant surveys – Interviews with implementer and program staff – Agency interviews – Program database review – Secondary research
Non-Residential		
Continuous Energy Improvement (CEI) Program	– The program was highly influential in participants' decision-making. – Energy managers at each school district, the ICSP, and PPL program management staff reported high satisfaction with the program. – The ICSP had been very successful in engaging energy managers from each participating school district by creating a dynamic and motivating environment in which energy managers learn from each other and improve operations in their own school districts. – Survey participants reported that some improvements could be made to engage the school communities in each school district. – In some cases, teachers and staff had little influence on the decision to participate in the program. The decision was made at the superintendent level. – Some school districts had difficulties involving students due to schedule conflicts, part-time students, teacher involvement, and challenges with communicating to elementary school students about energy efficiency. – School districts would have participated in the program without the incentive. Two of the eight respondents (25%) said they would be very likely and four (50%) said they would be somewhat likely to participate in the program even without an incentive because they found the technical assistance provided by the program to be valuable.	– Interviews with program and implementer staff – Participant surveys – Database and QA/QC review of records
Custom Incentive Program	– Achieving 80% customer satisfaction is a KPI. In PY6, 75% of participants reported they were satisfied. Generally, respondents were satisfied with the program, but there	– Participant surveys – Partial participant surveys

Program	Key Findings	Data Sources
	were some challenges regarding responsiveness and program timelines. – Customers have difficulty determining if a project will qualify for the program during the application process. This may be limiting participation. – Final energy and cost calculations can be challenging for customers. The need to hire a third party to supply data for calculations added costs, and created more delay on finalizing the project, and therefore delayed rebate processing for some customers.	– Interviews with program and implementer staff – Consulting firm interviews – Database and QA/QC review of records
School Benchmarking Program	– The program is working as planned. – Cadmus and PPL decided not to plan further evaluation activities because the program has not contributed any energy savings to the portfolio.	– Program staff and implementer interviews – Participant surveys – Program literature review and benchmarking – Process map development
Prescriptive Equipment Program	– The program is operating well and is on track to meet its planned energy savings goal – The pre-approval process has had both positive and negative impacts on the program. – Satisfaction with some aspects of the rebate application process is lower than in previous program years. The percentage of respondents who were very satisfied with the amount of time it took to receive the rebate after submitting the application fell from 72% in PY5 to 44% in PY6. This change in satisfaction is likely due to the introduction of the pre-application process in PY6. – According to contractor feedback, changes in consumer attitudes have increased emphasis on energy efficiency as part of contractor promotional strategies, and the boost in sales of energy efficient technologies can be attributed to the Prescriptive Equipment Program. – Participation rates for equipment, including HVAC equipment, has been lower than expected. – Responses from HVAC contractors indicated that PPL's commercial HVAC rebate program is not sufficiently engaging contractors. Although some respondents were familiar with the residential HVAC offerings, most were unaware of the commercial incentives and had not worked with customers through the Prescriptive Equipment Program. – Widespread contractor interest in a direct discount program for equipment is not likely. Although some respondents were open to this type of design, others were skeptical because of the burden of additional risk.	– Program staff and implementer interviews – Participant surveys – Contractor interviews – Distributor interviews – HVAC contractor focus groups – Database and QA/QC review of records

10.4 STATEWIDE EVALUATOR AUDIT ACTIVITIES AND FINDINGS

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

10.4.1 Residential Program Audit Summary

10.4.1.1 Appliance Recycling

In PY6, the PPL appliance recycling program includes rebates for room air conditioners, refrigerators, and freezers. For Room AC retirement, the SWE confirmed the accuracy of the ex ante savings adjustments and the weighted average calculation. For refrigerators and freezers in PPL's appliance recycling program, Cadmus used telephone survey verification to determine whether recycled equipment had been fully retired, replaced with a standard efficiency unit, or replace with an ENERGY STAR unit. The SWE reviewed the results of the telephone survey verification effort on the sample of program participants and confirmed the correct assignment of unit savings consistent with the 2014 PA TRM.

The SWE Team found no reportable errors and agrees with PPL's verified gross savings findings for the Appliance Recycling Program.

10.4.1.2 Residential EE Behavior and Education

In PPL's EM&V plan for PY6, Cadmus indicated it would use a DID approach to estimate program impacts, consistent with the IPMV Option C. Such an analysis would include use of an LFER modeling approach. However, the reported savings are based on a methodology employed by Allcott and Rogers,[46] 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. Cadmus concluded that the Allcott and Rogers method is appropriate for analysis of the HER behavioral programs because the programs have been in place for six years, and the fixed effects coefficient does a poorer job of accounting for changes in household consumption over a longer time series than does the Allcott and Rogers method. Furthermore, Cadmus indicated that the Allcott and Rogers approach produced savings estimates for PY2–PY4 that were more consistent with saving estimates in each planning year's evaluations than the DID method. Cadmus also ran DID models for each of the program groups and provided those models to the SWE. The SWE determined that the Allcott and Rogers approach provided reasonable estimate of program savings. The DID modeling approach provided a different savings estimate than the reported savings from the Allcott and Rogers methodology, but the estimate was within the reported 90% confidence interval for total program energy savings reported by PPL. The SWE agrees with the rationale that the Allcott and Rogers methodology better accounts for changes in household consumption over time than does the DID approach. The SWE recommends PPL and Cadmus revise their EM&V plan to include use of the Allcott and Rogers approach if they intend to continue use of this methodology for PY7.

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 very small, a total of 0.04% of measured energy savings, or a total of 13 MWh/yr. To account for double counting, PPL subtracted the estimated double counted savings from PPL's portfolio savings.

[46] 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.

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.

10.4.1.3 Residential Home Comfort

The SWE Team reviewed each of the eight strata of the RHC Program (Audits, Weatherization, Air-Source Heat Pumps (ASHP), Ductless Heat Pumps (DHP), Fuel-Switching, Pool Pumps, New Homes, and Manufactured Homes) to verify saving in PY6. Approximately 86% of the verified energy savings, and 97% of the verified demand savings, occur in the Audit, Weatherization, ASHP and DHP strata.

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 2014 TRM. The SWE did note and confer with Cadmus regarding a small calculation error in the verified sample of the PY6Q1 weatherization projects. Cadmus and the SWE jointly determined that the error was sufficiently small, and that a correction to the error would not change the final stratum and program verified energy and demand savings.

Based on its review of Cadmus's records, the SWE Team confirmed that the reported savings of the Residential Home Comfort Program were appropriately adjusted, and that the verified gross energy and demand savings calculations were reasonable and accurate.

10.4.1.4 Residential Retail

For the rebated equipment subsection of the Residential Retail 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 PA TRM deemed savings values or savings algorithm calculations. The SWE Team also verified a small sub-sample (n=10) 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. The SWE does note that a significant portion of equipment savings are the result of lagged transactions from PY5, with the lag as large as a full calendar year. More than two-thirds of refrigerators and one-third of HPWH PY6 savings come from equipment installed during PY5.

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 2014 TRM.[47] Cadmus performed a complete audit using a routine very similar to the one the SWE Team follows for the annual-based 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. Because Cadmus already had reviewed the complete database, the SWE Team selected a small sub-sample of the tracking system records to confirm that the baseline wattage and efficient wattage had been assigned properly. Furthermore, the SWE Team mirrored Cadmus' review of multi-pack quantity counts, and verified a sub-sample of bulb packs to ensure accurate accounting.

[47] Approximately 10% of bulbs were invoiced during PY6 but purchased during PY5. Savings from bulbs purchased in PY5 were calculated using the 2013 PA TRM. This approach is consistent with guidance found in the Evaluation Framework.

Last, the SWE reviewed the evaluator's PY6 cross-sector sales study, including the calculation of average non-residential hours of use (HOU) and coincidence factors. The PY6 cross-sector sales study estimated 20% of residential bulbs were being installed in non-residential socket. However, given a relatively wide confidence range and the associated effect on program savings, PPL opted to continue to use the more conservative estimate of 12% from its PY4 cross-sector sales analysis. The SWE believes this approach to estimating cross-sector sales to be reasonable.

Based on the review described above, the SWE Team agrees with PPL's verified gross savings findings for the Residential Retail Program.

10.4.1.5 Student and Parent Education

The Student and Parent Energy Efficiency Education Program provides school-based EE education and take-home EE kits that include low-cost items to install at home. The program includes five unique delivery components. 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/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 in-service rates (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.

10.4.2 Low-Income Program Audit Summary

10.4.2.1 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 2014 TRM algorithms by applying in-service rates determined through surveys of program participants. The SWE Team reproduced Cadmus's per-measure calculations using these in-service rates, reviewed the calculation of behaviorally based savings, and verified that the energy and demand savings reported in PPL's PY6 Annual Report were accurate.

10.4.2.2 Low-Income EE Behavior and Education

No savings were reported to the Low-Income EE Behavior and Education Program, as it was launched late in PY6. The program evaluation will occur in PY7.

10.4.2.3 Low-Income WRAP

The program evaluation for the PY6 WRAP included a billing analysis of participating customers with a monthly fixed-effects model. The billing analysis was conducted on participants from Phase I PY3 and PY4 for the period of January 2009 through February 2014. From these models, savings estimates for three different job types were produced to apply to PY6 program participants: baseload, low-cost, and full-cost jobs. 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 models similar to the Princeton Scorekeeping Method (PRISM) to evaluate the robustness of the savings estimates. 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.

The SWE Team also reviewed evaluation data to determine if PPL complied with the requirement that the number of conservation measures offered to low-income households was proportionate to those households' share of the total energy usage in PPL's service territory. PPL greatly exceeded their target for proportionate number of measures offered at no cost to low-income customers with 54%. The SWE review found that several of the low-income specific measures are neither in the TRM nor have any electric savings associated with them. Examples include: Attic Eve Chutes, Baseboard Replacement Repair, CO_2 Detector, Drill Masonry for Dryer Vent, Install Reg. T-Stat, Plumbing Repairs, and Water Heater Relief Valve. If these types of measures are excluded from the count PPL would still attain a percentage of over 40%, well in excess of their target.

The SWE also notes that the PY5 and PY6 have incorrectly specified the low-income proportionate measure target as 8.6%. The SWE confirmed that his target is out-of-date and that the Phase II target consistent with the Phase II EE&C Plan is 9.95%. Although the SWE recommends that PPL update their low-income target in the PY7 report, the number of low-income specific measures in the PPL portfolio well exceeds the revised target of 9.95%.

10.4.3 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. In general, data from the project files were consistent with PPL's tracking database, and project documents were complete. Specific examples of deficiencies noted in the project file review are explored in Appendix A.7.1. Based on the deficiencies documented, the SWE Team provides the following recommendations to ensure the accuracy of the reported savings presented in upcoming program years:

1) If site-specific HOU is used, then site-specific CF must also be used to determine kW savings.

2) Finalized invoices of purchased equipment should be included in PPL's project files.

The SWE Team reviewed tracking data and quarterly reports upon their submission to ensure consistency across tracking and reporting documents. The SWE Team found variances in the reported participation counts and incentive amounts. Further detail is provided in Appendix A.7.2.

The SWE Team reviewed PPL's PY6 sample design to ensure its compliance with the Evaluation Framework. The results are displayed in Table 10-10, showing relative precision at the 85% confidence level (CL).

Table 10-10: Compliance across Sample Designs for PPL's PY6 Non-Residential Programs

Program	Relative Precision at 85% CL for Energy	Relative Precision at 85% CL for Demand	Compliance with Evaluation Framework
Custom Incentive	5.0%	7.0%	✓
Master Metered Low-Income Multifamily Housing	5.8%	6.1%	✓
Prescriptive Equipment	2.4%	6.1%	✓
Prescriptive Equipment (GNI Contribution)	8.2%	16.6%	✓
Continuous Energy Improvement	29%	425%	✗

The goal of 15% precision at the 85% confidence level for energy was reached for all non-residential program groups except Continuous Energy Improvement. This program was new in Phase II and no savings were reported in PY5, so this is the first year that savings were reported. The main factors influencing precision of a billing analysis, which was used for this program, are model specification and sample size, both of which were constrained in this first pilot run. The evaluator expects this to improve in future program years. Details about each program evaluation sample are provided in Appendix A.7.3.

As part of the audit process, the SWE Team performed 10 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, compressed air system upgrades, and VFD projects. The SWE Team made recommendations on two of the site visits, and these were considered to be minor evaluation issues. PPL submitted revised analyses for all applicable projects, and the verified savings are accurate. Details of all 10 projects and their associated findings are presented in Appendix A.7.4.

The SWE Team performed a verified savings analysis on seven submitted projects, checking the accuracy of the calculations, the appropriateness of the evaluation method, and the 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. The results of the verified savings analysis are explored in Appendix A.7.5.

10.4.4 Net-to-Gross and Process Evaluation Audit Summary

Table 10-11 presents a high-level summary of the results of the SWE Team's audit of Cadmus's NTG assessment and process evaluation of the PPL programs. The following subsections present detailed discussions and a summary of the findings, starting with the audit of NTG reporting and related files, followed by findings based on the review of process reports and supporting documents. Appendix C.4 provides detailed program-specific reviews of the process evaluation activities.

Table 10-11: Summary of SWE Team's Review of PPL Process and NTG Evaluations

Elements Reviewed in the Annual Report	Findings
Inclusion of Required Elements per Report Template	
Description of the methods	Consistent with SWE guidelines
Summary of findings	Consistent with SWE guidelines
Summary of conclusions	Consistent with SWE guidelines
Table of recommendations and EDC's response	Consistent with SWE guidelines
Consistency with the Evaluation Plan	
Process evaluation implemented the evaluation plan	Yes
Evidence-based Recommendations	
Recommendations supported by findings and conclusions	Mostly, with exceptions noted
Recommendations actionable	Yes
Use of NTG Common Method or Explanation for Alternate Method	
Availability of NTG data files and documents	Mostly, 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 (where possible to verify)

10.4.4.1 Net-to-Gross Audit Results

This section documents the results of the SWE Team's NTG audits of PPL programs in PY6. The results are provided for residential, low-income, and non-residential programs.

10.4.4.1.1 Residential Programs

Cadmus estimated NTG for two residential programs: the Residential Retail Program and the Appliance Recycling Program (ARP). Cadmus did not do NTG research for three other programs. For the Residential Home Comfort Program, Cadmus reported the PY5 NTG values, citing no significant changes to program components and no changes to rebates since PY5, no expected changes in the participant population, and the program's relatively low contribution to the total portfolio. Cadmus 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. Finally, Cadmus noted that the impact evaluation for the Residential Energy-Efficiency Behavior & Education Program produces net savings, 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 PY6 annual report and showed calculations in corresponding Excel workbooks for each program.

Cadmus used the common method for downstream program components. While the provided Excel workbooks demonstrate proper and error-free use of the common method, and the description of the common method for Appliance Recycling was detailed, the SWE Team found the description of the downstream NTG methods to be largely unclear and prefers a full description of the NTG method, like

that which Cadmus included in its EM&V Plan. In the PY6 Annual Report, Cadmus provided a high-level summary of the NTG methods, stating it followed the SWE's "Common Approach for Measuring Net Savings for Appliance Retirement Programs" and summarized the four major factors in the net savings analysis: freeridership, 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 several data limitations of the demand elasticity approach, Cadmus suggested that the demand elasticity model's NTGR of 52% is an underestimate and suggests that 75% may be a more accurate estimate., These limitations included the lack of a spillover estimate, the fact that the demand elasticity model produced a higher free-ridership estimate for LEDs (a relatively new technology) than it did the previous year for CFLs, and a reported preponderance of evidence from process evaluation research that PPL's upstream lighting incentives are increasing the rate of LED adoption.

The SWE Team acknowledges that, for the reasons given, the demand elasticity model may have underestimated NTGR. However, Cadmus does not present sufficient evidence to support an estimate of 75%, which is shown in Table 3-11 of the annual report as an "adjusted" value. While the report cites several sources of data that Cadmus believes support the 75% estimate, the report does not show calculations or otherwise describe how those sources of data provide the 75% estimate. Therefore, the SWE Team suggests that it would have been more accurate to report the NTGR as "at least 52%." The SWE Team further suggests that future reports should provide more details to support such alternative NTGR values.

A summary table in the PPL PY6 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. In response to the draft of this report, Cadmus clarified that the program-level NTGR is a savings-weighted average, which Cadmus will note in future reports. The SWE Team is satisfied with that explanation.

Although residential and nonresidential customers can participate in ARP, Cadmus did not estimate sector-specific NTGR for this program, since most participants were in the residential sector. The survey instrument used and methods reported indicate that Cadmus used the common method Cadmus reported average spillover kWh of 18 per-unit for freezers and 20 per-unit for refrigerators. This was applied to the net savings estimates shown in Table 5-11 in PPL's PY6 Annual Report. Cadmus reports two different NTGR values in its annual report: while the summary table in the report's overview section shows NTGR as .87 NTGR, the ARP-specific report section shows NTGR as .60. Subsequent discussions with Cadmus staff clarified that net savings was the numerator for both two ratios, but they used different denominators. The SWE Team will consider the two approaches and identify a preferred approach.

The SWE Team did not question Cadmus's assumption of a NTGR of 1.0 for the Student and Parent Energy-Efficiency Education Program in its PY5 annual report. However, the SWE Team does disagree 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 did not state that in the PY5 annual report, but is commenting now and anticipates that PPL and its evaluation consultant will review all assumptions about NTG in future studies.

Table 10-12 provides a detailed summary of the SWE Team's review of the NTG activities by program.

Table 10-12: 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 free-ridership 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. Cadmus provided evidence that the demand elasticity model underestimated NTGR for upstream lighting but did not detail the methods used to calculate its alternative estimate.
Appliance Recycling Program (ARP)	The common method was used.	Cadmus estimated a single NTGR value for residential and nonresidential ARP participants, as most participants were in the residential sector. Cadmus reported using the SWE common NTG method for Appliance Recycling, but the backup workbooks did not provide the data needed to confirm the method or the reported NTGR value. Cadmus reports alternative NTGR values of .87 and .60, using different denominators. The SWE Team will consider the two approaches and identify a preferred approach.
Student and Parent Energy-Efficiency Education Program	NTGR was assumed to be 1.0.	Cadmus assumed no free-ridership or spillover for this program. The SWE Team disagrees with this assumption but allows it for PY6.
Residential Home Comfort Program	Not calculated: used PY5 values.	Because of low response rates for new program components and the assumption that previously existing program components did not experience changes in NTGR, Cadmus used the PY5 NTGR for the PY6 NTGR. The SWE Team agrees with this decision.
Residential Energy-Efficiency Behavior & Education Program	NTGR was assumed to be 1.0.	Cadmus reported that no net savings calculations were needed for this program, as the impact evaluation estimates net savings, which inherently capture free-ridership and spillover.

Table 10-13 summarizes the free-ridership, spillover, and NTGR estimates reported in PPL's PY6 annual report for residential programs.

Table 10-13: Summary of NTG Estimates for PPL's Residential Programs

Approach	Program	Free-Ridership	Spillover	NTGR	Sample Size[a]
Estimated	Residential Retail Program[b]	0.48	0.0	0.52	150
	Appliance Recycling Program (ARP)[c]	–	0.2	0.6 or 0.87 [c]	140
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	0.0	0.0	1.0	N/A
Referenced from PY5	Residential Home Comfort Program	0.46	0.06	0.6	N/A
NOTES					

[a] The samples provided at least 85/15 precision/confidence.
[b] Program-level NTGR combines downstream and upstream NTG values. Downstream NTGR was estimated from surveys with 150 participants. Upstream NTGR was estimated using sales data.
[c] The PPL annual report shows two NTGR values in two separate parts of the report. Both ratios reflect the same net savings; they differ in how the denominator was calculated. The SWE Team does not suggest that one of the two NTGR values is the accurate one but will work with PPL and the other EDCs in the future to establish a consistent method of calculation.

10.4.4.1.2 Low-Income Residential Programs

Cadmus assumed NTGR to be 1.0 for both PPL low-income programs.

10.4.4.1.3 Non-Residential Programs

Cadmus estimated NTG for four non-residential programs: the Prescriptive Equipment Program, Custom Incentive Program, the Master-Metered Low-Income Multifamily (MMMF) Program, and the Continuous Energy Improvement (CEI) Program. 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 the Prescriptive Incentive Program and Custom Incentive Program and for the rebated measures component of MMMF; Cadmus assumed an NTGR of 1.0 for the direct-install measures component of MMMF, based on the fact that energy efficiency measures are provided at no cost. Cadmus used survey data for CEI, and asked participants to rate the ICSP's and program's influence on decisions, including developing tools to implement their strategic energy management plan and to implement operational or behavioral activities.

Cadmus described the NTG methodology in the PPL PY6 annual report and showed calculations in corresponding Excel workbooks for each program. In each program that served both the C/I and GNI sectors, Cadmus provided a single NTGR estimate for the two sectors.

The SWE Team notes that the achieved sample of 15 for the Custom Incentive Program is shy of the 17 needed for the required 85/15 confidence/precision under the assumed Cv of 0.50. However, given that some participants had multiple projects in both the population and the sample—as is frequently the case in this type of program—the standard method for calculating confidence/precision may not be applicable. The SWE Team believes this is a good topic for future discussion.

The SWE Team disagrees with Cadmus's arguments for the assumption of a NTGR of 1.0 for the free direct-install component of the MMMF Program. 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 mean there were no free-riders. The SWE Team anticipates that PPL and its evaluation consultant will review all assumptions about NTG in future studies.

Cadmus reports NTGR for MMMF at 85/20 confidence/precision based on completed surveys with five of 13 participants. Two participants did not answer the NTG questions, and Cadmus could not reach six participants. Cadmus appeared to make reasonable efforts to achieve the required confidence/precision levels, given the small population. The SWE Team suggests that Cadmus include information on the number of call attempts made to the six unreached participants.

Table 10-14 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, the SWE Team found description of the NTG methods to be largely unclear: instead of explaining even a high-level summary of

the methods, Cadmus's annual report simply acknowledges it followed the SWE common method for downstream programs.

Table 10-14: Summary of NTG Audit of PPL's Non-Residential Programs

Program	NTG Method	Review Comments
Prescriptive Equipment Program	The common method was used for Standard Path Lighting.	Cadmus used the common method, but the description of the methods in the annual report could have been clearer. The program's NTG results are informed by only one of the three program components (Standard Path Lighting). NTG was not estimated for Direct Discount Lighting or Equipment, as those components accounts for only about 6% of the program participants and a comparable share of the gross verified savings.
Custom Incentive Program	The common method was used for PY6 data, with an exception for spillover.	Cadmus used the common method, but the description of the methods in the annual report could have been clearer. Cadmus found evidence of spillover but did not quantify it. In addition to reporting PY6 NTGR based on a sample of 13 customers representing 15 projects, Cadmus reported a savings-weighted combined PY5/PY6 estimate. The SWE Team notes that the achieved sample of 15 is shy of the 17 needed for the required 85/15 confidence/precision under the assumed Cv of 0.50. However, given that some participants had multiple projects in both the population and the sample, the standard method for calculating confidence/precision may not be applicable.
Master-Metered Low-Income Multifamily (MMMF) Program	The common method was used for rebated measure components. Direct-install NTGR was assumed to be 1.0.	Cadmus used the common method for the rebated common area lighting program component, but the description of the methods in the annual report could have been clearer. The SWE Team disagrees with the assumption that NTGR is 1.0 for the free direct-install program component but allows it for PY6.
Continuous Energy Improvement (CEI) Program	Billing analysis, supported by assessment of program influence.	Cadmus used survey data, where participants reported very high program influence on savings-related decisions.
School Benchmarking Program	NTGR was not estimated.	NTG was not estimated, as the program does not generate savings.

Table 10-15 summaries the free-ridership, spillover, and NTGR estimates reported in Cadmus's annual report for non-residential sector programs.

Table 10-15: Summary of NTG Estimates for PPL's Non-Residential Programs

Approach	Program	Free-Ridership	Spillover	NTGR	Sample Size[a]
Estimated	Prescriptive Equipment Program	0.28	0.02	0.74	60
	Custom Incentive Program	0.55	0.0	0.45	15
	Master Metered Low-Income Multifamily (MMMF) Program	0.14	0.0	0.86	5
	Continuous Energy Improvement (CEI) Program	0.0	–	1.0	8

Approach	Program	Free-Ridership	Spillover	NTGR	Sample Size[a]
Not estimated	School Benchmarking Program	N/A	N/A	N/A	N/A

NOTES
[a] Cadmus reported confidence/precision to be not applicable for the Prescriptive Equipment Program and CEI. It is unclear if the sample size for the Custom Incentive Program provided at least 85/15 confidence/ precision. The sample size for MMMF provides 25% precision at 85% confidence. Although 13 respondents started the process survey for CEI, only five completed the NTG portion.

10.4.4.2 Process Evaluation Review Results

The SWE Team's audit included a review of the process evaluation methods, findings, conclusions, and recommendations in PPL's PY6 annual report to determine whether it was 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 SWE Team found that the evaluations appeared to be consistent with the Phase II evaluation plan, with some exceptions. The report generally provided a comprehensive overview of the process evaluation findings, conclusions, and recommendations, although as noted below, the SWE Team noted areas where additional detail on the methods and results would be valuable in program-level findings. In the following subsections, the SWE Team summarizes the review of the process evaluation sections in the annual report. In the following subsections, the SWE Team summarizes the review of the process evaluation sections in the annual report. Detailed summaries by program are in Appendix C.4.

10.4.4.2.1 Summary of Research Activities and Consistency with the Evaluation Plan

The process evaluation conducted by Cadmus involved review of key program documentation; interviews with program staff, implementers, program-affiliated contractors, retailers, distributors, community-based organizations, and other market actors; and surveys with program participants, partial participants, and nonparticipants. The research issues addressed varied by program but generally included key aspects of program administration, implementation, and delivery, including program communication, program awareness, and participant and contractor satisfaction. The process evaluations generally appeared consistent with the evaluation plan.

10.4.4.2.2 Summary of Sampling Strategies

The SWE Team determined that the sampling approaches for the process evaluation activities were generally 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 85/15 confidence/precision (achieving 90/10 on some samples), 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.

10.4.4.2.3 Report Elements and Clarity of the Reporting

The SWE Team deemed the reporting to be generally well done. Overall, the evaluator 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 SWE Team has identified the following areas that could be improved:

- The report did not always include the number of in-depth interviews.
- The report identified the number of completed interviews and surveys with participants and retailers, but did not always indicate the contact protocols (how many calls were made to each sample element and how many attempts). This is useful to include, particularly for programs that used a census method.
- In the methods sections of the process evaluations for all programs, when mixed methods were used to achieve survey completions, it would have been helpful to have some context for why mixed methods were used.

The SWE Team considers the above issues to be minor and easily remedied.

The PY6 annual report provided a summary of methods, high-level findings, and a table of recommendations. All programs drew on multiple sources to inform findings and recommendations.

10.5 STATEWIDE EVALUATOR FINAL RECOMMENDATIONS

The SWE Team has the following recommendation for PPL's EE&C programs going forward:

1) If site-specific HOU is used, then site-specific CF must also be used to determine kW savings.

2) The SWE Team recommends PPL consider a leave-behind flyer as part of the ARP or post card that includes information on all PPL Electric program offerings, including Act 129 programs, to ensure participants are aware of all program resources available. Although PPL reports that all programs are achieving their savings targets, this recommendation follows from the evaluation consultants' conclusion that identifying and reaching the remaining income-eligible population and maintaining current participation levels for the WRAP may be challenging in the future.

3) The SWE Team recommends PPL continue to research changes in residential customer purchasing behavior with regard to LEDs, in preparation for optimal program impact in Phase III.

4) The SWE Team recommends PPL consider changes to the Home Comfort program including eliminating the SEER 15 rebate raising the minimum SEER requirement for the air source heat pump rebate to SEER 16 or above to push installation of equipment that is significantly above the baseline of SEER 14, and increase savings.

11 SUMMARY

This chapter briefly summarizes the findings and recommendations of the SWE Team and describes the SWE Team's review of energy efficiency best practices studies.

11.1 FINDINGS

The SWE Team, TUS staff, EDCs, and EDC evaluation contractors have worked hard to develop a solid foundation for the EM&V of the Act 129 EE&C programs. The SWE Team notes that improvements continue to be made to the SWE Team audit processes, and it appreciates the support and responsiveness of the Pennsylvania Energy Association, the EDCs and their EM&V contractors.

The SWE Team believes the following are the most important findings from PY6:

1) The EDCs are continuing to make steady progress toward meeting the Phase II savings targets listed in the Phase II Implementation Order of Act 129.

2) The TRC B/C ratio for PY6 was 1.6 to 1.

3) The NPV savings of the EDCs' programs in PY6 was $257 million.

11.2 BEST PRACTICES

The SWE Team reviewed several existing energy efficiency best practices studies. These studies provide considerable ideas on how to make energy efficiency programs as efficient and effective as possible. The lessons learned from years of program implementation across the United States provide a roadmap for continuous improvement of the Act 129 programs operated by Pennsylvania's EDCs. For PY6, the SWE Team reviewed several evaluation protocols and investigated best practices for residential program design and implementation. The results of these reviews are discussed in Appendix F.

11.3 FINDINGS AND RECOMMENDATIONS

Based on the SWE Team audit activities conducted in PY6, 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 Chapters 4–10 of this report.

1) The SWE Team reviewed EDC reported and evaluated savings and generally affirm their validity. The SWE Team does however note a number of small errors in the calculations of report MWh/yr and MW savings. 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. See Chapters 4–10 of this report for more detailed information about such errors. The SWE Team recommends that any errors in reported PY6 verified MWh/yr or MW savings or reported benefit/cost calculations for an EDC should be corrected in that EDC's final Phase II annual report to the Commission.[48] See Chapters 4–10 of this report for more detailed information about SWE findings and recommendations regarding such errors.

2) The SWE Team found instances where EDCs chose not to use values or algorithms in the applicable Pennsylvania TRM. The 2013 SWE Evaluation Framework states if an EDC does not wish to use the

[48] In February 2015 the PUC's Technical Utility Services 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."

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 (1) also calculates the savings using TRM protocols and (2) 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 reported savings. The SWE recommends that EDCs be reminded by TUS staff that their final Phase II reports must report savings for both sets of results in the quarterly and/or annual EDC reports.

3) The SWE Team found that most of their respective TRC ratios for PY6 were calculated correctly, but that some EDCs made errors in their calculations of the Total Resource Cost (TRC) test benefit/cost (B/C) ratios. These discrepancies are discussed in Chapters 4–10 of this report. The SWE Team recommends that such TRC discrepancies be corrected in each EDC's final report for Phase II.

4) The SWE Team found that EDC evaluation consultants assumed a net-to-gross (NTG) ratio of 1.0 for most low-income programs as well as for three residential programs that were not low-income and for two non-residential programs. The SWE Evaluation Framework states that EDCs' evaluation contractors should conduct NTG research and consider conducting additional research to assess market conditions and market effects to determine net savings.[49] Looking forward, the SWE recommends that NTG research be conducted for all market segments where an EDC offers Act 129 programs, including the residential low-income sector.

5) The SWE Team finds that the seven Pennsylvania EDCs subject to the Phase II electricity savings requirements of Act 129 are making steady progress toward meeting the Phase II kWh/yr savings targets listed in the Phase II Implementation Order for Act 129. On a statewide basis, the EDCs have achieved 93% of the Phase II MWh/yr savings goal for 2016, based on the numbers verified by the EDCs' evaluators. Since progress towards the Phase II MWh/yr targets is satisfactory, the SWE Team has no recommendation relating to this finding.

6) The overall TRC test B/C ratio, as reported by the EDCs and consolidated across each EDC for PY6, is almost 1.6. The net present value (NPV) savings to Pennsylvania ratepayers reported by the EDCs for PY6 is approximately $257 million ($674 million in benefits compared to $417 million in costs). In those instances where calculation errors cause the net present value savings for an EDC's PY6 program portfolio to change by one percent or more, the SWE Team recommends that the EDC cost-effectiveness calculations be revised (in those instances where the SWE has identified errors in the individual EDC sections of this report). If the errors cause EDC portfolio PY6 net present value savings to change by less than one percent, the errors can be fixed in the EDC's final report for Phase II. Examples of EDC errors identified by the SWE that affect cost effectiveness calculations include errors in calculations of PY6 electricity savings and other minor errors the SWE Team found in TRC calculations (such as using incorrect avoided costs of electricity).

7) There still is evidence of high free-ridership for several EDC programs. 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 government, nonprofit, and institutional segments. When high free-ridership exists, the SWE Team recommends that EDCs should continue to examine program requirements and practices to determine whether free-ridership can be reduced during the remainder

[49] See July 2015 Pennsylvania Statewide Evaluator "Evaluation Framework for Pennsylvania Act 129 Phase II Energy Efficiency and Conservation Programs", Net Impact Evaluation section, page 66.

of Phase II as well as in program designs for Phase III. All EDCs should consider actions to reduce free-ridership in Phase III. In the nonresidential sector, EDCs that allow customers to submit rebate applications after equipment purchase should consider implementing a 90-day rebate eligibility clause for such purchases, if such a clause has not already been implemented.[50] There are other ways to reduce free-ridership, and the SWE Team recommends that the EDCs determine which methods suit their programs.

8) The EDC process evaluations identified that retailers and contractors are an important source of program information. 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 to increase program participation.

9) Process evaluations of home audit programs tended 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 to develop findings, best practices and recommendations on program strategies that lead to the highest conversion rates for audit participants to program participants.

10) EDC database tracking systems should be sure 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 PY6 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 Chapters 4–10 of this report.

11) The SWE Team found that 9.3% of the verified savings in the non-residential sector in PY6 came from residential upstream lighting programs. This finding 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, the amount verified in this category was actually 0%. For PECO and PPL, the percentages verified were 16% and 12% respectively, with those for the FirstEnergy Companies ranging from 2.1% for Penn Power to 6.7% for Met-Ed. The SWE Team recommends continued cross-sector sales analysis as the findings show there are important shifts in the MWh/yr and MW savings being reported in this category.

12) 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 greater detail about methods and findings to support their conclusions. The SWE Team recommends

[50] The SWE has made this recommendation to the EDCs during Program Evaluation Group 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 this data is 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 to participants who applied more quickly for a rebate. The SWE recommends that this research recommendation be discussed with Program Working Group participants at a future meeting during 2016. 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.

that the SWE discuss these process evaluation issues with each EDC in March 2016 (after this report is filed with the Pennsylvania PUC).

13) The SWE process evaluation audit activities for the PY6 programs found that the evaluation contractors made 181 Phase II process evaluation recommendations to the EDCs. Of this total, 66 were implemented by the EDCs, 110 were still being considered for implementation, and five were rejected by the EDCs. This amounts to a 36% acceptance rate and a 3% rejection rate, which are both comparable to the PY5 rates (32% and 2%, respectively). The SWE Team concludes that the evaluation contractors are providing valuable and actionable recommendations. The fact that 61% of the recommendations were still being considered by the EDCs at the time their PY6 annual reports were submitted to the Pennsylvania PUC is not surprising, given the relatively 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 Team plans to continue to monitor the status of the evaluation contractor recommendations in PY7. Chapter 3 of this report (Table 3-13) summarizes the status of the 181 process evaluation recommendations by EDC and program. The SWE Team recommends that the EDCs establish the priority for the process evaluation recommendations so that the most important recommendations are resolved quickly.

14) For PY6, 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 in-service rate (ISR) for residential lighting measures provided in the TRM applicable for PY6, unless the EDC has conducted research in its service area to document the actual ISR achieved during PY6.

15) The SWE Team completed 69 ride-along site inspection reports (RASIRs) of randomly selected PY6 commercial and industrial (C/I) energy efficiency measure installations. Through these rigorous ride-along site inspections, the SWE Team found that it was very common to have deviations from the non-residential customers' initial project applications relating to the quantity, type, or operational characteristics of energy efficiency measure installations. Specifically, the SWE Team found significant deviations in 24 of the 69 (35 %) ride-along site inspections conducted for PY6. While there is an expected and allowable amount of discrepancy based on what is received from the customer, the SWE Team recommends that the EDC evaluation contractors perform additional pre-trip communication and inspection preparation with either the CSP or the program participant, as appropriate, to determine if the participant's initial project application has changed. Any changes discovered through this process should be communicated and presented to the SWE personnel in advance of their ride-along site inspection whenever possible. In addition, the SWE Team recommends that each EDC take additional steps with program participants in order to reduce such deviations in future program years.

16) 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 evaluators should investigate whether customers who had audits in a given program are more likely than customers who did not receive an energy 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.

17) The PPL process evaluation of the Company's residential lighting program found that CFL disposal behavior remains relatively unchanged from prior years, with over half of customers disposing of CFLs in the trash, in spite of more recycling bins in diverse locations. The SWE recommends that the EDCs work together during PY7 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.

18) The PECO LEEP evaluation found that 75% of homes visited during ride-along surveys had unfinished basements with no floor insulation, and up to 25% had windows that did not shut properly or were broken. The SWE recommends that PECO examine these issues and determine if any program modifications are appropriate for the Company's residential low income energy efficiency program.

19) The SWE Team found several 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 EDCs final report for Phase II.

20) The SWE Team found the discussion regarding shifts in cross-sector residential lighting and low-income sales from PY5 to PY6 to be lacking some key technical information for some of the EDCs. 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 bias between the two samples from different years to ensure that the differences in PY5 and PY6 parameters were entirely driven by changes to program rather than changes in methods and samples. Given the upstream residential lighting programs' significant contribution to each EDC's portfolio savings, the SWE Team recommends that the EDC evaluators include additional details regarding the research methods in future annual reports as well as a discussion related to differences in parameter estimates.

21) The SWE recommends that more thorough auditing of program applications for commercial and industrial measures be conducted by EDCs to ensure clarity of the project files for the subsequent SWE review.

22) 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, however, has several recommendations relating to the methodology used by EDCs to determine program net to gross ratios. Where applicable, the SWE Team recommends that EDC evaluator reports 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 results that would be achieved if the common method were utilized.

23) The EDC PY5 and PY6 reports show different participation rates across EDCs for similar types of programs. The SWE plans to examine this issue more thoroughly for the Phase II final report to understand the factors causing these different levels of participation, including whether the EDCs calculating and reporting participation rates on the same basis. The SWE plans to use the results of this analysis for two purposes: (1) to determine if the SWE needs to clarify how program participation levels and participation rates should be calculated and reported to the PUC and (2) to develop recommendations, as appropriate, on 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. The SWE Team has a contractual responsibility to the Pennsylvania PUC to

examine, consider and recommend such program efficiency and effectiveness improvements where appropriate.[51]

[51] See page 26 of the 2013 SWE Team Phase II contract with the Pennsylvania PUC, page 26, first sentence.

APPENDIX A | AUDIT ACTIVITY DETAIL – NON-RESIDENTIAL PROGRAMS

This appendix provides further detail on the SWE Team's audits performed for non-residential programs in PY6.

A.1 DUQUESNE

A.1.1 Project Files Review

The SWE Team review of non-residential projects completed by Duquesne in PY6 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, process improvements, ventilation improvements, and electrically commutated motors (ECMs).

In PY5 the SWE Team commented that Duquesne's project files typically presented minor oversights indicative of miscalculated savings. Straightforward prescriptive projects were well documented, but custom projects and projects involving revisions to the original scopes of work tended to introduce uncertainty, with mismatching documentation and lack of organization, detail, or explanation.

The SWE Team is pleased to see that this was not an issue for Duquesne in PY6. PY6 project files contained clearly labeled folders and files and displayed a higher level of detail than the EDC has made available in the past. For example, project number 5000006639.20.20 was a custom ventilation project submitted to the commercial sector in Q1 whose project file included several pieces of email correspondence from the duration of the project review process, creating a clear path from project inception to reported savings. Detailed reports accompanying project numbers 7000009088.24.61 (a custom process upgrade project submitted to the industrial sector in Q1) and 2000008742.23.01 (a lighting and controls project submitted to the industrial sector in Q3) showed thorough scrutiny of savings calculations for these projects as well. Of the 11 projects reviewed, only two presented discrepancies that impeded the SWE Team's verification efforts. They are described in more detail in the following paragraphs.

The savings calculator for project number 5000007382.23.01 had several incorrect equations, causing all outputs to appear as "#NAME?". The workbook (see) appeared to have macros but was not saved as a macro-enabled file. The installation report submitted summarized the inputs, which matched the viewable inputs in the saving calculator. Because of this, it is assumed that the spreadsheet version used by the CSP was of the correct format, and therefore produced the savings values summarized in the installation report. The SWE Team, however, was not able to verify this.

Figure A-1: Faulty Savings Calculator Submitted with Project Number 5000007382.23.01

Compressor Model, Control, Unit #	40hp Mod #1	40hp Mod #1	40hp Mod #1	40hp Mod #1		40hp Mod #1	40hp Mod #1	40hp Mod #1	40hp Mod #1	
Compressor Type	Single Stage Rotary Screw	Single Stage Rotary Screw	Single Stage Rotary Screw	Single Stage Rotary Screw	Baseline Compressor Sums	Single Stage Rotary Screw	Single Stage Rotary Screw	Single Stage Rotary Screw	Single Stage Rotary Screw	Proposed Compressor Sums
Control Type	Load/Unload	Load/Unload	Load/Unload	Load/Unload		VSD	VSD	VSD	VSD	
Input Choice - CFM or kW	CFM	CFM	CFM	CFM		CFM	CFM	CFM	CFM	
Rated hp	40	40	40	40		40	40	40	40	
Rated kW/100cfm (@100 psi)	19.5	19.5	19.5	19.5		19.5	19.5	19.5	19.5	
Rated cfm (@100 psi)	187	187	187	187		187	187	187	187	
Rated kW	36.5	36.5	36.5	36.5		36.5	36.5	36.5	36.5	
Hours of Production (hr/yr)	250	1000	1000	250	2500	250	1000	1000	250	2500
Discharge Pressure (psig - actual)	105	105	105	105		105	105	105	105	
Storage (total gallons)	#NAME?	#NAME?	#NAME?	#NAME?		#NAME?	#NAME?	#NAME?	#NAME?	
CFM Demand (estimated or measured)	#NAME?	#NAME?	#NAME?	#NAME?		#NAME?	#NAME?	#NAME?	#NAME?	
kW (enter only if measured)	30.1	30.1	30.1	30.1		40.1	40.1	40.1	40.1	
Rated cfm at actual discharge pressure	#NAME?	#NAME?	#NAME?	#NAME?		#NAME?	#NAME?	#NAME?	#NAME?	
% cfm	#NAME?	#NAME?	#NAME?	#NAME?		#NAME?	#NAME?	#NAME?	#NAME?	
% Unloaded Power	25.0	25.0	25.0	25.0		25.0	25.0	25.0	25.0	
Demand mod w/unloading (kW) =	#NAME?	#NAME?	#NAME?	#NAME?		#NAME?	#NAME?	#NAME?	#NAME?	
Demand load/unload (kW) =	**#NAME?**	**#NAME?**	**#NAME?**	**#NAME?**		#NAME?	#NAME?	#NAME?	#NAME?	
Demand variable displacement (kW) =	#NAME?	#NAME?	#NAME?	#NAME?		#NAME?	#NAME?	#NAME?	#NAME?	
Demand VSD (kW) =	#NAME?	#NAME?	#NAME?	#NAME?	#NAME?	**#NAME?**	**#NAME?**	**#NAME?**	**#NAME?**	#NAME?
Energy Use mod w/unloading (kWh/yr) =	#NAME?	#NAME?	#NAME?	#NAME?		#NAME?	#NAME?	#NAME?	#NAME?	
Energy Use load/unload (kWh/yr) =	**#NAME?**	**#NAME?**	**#NAME?**	**#NAME?**		#NAME?	#NAME?	#NAME?	#NAME?	
Energy Use variable displacement (kWh/y	#NAME?	#NAME?	#NAME?	#NAME?		#NAME?	#NAME?	#NAME?	#NAME?	
Energy Use VSD (kWh/yr) =	#NAME?	#NAME?	#NAME?	#NAME?	#NAME?	**#NAME?**	**#NAME?**	**#NAME?**	**#NAME?**	#NAME?
Savings Summary	**Baseline Energy (kWh/yr)**	**Baseline Demand (kW)**	**Proposed Energy (kWh/yr)**	**Proposed Demand (kW)**	**Energy Savings (kWh/yr)**	**Demand Savings (kW)**				
Air Compressor	#NAME?	#NAME?	#NAME?	#NAME?	#NAME?	#NAME?				
No Air Loss Drains					0	0.00				
Cycling Dryer					0	0.00				
Totals	**#NAME?**	**#NAME?**	**#NAME?**	**#NAME?**	**#NAME?**	**#NAME?**				
Energy and Demand Incentive					**#NAME?**	**#NAME?**				

This was found to be a recurring issue, appearing also in the installation report for project number 9000690947.17.14 and in the savings calculation spreadsheet for project number 6000590554.18.01 (see Figure A-2). However, in these examples the redundancy created by the high level of detail in the project documents submitted made it possible to verify values elsewhere.

Figure A-2: Faulty Savings Calculator Submitted with Project Number 6000590554.18.01

Savings Data

Total Peak kW Reduction	#REF!
Total Annual kWh Savings	#REF!

Project number 6000007491.17.03 claimed savings for a wide variety of lighting measures, including 142 refrigerated display case LEDs all rated at 18W for a total of 2,556 installed watts. While the invoices corroborate 142 installed refrigerated display case fixtures, the customer-edited cut sheets signify two different units installed: 18W center units and 9W end units. The installation report comments that two LED case lighting scenarios existed: (1) 19.3W center bar and (2) 10W left/right door bars. However, this document presents some skepticism as it was clearly edited via Adobe Acrobat after its execution without explanation. Due to a lack of information on specific quantities and corresponding wattages, it is unclear how much the savings may have been overstated, if at all, due to this oversight. This, however, appears to be an isolated incident.

In summary, the SWE Team review of Duquesne's PY6 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. At this time, the SWE Team only recommends that more thorough auditing of applications be conducted to ensure clarity of the project files for the SWE Team review.

A.1.2 Tracking Data Review

Duquesne reported impact and demand savings from 11 non-residential programs in PY6. Seven of these programs are offered to the commercial and GNI sectors, and four are offered to the industrial sector. The gross reported energy savings for these programs was 78,356 MWh/yr, and the gross reported demand impact was 11.5 MW. The Office Buildings-Large EE and Office Buildings-Small EE programs resulted in the largest energy and demand saving and contributed 26% of Duquesne's total PY6 non-residential energy savings. Table A-1 provides the reported number of participants, energy savings, demand savings, and incentives determined from Duquesne's PY6 quarterly reports. Demand impact figures were adjusted to reflect a peak LLF of 6.9% for non-residential programs prior to reporting to account for T&D losses.

Table A-1: Duquesne's PY6 Quarterly Reports Summary for Non-Residential Programs

Program	Number of Participants	MWh/yr	MW	Incentive ($1,000)
Commercial Sector Umbrella EE	13	560	0.1	$25
Commercial Sector Umbrella EE-Upstream Lighting	N/A	7,911	2.4	
Healthcare EE	2	27	0.0	$524
Industrial Sector Umbrella EE	1	157	0.0	$17
Chemical Products EE	5	209	0.0	$13
Mixed Industrial EE	35	7,698	1.3	$341
Office Buildings-Large-EE	54	20,008	1.7	$1,431
Office Buildings-Small-EE	10	115	0.0	
Primary Metals EE	19	8,111	1.0	$412
Public Agency/Non-Profit	65	16,530	2.5	$2,227
Retail Stores	255	9,430	1.5	$653
Multifamily Housing Retrofit	41	2,171	0.0	$0
Small Commercial Direct Install	90	5,429	1.0	$0
Total	**590**	**78,356**	**11.5**	**$5,643**
Total (without Upstream Lighting)	**590**	**70,445**	**9.1**	**$5,643**

After each quarter in PY6, Duquesne submitted program tracking data to the SWE Team for review. The SWE Team combined these quarterly data extracts and compared them to the values shown in Table A-1. Several of Duquesne's programs were composed of multiple subprograms. For example, Duquesne's Public Agency/Non-Profit program is made up of the Education, PAPP, and Non-Profit customer segments. The two Retail EE programs (Small and Large) are presented together because the extract-level databases did not differentiate projects from the Small and Large programs. **Table A-2** provides the participant counts, energy impacts, demand impacts, and incentives reported in Duquesne's quarterly database extracts. The commercial sector Umbrella EE-Upstream Lighting program is not included in the table below.

Table A-2: Duquesne's PY6 Tracking Database Summary for Non-Residential Programs

Program	Number of Participants	MWh/yr	MW*	Incentive ($1,000)
Commercial Sector Umbrella EE	12	560	0.1	$19
Healthcare EE	2	27	0.0	$2
Industrial Sector Umbrella EE	1	157	0.0	$17
Chemical Products EE	5	209	0.0	$17
Mixed Industrial EE	35	7,698	1.3	$316
Office Buildings-Large-EE	50	20,008	1.7	$1,268
Office Buildings-Small-EE	10	115	0.0	
Primary Metals EE	17	8,111	1.0	$395
Public Agency/Non-Profit	62	16,530	2.5	$985
Retail Stores	248	9,430	1.5	$614
Multifamily Housing Retrofit	39	2,171	0.2	$0
Small Commercial Direct Install	88	5,429	0.7	$0
Total	**569**	**70,445**	**9.1**	**$3,636**

**** Database demand impacts adjusted to reflect a peak loss factor of 7.4% for all non-residential programs.***

In Table A-3, the variances between the reported figures and the information provided in the database are calculated as follows:

$$Reported\ Figure\ - Database\ Summary = Variance$$

Table A-3: Duquesne's Non-Residential Program Discrepancies

Program	Number of Participants	MWh/yr	MW*	Incentive ($1,000)
Commercial Sector Umbrella EE	1	0	0.0	$6
Healthcare EE	0	0	0.0	$522
Industrial Sector Umbrella EE	0	0	0.0	$0
Chemical Products EE	0	0	0.0	-$4
Mixed Industrial EE	0	0	0.0	$25
Office Buildings-Large-EE	4	0	0.0	$163
Office Buildings-Small-EE	0	0	0.0	
Primary Metals EE	2	0	0.0	$17
Public Agency/Non-Profit	3	0	0.0	$1,242
Retail Stores	7	0	0.0	$39
Multifamily Housing Retrofit	2	0	0.0	$0
Small Commercial Direct Install	2	0	0.0	$0
Total	**21**	**0**	**0.0**	**$2,007**

**** Database demand impacts adjusted to reflect a peak loss factor of 7.4% for all non-residential programs.***

There were no variations between the energy savings values and demand savings values listed in the annual report and those derived from the tracking database. However, the SWE Team observed minor differences in the number of participants and the total amount of incentives. The SWE Team determined the number of participants from the database extract using unique participant account numbers. However, Duquesne's reports explain that customers participating more than once within a quarter are counted once while customers participating more than once but in different quarters are counted more than once (once in each quarter). This explains why the participant counts in the annual report are higher than the counts the SWE Team found in the tracking database.

The total incentive amount derived from the quarterly reports was approximately $2,007,000 greater than the values reported in the tracking databases. The largest discrepancy resulted from the Public Agency/Non-Profit Program, which was responsible for 60% of the difference. The explanation for this is that Duquesne reported the incentives that were actually paid during the year, rather than the sum of the incentives associated with projects completed in the year.

A.1.3 Sample Design Review

Duquesne's PY6 annual report provided detailed information about the sample design for the PY6 gross impact evaluation of non-residential programs. Programs in the non-residential sector were divided into five groups: commercial, industrial, government, non-profit, and institutional (GNI, Small Commercial Direct Install, and Multi-family Housing Retrofit (MFHR)). 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 PY5. This approach is aligned with the guidance in the Evaluation Framework. The Small Commercial Direct Install Program and the MFHR Program were new programs implemented in PY6. Even though they are commercial-sector programs, these two programs received separate treatment in PY6 because they were new. Duquesne's evaluation contractor addressed five main evaluation groups for the non-residential sector's gross impact evaluation:

- Commercial Program Group
- Industrial Program Group
- GNI Program Group
- Small Commercial Direct Install Group
- MFHR Group

Duquesne's targeted level of precision for each of the five 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 and precision level requirement in the Evaluation Framework.

A.1.3.1 Commercial Program Group

The Commercial Program Group includes an overall umbrella program and four market-segment programs: Office, Public Agency, Retail, and Healthcare. Two additional programs, the Small Commercial Direct Install Program and the MFHR Program, typically fall within the commercial sector, but they received separate treatment in PY6 because they were new. 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 PY6 commercial-sector sampling strategy is shown in Table A-4.

Table A-4: Duquesne's PY6 Sampling Strategy – Commercial Program Group

Stratum	Population	Target Levels of Confidence & Precision	Target Sample Size	Achieved Sample Size
Commercial – Large	4	85% / 0%	4	3
Commercial – Medium	17	85% / 28.8%	6	7
Commercial – Small	330	85% / 29.4%	10	10
Program Total	**351**	**85% / 15%**	**20**	**20**

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-5 show that Duquesne met the 85%/15% confidence and precision level for energy but not for peak demand. The Evaluation Framework only requires that ±15% precision be achieved for energy savings.

Table A-5: Observed Coefficients of Variation and Relative Precisions – Duquesne's Commercial Programs 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	0.45	29.5%	0.81	168.8%
Commercial – Medium	0.44	21.2%	0.49	27.3%
Commercial – Small	0.16	8.0%	0.55	27.2%
Program Total		**8.5%**		**21.9%**

A.1.3.2 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 PY6 sampling strategy for the Industrial Program Group is shown in Table A-6.

Table A-6: Duquesne's PY6 Sampling Strategy – Industrial Programs Group

Stratum	Population (measures)	Target Levels of Confidence & Precision	Target Sample Size	Achieved Sample Size
Industrial – Small	319	85% / 25.9%	16	86
Industrial – Medium	31	85% / 27.9%	7	11
Industrial – Large	5	85% / 19.2%	4	4
Program Total	**355**	**85% / 15%**	**27**	**101**

The achieved sample sizes of the Medium Industrial stratum and the Small Industrial stratum are larger than their targeted sample sizes respectively because of "bonus" measures the evaluation contractor was able to verify at sites with measures selected in the sample. The achieved precision values are shown in Table A-7.

Table A-7: Observed Coefficients of Variation and Relative Precision – Duquesne's Industrial Programs 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 – Small	0.57	8.0%	0.29	4.3%
Industrial – Medium	0.40	15.1%	0.56	21.0%
Industrial – Large	0.96	41.2%	0.89	38.3%
Program Total		**12.9%**		**12.2%**

A.1.3.3 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 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-8, and the achieved precision values are shown in Table A-9.

Table A-8: Duquesne's PY6 Sampling Strategy – GNI Programs Group

Stratum	Population	Target Levels of Confidence & Precision	Target Sample Size	Achieved Sample Size
GNI – Small	66	85% / 29.9%	9	9
GNI – Large	2	85% / 25.9%	2	2
Program Total	**68**	**85% / 15%**	**12**	**11**

Table A-9: Observed Coefficients of Variation and Relative Precision – Duquesne GNI Programs 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 – Small	1.29	63.7%	0.21	11.5%
GNI – Large	0.00	0.0%	0.09	0.0%
Program Total		**29.4%**		**5.8%**

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-9 show that Duquesne did not meet the 85%/15% confidence and precision level for energy, but did for peak demand. The SWE Team recommends targeting a higher sample size for the GNI – Small stratum in future evaluations of this program in order to achieve a higher level of precision.

A.1.3.4 Small Commercial Direct Install Program Group

The Small Commercial Direct Install Program Group was new in PY6 and was therefore evaluated as its own program group. In future program years, it will be evaluated under the umbrella of the Commercial Program Group. The sampling approach was at the project level. Three strata were defined: Small, Medium, and Large. The sampling strategy for this group is shown in Table A-10. In accordance with the Phase II Evaluation Framework, the program was designed to achieve 15% precision with 85% confidence. In PY6, the program actually achieved precisions of 2.4% for energy and 5.0% for demand. The achieved precision values are shown in Table A-11.

Table A-10: Duquesne's PY6 Sampling Strategy – Small Commercial Direct Install Programs Group

Stratum	Population	Target Levels of Confidence & Precision	Target Sample Size	Achieved Sample Size
Small Commercial Direct Install – Large	6	85% / 0%	6	6
Small Commercial Direct Install – Medium	18	85% / 25.1%	7	9
Small Commercial Direct Install – Small	64	85% / 33.3%	6	4
Program Total	**88**	**85% / 15%**	**19**	**19**

Table A-11: Observed Coefficients of Variation and Relative Precision – Small Commercial Direct Install Programs 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
Small Commercial Direct Install – Large	0.12	0.0%	0.23	0.0%
Small Commercial Direct Install – Medium	0.15	5.6%	0.33	12.4%
Small Commercial Direct Install – Small	0.04	4.0%	0.08	7.2%
Program Total		**2.4%**		**5.0%**

A.1.3.5 Multifamily Housing Retrofit (MFHR) Program Group

The MFHR Group was new in PY6 and was therefore evaluated as its own program group. In future planning years, it will be evaluated under the umbrella of the Commercial Program Group. The sampling approach was at the project level. Three strata were defined: Small, Medium, and Large. The sampling strategy for this group is shown in Table A-12. In accordance with the Phase II Evaluation Framework, the program was designed to achieve 15% precision with 85% confidence. In PY6, the program actually achieved precisions of 2.9% for energy and 4.1% for demand. The achieved precision values are shown in Table A-13.

Table A-12: Duquesne's PY6 Sampling Strategy – MFHR Programs Group

Stratum	Population	Target Levels of Confidence & Precision	Target Sample Size	Achieved Sample Size
Multifamily – Small	22	85% / 35.8%	5	5
Multifamily – Medium	13	85% / 32.5%	5	5
Multifamily – Large	4	85% / 0%	4	4
Program Total	**39**	**85% / 15%**	**14**	**14**

Table A-13: Observed Coefficients of Variation and Relative Precision – MFHR Programs 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
Multifamily – Small	0.13	8.8%	0.08	7.2%
Multifamily – Medium	0.10	5.9%	0.17	10.7%
Multifamily – Large	0.02	0.0%	0.23	0.0%
Program Total		**2.9%**		**4.1%**

A.1.4 Ride-Along Site Inspections

Table A-14 summarizes the SWE Team's PY6 ride-along site inspections of Duquesne's non-residential project installations. The Duquesne PY6 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-14: Duquesne's PY6 Non-Residential Site Inspection Findings

Project ID	Technology	Finding	Finding Type	Resolution
9023030087.51.01	Lighting	All equipment was installed and generally operating as reported.	N/A	The SWE Team had no recommendations based on its review of this project.
4066040085.49.01	Lighting	The verified savings were lower than reported values due to HOU being based on site gathered data and fixture verified fixture wattages being different than what was reported.	Pro	The SWE Team had no recommendations based on its review of this project.
5588600119.49.01	Case Lighting, Refrigeration	The evaluator used the general lighting HOU for grocery stores in determining savings for refrigerated case lighting. However, through an interview with the site contact, it was revealed that the HOU were about 50% greater than the general lighting HOU value.	Eval	The SWE Team recommended that the evaluator adjust the refrigerated case lighting HOU to reflect data gathered on-site. Navigant issued a response in which it disagreed with the SWE Team's suggestion as it is not in accordance with Navigant's approved evaluation plan.
8102840705.49.01	Case Lighting, Refrigeration	The evaluator applied the general service lighting HOU for a grocery store to the refrigerated case lighting.	Eval	The SWE Team recommended that refrigerated case lighting be treated separately from the general service case lighting for deriving HOU and CF, as the two lighting types generally greatly differ in usage patterns. Navigant issued a response in which it disagreed with the SWE Team's suggestion as it is not in accordance with Navigant's approved evaluation plan.
5719440528.49.01	Case Lighting, Anti sweat heater controls (ASHC), Strip Curtains	The evaluator applied the general service lighting HOU for a grocery store to the refrigerated case lighting.	Eval	The SWE Team recommended that refrigerated case lighting be treated separately from the general service case lighting for deriving HOU and CF, as the two lighting types generally greatly differ in usage patterns. Navigant issued a response in which it disagreed with the SWE Team's suggestion as it is not in accordance with Navigant's approved evaluation plan.
9000007864.32.04	VFD	Generally, all retrofitted equipment and controls were verified as reported and inputs to the energy model reflected what was found on site.	N/A	The SWE Team had no recommendations based on its review of this project.
7685000806.51.01	Lighting	Generally, all retrofitted equipment and controls were verified as reported and inputs to the energy savings calculations reflected what was found on site.	N/A	The SWE Team had no recommendations based on its review of this project.

Project ID	Technology	Finding	Finding Type	Resolution
2619510308.51.01	Lighting	When determining savings derived from the residential units of this multifamily facility, the evaluator verified an inadequate number of units to meet the Evaluation Framework's specification of sampling of a relative precision of ±20% at the 90% confidence level at the facility level.	N/A	The SWE Team recommended the evaluator either use the reported savings as verified savings or reevaluate the project using a more rigorous approach in PY7. Navigant issued a response that the reduction in sampled units was due to safety concerns.
6367460530.51.01	Lighting	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.
9000007864.32.07	Lighting	When determining lighting HOU, the evaluator deployed an inadequate number of loggers to meet the Evaluation Framework's specification of sampling to meet relative precision of ±20% at the 90% confidence level at the facility level.	Eval	The SWE Team recommended the evaluator either use the reported savings as verified savings or reevaluate the project using a more rigorous approach in PY7. Navigant issued a response in general agreement with setting the reported savings to equal verified savings and will deploy more loggers in the future but cited a previous project in PY4 that did not receive this guidance.

A.1.5 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-15 provides an overview of the SWE Team's verified savings review.

Table A-15: 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	6000006637.20.04	2,737,094	312.5	Site inspection, desk review, metering	Option A
Commercial	0000007399.20.04	2,051,833	550.8	Site inspection, desk review, analysis of trending data	Option C
Commercial	8000006714.20.23	2,711,023	237.6	Site inspection, review of billing data	Option C
Commercial	3000708933.17.01	873,362	113.4	Site inspection, review of EMS data	Option A
Commercial	8000008126.20.02	269,121	87.8	Site inspection, desk review	Option A
Small Commercial Direct Install	5596350595.49.01	277,604	22.7	Site inspection, desk review	Option A

Project 6000006637.20.04 generated 2,737,094 kWh in energy savings and 312.5kW in demand savings. The project involved a lighting retrofit where 762 metal halide fixtures were replaced with 127 custom LED fixtures and occupancy sensors in an uncooled warehouse in Pittsburgh, PA. 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 meters were deployed at the panel because the fixtures were 23 feet in the air. Navigant used the metered HOU and CF values and provided a completed Appendix C Lighting calculator. The higher verified savings values (kWh RR of 155%) resulted primarily from Navigant's use of metered HOU and savings control factor.

Project number 0000007399.20.04 involved the replacement and reconfiguration of a chiller plant, the complete replacement of the electric heating system, and an upgrade to a building automation and control system (BACS) in an office building in Pittsburgh, PA. Due to the high expected energy savings of the project, Navigant performed a statistical billing analysis (IPMVP Option C). The low kWh realization rate of 58% and high kW rate of 311% are primarily due to using a longer time period of billing data and using hourly data instead of monthly data.

Project number 8000006714.20.23 involved recommissioning the HVAC system, optimizing HVAC controls, repairing leaks, upgrading the secondary water system, upgrading the outside air dampers, and upgrading the building automation system in an office building in Pittsburgh. Due to the high expected energy savings and custom nature of the project, Navigant performed a statistical billing analysis (IPMVP Option C). The verified savings are 19% less than the reported savings because the CSP used monthly billing data, whereas Navigant used hourly data as well as data from a broader period.

Project number 3000708933.17.01 involved a new construction lighting project wherein 1,393 LEDs, T8 fixtures, and T5 fixtures were installed in a retail store in Balden, PA. The Building Area Method was used to determine the minimum lighting power density for the baseline. Navigant was able to obtain EMS data from the store, and was able to use this to determine overall HOU for the site. The reported fixture wattages and configurations were installed as reported. The kWh realization rate of 80% was due primarily to the fact that reported savings used 8,760 hours per year, whereas verified hours were 7,005.

Project number 8000008126.20.02 involved a lighting retrofit that included the replacement of 1,000 75W incandescent bulbs with 9.5W LED bulbs. Navigant verified the lights to be controlled by an EMS and used the programmed lighting schedule to update the HOU and CF. The ex post lighting HOU were calculated to be 3,669, about 18% more than the ex ante HOU of 3,120. This resulted in the realization rate of 118%.

Project number 5596350595.49.01 involved the installation of refrigerator strip curtains, door auto-closers, ASHC, upgraded evaporator fan motors, and refrigeration lighting measures at a grocery store in Pittsburgh, PA. Following the site verification visit, Navigant used a TRM lighting and refrigeration tool to calculate an updated ex post savings estimate. Navigant updated the HOU and CF with the customer reported lighting schedule. The TRM algorithms were used for all measures.

A.2 MET-ED

A.2.1 Project Files Review

Through the quarterly data request process, the SWE Team requested that FirstEnergy make available for review the supporting documentation for 10 projects completed in PY6 from each of the four EDCs. In compliance with the request, FirstEnergy submitted documentation files for 115 projects completed across all four EDCs, including 27 specifically for the Met-Ed territory.

The SWE Team reviewed nine projects in Met-Ed's PY6 non-residential programs across various measures, including lighting, air compressors, VFDs, refrigeration, pumps, and motors and drives. 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, project documentation was complete and thorough, with ample notes and explanation where necessary. Of the nine projects reviewed, only two were found to be inconclusive due to either missing or inconsistent documentation. The details of the identified issues are presented in the following paragraphs.

Project CR_PRJ-253521 was a new construction project that included energy efficient refrigerated cases and HVAC units. The tracking database accurately reflects the savings associated with the HVAC units but does not include the refrigeration savings. Review of the savings calculators for the refrigeration measures concluded that the savings were calculated incorrectly. Table 3-30 in the 2014 TRM provides algorithms for calculating the savings associated with refrigerated cases based on the volume of the case. Table 3-32 provides default savings values based on tiered volumes in the event that the exact volume is unknown.

The calculator is set to use Table 3-32, regardless of whether or not the equipment volume is known. In this specific instance, the volume of the two units was 23 cubic feet, yet the volume tier selected was "<15 cu. ft." The associated energy savings for the refrigeration measures were calculated at 1,444 kWh. However, using the appropriate volume, Table 3-32 dictates a savings value of 1,366 kWh; Table 3-30 dictates a savings value of 1,336 kWh. Erroneous calculations aside, it is unclear why no refrigeration savings were translated to the Q2 tracking database.

Project CR_PRJ-255765 was an interior lighting retrofit project completed in PY6 Q2 and claiming savings from the retrofit of two 1000W metal halide lamps to two 250W LED fixtures. The invoice provided simply states "materials" without detailing quantities or model numbers. The cut sheet provided for the LED fixture lists several available configurations, none of which are called out as being the specific units installed. Review of the manufacturer's website shows several photometric data sheets for the cut sheet provided based on various configuration details. The wattages appear to range from 184W to 239W, but never as high as 250W. Given the inconclusive invoice and cut sheet, the SWE Team is unable to verify the claimed savings of this project, and questions the implementation CSPs ability to do so as well.

In PY5 the SWE Team recommended that more thorough documentation be kept regarding changes in scopes of work, and that detailed information regarding measure type and quantity be included in project invoices. Issues encountered in the PY6 project file review were in the same vein but occurred with much less frequency. In summary, the SWE Team is pleased with Met-Ed's PY6 project files. The review process was almost seamless, identifying only minimal issues proving to be detrimental to the SWE Team's understanding of the projects. Project files were found to be conclusive and organized, with few exceptions. At this time, the SWE Team only recommends that custom calculators be more carefully crafted to follow governing TRM equations and requirements.

A.2.2 Tracking Data Review

Met-Ed listed five programs in its non-residential portfolio, all of which achieved energy savings and demand savings[52] in PY6. The number of participants, energy and demand savings, and incentives derived from Met-Ed's PY6 quarterly reports are summarized in Table A-16. The reported gross energy savings from non-residential programs was 42,977 MWh/yr, and the reported gross demand savings was 7.1 MW. The C/I Large Energy Efficient Equipment Program was responsible for a large portion of the non-residential portfolio savings, accounting for 63% and 44% of the total energy and demand impacts, respectively.

Table A-16: Met-Ed's Non-Residential PY6 Quarterly Reports Summary

Program	Number of Participants	MWh/yr	MW	Incentive ($1,000)
C/I Small Energy Efficient Equipment	387	12,502	3.2	$765
C/I Small Energy Efficient Buildings	2,126	2,719	0.6	$174
C/I Large Energy Efficient Equipment	131	27,161	3.1	$1,508
C/I Large Energy Efficient Buildings	40	506	0.2	$33
Government & Institutional	4	89	0.0	$6
Total	**2,688**	**42,977**	**7.1**	**$2,486**

[52] The Government & Institutional program achieved reported demand impacts of 21.8 kW. This rounds to the 0.0 MW values shown in and Table A-16.

In each quarter, FirstEnergy provided the SWE Team with a tracking database for each of its operating companies. This database contained the key reporting metrics for each project, reporting savings for each quarter, and additional details about the types of efficient equipment installed at each site to generate savings. Table A-17 contains the tracked total participant counts, energy and demand savings, and incentives by program.

Table A-17: Met-Ed's Non-Residential PY6 Program Savings Database Summary

Program	Number of Participants	MWh/yr	MW	Incentive ($1,000)
C/I Small Energy Efficient Equipment	387	12,502	3.2	$810
C/I Small Energy Efficient Buildings	2,141	2,719	0.6	$70
C/I Large Energy Efficient Equipment	133	27,161	3.1	$1,678
C/I Large Energy Efficient Buildings	201	506	0.2	$22
Government & Institutional	4	89	0.0	$6
Total	**2,866**	**42,977**	**7.1**	**$2,586**

In Table A-18, the variances between the reported figures and the information contained in the FirstEnergy EDC tracking databases are presented.

Table A-18: Met-Ed's Non-Residential Program Discrepancies

Program	Number of Participants	MWh/yr	MW	Incentive ($1,000)
C/I Small Energy Efficient Equipment	0	0	0.0	-$45
C/I Small Energy Efficient Buildings	-15	0	0.0	104
C/I Large Energy Efficient Equipment	-2	0	0.0	-$170
C/I Large Energy Efficient Buildings	-161	0	0.0	11
Government & Institutional	0	0	0.0	0
Total	**-178**	**0**	**0.0**	**-$100**

There was zero variance between the tracked and reported energy and demand savings. However, the SWE Team found discrepancies in the number of participants and the total amount of incentives. Variances do not necessarily indicate inadequate QA/QC or incorrect reported values. Variability in the number of participants is connected to the definition of "participant" used by the SWE Team and EDC for a given program or measure. In the case of Met-Ed, the SWE Team's participant counts for Power Direct kits are much higher than Met-Ed's. The SWE Team recommends that Met-Ed and its evaluation contractor memorialize the definition of "participant" in future report filings and compare incentive values reported in the annual report with the information in the tracking data extracts. This will help ensure that reported figures are an accurate representation of project financials.

A.2.3 Sample Design Review

Met-Ed's PY6 annual report provides detailed information about the sample design of the PY6 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.2.3.1 Small C/I Energy Efficient Equipment Program

In PY6, 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.

Over 99% of the PY6 program impact came from the equipment incentives. This component includes lighting projects, custom C/I projects, and prescriptive (HVAC and food service) projects. Custom C/I projects include air compressor projects, water pumping projects, general process improvements, and general space and process cooling improvements. 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 Cv used in the sample design was 0.5 for all projects. The detailed sampling strategy for this program in PY6 and the achieved precision values for each stratum are presented in Table A-19. The data show that Met-Ed met the SWE Team requirements of 85%/15% confidence and precision for both energy and peak demand.

Table A-19: Met-Ed PY6 Sampling Strategy and Relative Precision – C/I Small 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	100.0%	0	0	100.0%	100.0%
Lighting – Certainty	0	N/A	0	0	0.0%	0.0%
Lighting – 2	12	17.6%	7	7	17.6%	17.6%
Lighting – 3	26	21.2%	8	8	21.2%	21.2%
Lighting – 4	201	24.9%	8	8	24.9%	24.9%
Custom – Certainty	0	N/A	0	0	0.0%	0.0%
Custom – 2	3	29.4%	2	2	29.4%	29.4%
Custom – 3	19	48.2%	2	2	48.2%	48.2%
HVAC and DHW-1	0	N/A	0	0	0.0%	0.0%
HVAC and DHW-2	17	69.9%	1	1	69.9%	69.9%
Appliance Turn-in – 1	107	71.7%	1	1	71.7%	71.7%
Kitchen/Appliances-1	2	50.9%	1	1	50.9%	50.9%
Program Total	**387**	**11.4%**	**30**	**30**	**12.2%**	**14.8%**

A.2.3.2 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 C/I Small Efficient Equipment Program above. The sample design strategy and the achieved precision values for energy and demand are shown in Table A-20. The precision levels for energy and for demand met the SWE Team requirements.

Table A-20: Met-Ed PY6 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	2119	14.3%	25	20	16.0%	16.0%
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	0	N/A	0	0	0.0%	0.0%
Custom-2	5	39.4%	2	2	39.4%	39.4%
Custom-3	11	35.5%	3	3	35.5%	35.5%
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	**2135**	**13.2%**	**30**	**25**	**14.7%**	**14.7%**

A.2.3.3 Large C/I Energy Efficient Equipment Program

This program had three components in PY6: equipment incentives, appliance recycling, and conservation kits to multifamily establishments. Equipment incentive measures contributed the majority of the gross energy savings for the 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 PY6 and the achieved precision values for each stratum are presented in Table A-21. The data show that Met-Ed met the SWE Team requirements of 85%/15% confidence and precision for energy and peak demand for this program.

Table A-21: Met-Ed PY6 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	9	0.0%	9	9	0.0%	0.0%
Lighting-2	5	39.4%	2	2	39.4%	39.4%
Lighting-3	17	31.5%	4	4	31.5%	31.5%
Lighting-4	73	35.0%	4	4	35.0%	35.0%
Custom-Certainty	6	0.0%	6	6	0.0%	0.0%
Custom-2	5	64.4%	1	1	64.4%	64.4%
Custom-3	14	47.1%	2	2	47.1%	47.1%
HVAC and DHW-1	0	N/A	0	0	0.0%	0.0%
HVAC and DHW-2	4	62.4%	1	1	62.4%	62.4%
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	**133**	**9.1%**	**29**	**29**	**8.9%**	**9.6%**

A.2.3.4 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 C/I Small Efficient Equipment Program above. The sample design strategy and the achieved precision values for energy and demand are shown in Table A-22. The precision levels for energy and for demand met the SWE Team requirements.

Table A-22: Met-Ed PY6 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	198	23.4%	9	9	23.4%	23.4%
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	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	2	0.0%	2	2	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	**201**	**6.6%**	**12**	**12**	**10.2%**	**4.6%**

A.2.3.5 Government and Institutional Program

This program had three categorical components in PY6: equipment incentives, appliance recycling (new for Phase II), and conservation kits to multifamily establishments. The evaluation contractor reviewed all rebated projects in PY6. The detailed information of the sample design and the achieved precision values for each stratum are shown in Table A-23.

Table A-23: Met-Ed's PY6 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	0	N/A	0	0	0.0%	0.0%
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	1	0.0%	1	1	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**	**0.0%**	**4**	**4**	**0.0%**	**0.0%**

The sample for the entire program was a census and therefore the precision was 0.0%, exceeding the SWE Team's requirements.

A.2.4 Ride-Along Site Inspections

Table A-24 summarizes the SWE Team's PY6 ride-along site inspections of Met-Ed's non-residential project installations. The Met-Ed PY6 site inspection findings are categorized in 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-24: Met-Ed's PY6 Non-Residential Site Inspection Findings

Project ID	Technology	Finding	Finding Type	Resolution
CR_PRJ-234729	Lighting	The evaluator used slightly different fixture wattages than what was found in the manufacturer's specifications. It was not clear why the evaluator chose close, but different, wattages.	Eval	The SWE Team recommends using the manufacturer's specifications and being more diligent about documenting deviances from those in the future.
CR_PRJ-186163	Lighting	While the on-site observations and overall findings appear reasonable to the SWE Team, the SWE Team was not able to fully follow the evaluator's work due to hard-coded values and lack of supporting documentation and/or notation.	Eval	The SWE Team recommends that more documentation be included with project analyses for the sake of clarity. More detailed notes would likely clear up the SWE Team's confusion over the use of certain values, calculators, and approaches.
CR_PRJ-215904	Lighting	The evaluator's on-site observations and verified savings appeared to be correctly performed. There was a slight difference between reported and verified savings due to site-gathered EMS data.	Eval	In the interest of transparency, the SWE Team recommends that the evaluator use the Appendix C calculator for lighting projects moving forward.
CR_PRJ-160629	Lighting	The evaluator used light loggers to determine HOU for the facility, which greatly reduced project energy savings. The SWE Team supports the evaluator's findings and use of site-gathered data over a reported 8,760 HOU.	Pro	In order to mitigate volatile realization rates in the future, the SWE Team recommends the implementation contractor be more diligent when estimating HOU, especially for larger projects such as this.
CR_PRJ-196123	Lighting	Generally, all retrofitted equipment and controls were verified as reported and inputs to the energy savings calculations reflected what was found on-site.	N/A	The SWE Team had no recommendations based on its review of this project.
CR_PRJ-176318	Lighting	The verified savings were lower than reported values generally due to lower verified HOU from site-gathered data. Otherwise, retrofitted equipment and controls were verified as reported and reported energy savings calculations appeared accurate.	Eval	The SWE Team had no recommendations based on its review of this project.
PRJ-191298	Cool Roof	The evaluator used an incorrect algorithm for the verified kW savings.	Eval	The SWE Team recommended that the evaluator use the correct kW approach from the 2014 TRM or best available sources such as end use load shapes.
PRJ-243376	Envelope, insulation, setback controls	The SWE Team found the evaluator's calculator modifications and report to be easy to follow and generally well executed.	N/A	The SWE Team had no recommendations based on its review of this project.
PRJ-388013	Insulation	The SWE Team found that the evaluator's review of the project is accurate.	N/A	The SWE Team had no recommendations based on its review of this project.

Project ID	Technology	Finding	Finding Type	Resolution
PRJ-226726	Refrigeration Controls	The SWE Team performed a duplicate analysis to verify the high realization rate for this project and it matched the evaluator's model.	N/A	The SWE Team had no recommendations based on its review of this project.
PRJ-258843	VFD	The SWE Team performed a duplicate analysis for this project and it matched the evaluator's model.	N/A	The SWE Team had no recommendations based on its review of this project.

A.2.5 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, but would like to see better organization and presentation in the project files. Table A-25 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-25: 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-219164	Lighting-3	216,086	22	On-Site Verification + Logging
Small C/I Equipment	CR_PRJ-165134	Lighting-2	200,087	31	On-Site Verification + Logging
Large C/I Equipment	CR_PRJ-185142	Lighting-Certainty	1,746,556	195	On-Site Verification + EMS Trending Data Analysis + Logging
Large C/I Equipment	CR_PRJ-206939	Custom-Certainty	1,227,395	140	On-Site Verification + Billing Analysis + Metering

Project CR_PRJ-219164 involved the indoor and outdoor lighting retrofits as well as installation of motion sensors at an industrial process facility in Spring Grove, PA. The evaluation contractor performed a site visit to verify the types and quantities of installed fixtures and installed four light loggers throughout the facility. These loggers measured lighting schedules in several locations for 45 days. 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 but would like to see better organization and a more streamlined presentation of the M&V plan and associated documentation. There was a document titled "M&V Plan" in the project file that was blank and appeared to be a template that was not used. The SWE Team would like extraneous documentation like this to be completed or removed from the project file, to improve clarity and transparency.

Project CR_PRJ-165134 involved the indoor and outdoor lighting retrofits at a different building within the same industrial process facility in Spring Grove, PA. The evaluation contractor performed a site visit to verify the types and quantities of installed fixtures and installed four light loggers throughout the facility. These loggers measured lighting schedules in several locations for 37 days. 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-185142 involved lighting retrofits of 378 fixtures, including occupancy sensors, in a non-refrigerated warehouse in York, PA. The facility operates 24/7, and three loggers were placed to confirm this. To determine occupancy sensor impact, the evaluator was able to get EMS data from the facility for a period of 29 days. Verified savings totaled 1,747 MWh/yr and peak demand was 0.20 MW. The SWE Team agrees with the analysis and verified savings for this project.

Project CR_PRJ-206939 involved the replacement of three air compressors with new VFD air compressor systems including computerized demand controls and desiccant dryers at a manufacturing facility in York, PA. The ex ante savings were determined from a two-month billing analysis and extrapolated over the course of a year. This overestimated the savings by not taking into account variations in production and

resulted in the low realization rate of 65%. The verified savings were derived through a combination of billing analysis and metering. Using 18 days of post-retrofit monitoring data and the spec sheets for the baseline compressors, the evaluation contractor calculated the required kW input to produce the same cubic feet per minute (CFM), assuming the CFM for the pre- and post-retrofit compressors will remain the same. The SWE Team agrees with the analysis and verified savings for this project.

A.3 PENELEC

A.3.1 Project Files Review

The SWE Team requested that FirstEnergy make available for review the supporting documentation for 10 projects completed in PY6 from each of the four EDCs. In compliance with the request, FirstEnergy submitted documentation files for 115 projects completed across all four EDCs, including 32 specifically for the Penelec territory.

The SWE Team reviewed nine projects in Penelec's PY6 non-residential programs across various measures, including interior and exterior lighting, VFDs, air compressors, ductless heat pumps, and rooftop units. 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, but showed evidence of loose interpretations of the applicable TRM on many occasions. Of the nine reviewed projects, four were found to have misrepresented and/or illegitimate savings. Details of these projects are provided in the following paragraphs.

Project CR_PRJ-261816 involved installation of four ductless heat pumps. No invoices were submitted to verify the quantity of units installed. Furthermore, the cut sheet and Air-Conditioning Heating & Refrigeration Institute (AHRI) certificate for two of the units both list the SEER as 14.0, which does not meet the TRMs specified minimum cooling efficiency requirement of 14.5. The savings calculator submitted lists the units as having a SEER of 14.5, which is not justified by any of the supporting documentation. Removal of these units from the calculator reduces the savings by more than 50%.

Project CR_PRJ-253980 was a new construction lighting project submitted in PY6 Q3 that claimed 3,631,094 kWh of savings, which accounted for 7% of Penelec's PY6 reported savings. The project file was very thorough, including cut sheets, invoices, a completed COMcheck report, a lighting calculator, and construction drawings. Comparison of the construction drawings to the lighting savings calculator revealed cause for concern in the way the TRM was applied.

The 2014 TRM allows for calculation of new construction lighting savings by one of two methods: the Building-Area-Method, or the Space-by-Space-Method. The Space-by-Space-Method is used to assign appropriate lighting power density (LPD) allowances to the exact square footage of each space within a facility. When square footages are unknown, or if it is otherwise advantageous, the Building-Area-Method provides an LPD allowance that has been calculated as a practical weighted average of all the space types for a given facility type. For the project in question, the ex ante savings were calculated by applying the largest available Space-by-Space-Method LPD allowance to a Building-Area-Method evaluation. A comparison of the results of TRM allowed evaluation methods and the ex ante calculations is presented in Table A-26.

Table A-26: Lighting Power Density Calculations for Project CR_PRJ-253980

Space Type	Square Footage	LPD Allowance	Wattage Allowance
Building Area Method			
Manufacturing	**590,533**	**1.7 w/ft^2**	**1,003,906.10**
Space by Space Method			
Manufacturing <25' ceilings	TBD	1.2 w/ft^2	TBD
Manufacturing >25' ceilings	TBD	1.7 w/ft^2	TBD
Detailed manufacturing	TBD	2.1 w/ft^2	TBD
Equipment Room	TBD	1.2 w/ft^2	TBD
Control Room	TBD	0.5 w/ft^2	TBD
Lobby	TBD	1.3 w/ft^2	TBD
Hallways	TBD	0.5 w/ft^2	TBD
Stairs	TBD	0.6 w/ft^2	TBD
Private Offices	TBD	1.1 w/ft^2	TBD
Total	**590,533**		**~1,003,906.10**
Ex-Ante Savings Calculation Method			
Manufacturing	**590,533**	**2.1 w/ft^2**	**1,240,119.30**

Using the Building-Area-Method, the appropriate allowable power draw for this facility would be 1,004 kW. While exact square footages of the space types within the building have not been identified, it is assumed that the Space-by-Space-Method would provide approximately the same allowable power draw. The ex ante savings, however, provide an overly generous baseline allowable power draw of 1,240 kW. This represents an increase of 20% in the baseline to which the installed measures are compared, ultimately resulting in a decrease in energy and demand savings of 46%. The SWE Team feels it is important to note in this instance that use of the TRM-specified Appendix E calculator would not have allowed these erroneous calculations to occur. Further confusion was introduced to this project file by the inclusion of interactive effects in later versions of the lighting savings calculator where they did not appear in earlier versions; it is unclear from the remaining documents whether the entire facility is conditioned or not.

Project CR_PRJ-281413 was another new construction project submitted in PY6 Q3 that claimed 7,416,671 kWh of savings, which accounted for 13% of Penelec's PY6 reported savings. The majority of the savings were realized by efficient lighting, with only a small portion of savings being attributed to HVAC. Due to the extraordinary size of the project, it seems the evaluation contractor was involved in the savings calculations early on in the project's development. Furthermore, the building is LEED certified and has all of the required paperwork to achieve accreditation. While there is evidence to believe that there are tremendous savings, no savings calculator was submitted for SWE Team review. The baseline LPD calculations are provided, and are calculated in accordance with the TRM. However, there is no supporting documentation or any explanation as to how the installed wattage or LPD was calculated. The 2014 TRM dictates "for projects having a connected load savings of 20 kW or higher, a detailed inventory sheet is required." Omission of this document makes SWE Team verification of the project's alignment with the TRM impossible.

Project CR_PRJ-221539 was a lighting retrofit project also submitted in PY6 Q3. The project file contains three different iterations of the lighting savings calculator, none of which match the tracking data savings values. The tracking data assigns 14,426 kWh of savings to the project; the closest of the three savings calculators claims 14,436 kWh. This particular savings calculator appears to accurately reflect the scope

of work laid out by the invoices, cut sheets, and other supporting documents. It appears the value in the tracking data is erroneous.

In summary, the SWE Team review of Penelec's PY6 project files revealed cause for concern as several instances arose where the TRM was not followed appropriately. The SWE Team provides the following recommendations to ensure the accuracy of the reported savings presented in upcoming program years:

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.

A.3.2 Tracking Data Review

Penelec listed five programs in its non-residential portfolio, all of which achieved energy and demand savings in PY6. Table A-27 provides the reported number of participants, energy savings, demand savings, and incentives from PY6 quarterly reports. The reported gross energy savings was 58,677 MWh/yr, and the reported gross demand savings was 7.7 MW. The C/I Large Energy Efficient Equipment Program achieved the most savings, accounting for 47% and 45% of total energy and demand savings respectively.

Table A-27: Penelec's PY6 Quarterly Reports Summary for Non-Residential Programs

Program	Number of Participants	MWh/yr	MW	Incentive ($1,000)
C/I Small Energy Efficient Equipment	500	17,624	2.6	$1,041
C/I Small Energy Efficient Buildings	3,664	3,740	0.5	$213
C/I Large Energy Efficient Equipment	138	27,860	3.5	$1,460
C/I Large Energy Efficient Buildings	38	9,299	1.0	$565
Government & Institutional	8	154	0.1	$18
Total	**4,348**	**58,677**	**7.7**	**$3,297**

In each quarter, FirstEnergy provided the SWE Team with a tracking database of project activity for each of its operating companies. This database contained the key reporting metrics for each project and reported savings for each quarter and provided additional detail on the types of efficient equipment installed at each site to generate savings. Table A-28 displays the total participant counts, energy and demand savings, and incentives by program, from the FirstEnergy EDCs' tracking databases.

Table A-28: Penelec's PY6 Tracking Database Summary for Non-Residential Programs

Program	Number of Participants	MWh/yr	MW	Incentive ($1,000)
C/I Small Energy Efficient Equipment	499	17,589	2.6	$1,071
C/I Small Energy Efficient Buildings	3,665	3,740	0.5	$67
C/I Large Energy Efficient Equipment	138	27,860	3.5	$1,565
C/I Large Energy Efficient Buildings	131	9,299	1.0	$562

Program	Number of Participants	MWh/yr	MW	Incentive ($1,000)
Government & Institutional	9	189	0.0	$17
Total	**4,442**	**58,677**	**7.7**	**$3,282**

Table A-29 presents the variances between the quarterly report figures and the values derived from the tracking database.

Table A-29: Penelec's Non-Residential Program Discrepancies

Program	Number of Participants	MWh/yr	MW	Incentive ($1,000)
C/I Small Energy Efficient Equipment	1	35	0.0	-$30
C/I Small Energy Efficient Buildings	-1	0	0.0	$146
C/I Large Energy Efficient Equipment	0	0	0.0	-$105
C/I Large Energy Efficient Buildings	-93	0	0.0	$3
Government & Institutional	-1	-35	0.0	$1
Total	**-94**	**0**	**0.0**	**$15**

The total energy and demand impacts provided in the database summary match the figures reported in Penelec's PY6 quarterly reports. Reclassification of a project from the C/I Small Energy Efficient Equipment to the Government & Institutional programs leads to program-level variability that cancels out. Given the compliance target for the GNI sector, EDCs are encouraged to validate that projects are assigned to the correct programs within the non-residential sector to ensure accurate reporting of progress toward goals. Minor variances were found in the number of participants because the SWE used a slightly different methodology to count participants in the Power Direct kit offering. Incentive amounts also differed slightly (less than 0.5%) between the tracking data submission and quarterly report tables.

A.3.3 Sample Design Review

Penelec's PY6 final annual report provides detailed information about the sample design of the PY6 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.3.3.1 Small C/I Energy Efficient Equipment Program

In PY6, 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.

Over 99% of the PY6 program impact came from the equipment incentives. This component includes lighting projects, custom C/I projects, and prescriptive (HVAC and food service) projects. Custom C/I projects include air compressor projects, water pumping projects, general process improvements, and general space and process cooling improvements. 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 PY6 and the achieved precision values for each stratum are presented in Table A-30. The data show that Penelec met the SWE Team requirements of 85%/15% confidence and precision for both energy and peak demand.

Table A-30: Penelec PY6 Sampling Strategy and Relative Precision – C/I Small 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	1	0.0%	1	1	0.0%	0.0%
Lighting – 2	14	22.2%	6	6	22.2%	22.2%
Lighting – 3	51	23.4%	8	8	23.4%	23.4%
Lighting – 4	248	25.0%	8	8	25.0%	25.0%
Custom – Certainty	1	0.0%	1	1	0.0%	0.0%
Custom – 2	3	58.8%	1	1	58.8%	58.8%
Custom – 3	20	70.2%	1	1	70.2%	70.2%
HVAC and DHW-1	0	N/A	0	0	0.0%	0.0%
HVAC and DHW-2	45	71.2%	1	1	71.2%	71.2%
Appliance Turn-in – 1	109	71.7%	1	1	71.7%	71.7%
Kitchen/Appliances-1	5	64.4%	1	1	64.4%	64.4%
Program Total	**497**	**11.6%**	**29**	**29**	**11.7%**	**12.5%**

A.3.3.2 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 C/I Small Efficient Equipment Program above. The sample design strategy and the achieved precision values for energy and demand are shown in Table A-31. The precision levels for energy met the SWE Team requirements, but for demand they were slightly higher than 15%. This is permissible in Phase II.

Table A-31: Penelec's PY6 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	3,651	11.3%	40	22	15.3%	15.3%
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%
Custom-2	3	29.4%	2	2	29.4%	0.0%
Custom-3	6	65.7%	1	1	65.7%	65.7%
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	**3,660**	**10.7%**	**43**	**25**	**13.5%**	**15.2%**

A.3.3.3 Large C/I Energy Efficient Equipment Program

This program had three components in PY6: equipment incentives, appliance recycling, and conservation kits to multifamily establishments. Equipment incentive measures contributed the majority of the gross energy savings for the 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 PY6 and the achieved precision values for each stratum are presented in Table A-32. The data show that Penelec met the SWE Team requirements of 85%/15% confidence and precision for energy and peak demand for this program.

Table A-32: Penelec's PY6 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	6	0.0%	6	6	0.0%	0.0%
Lighting-2	9	21.5%	5	2	44.9%	44.9%

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
Lighting-3	13	18.5%	7	7	18.5%	18.5%
Lighting-4	81	31.2%	5	5	31.2%	31.2%
Custom-Certainty	3	0.0%	3	3	0.0%	0.0%
Custom-2	4	62.4%	1	1	62.4%	62.4%
Custom-3	10	68.3%	1	1	68.3%	0.0%
HVAC and DHW-1	12	68.9%	1	1	68.9%	68.9%
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**	**6.7%**	**29**	**26**	**8.6%**	**10.5%**

A.3.3.4 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 C/I Small Efficient Equipment Program above. The sample design strategy and the achieved precision values for energy and demand are shown in Table A-33. The precision levels for energy and for demand met the SWE Team requirements.

Table A-33: Penelec's PY6 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	124	23.1%	9	11	20.7%	20.7%
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	2	0.0%	2	2	0.0%	0.0%
Custom-2	0	N/A	0	0	0.0%	0.0%
Custom-3	4	62.4%	1	1	62.4%	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%

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	**130**	**7.7%**	**12**	**14**	**4.8%**	**0.5%**

A.3.3.5 Government and Institutional Program

This program had three categorical components in PY6: equipment incentives, appliance recycling (new for Phase II), and conservation kits to multifamily establishments. The detailed information of the sample design and the achieved precision values for each stratum are shown in Table A-34. The precision levels for energy and for demand met the SWE Team requirements.

Table A-34: Penelec's PY6 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	3	0.0%	3	3	0.0%	0.0%
Lighting-3	6	20.8%	4	4	20.8%	20.8%
Lighting-4	0	N/A	0	0	0.0%	0.0%
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	**9**	**9.8%**	**7**	**7**	**7.2%**	**13.0%**

A.3.4 Ride-Along Site Inspections

Table A-35 summarizes the SWE Team's PY6 ride-along site inspections of Penelec's non-residential project installations. The Penelec PY6 site inspection findings are categorized in 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-35: Penelec's PY6 Non-Residential Site Inspection Findings

Project ID	Technology	Finding	Type	Resolution
PRJ-305268	Lighting	Reported HOUs were much higher than what was verified using logging equipment on site, likely due to the site's use of occupancy sensors.	Pro	The SWE Team recommends the FirstEnergy Companies' implementation contractor de-rate HOU when baseline lighting controls are known to be occupancy sensors.
PRJ-333298	Lighting	The SWE Team agrees with the evaluator's findings. The low realization rate found by the evaluator stemmed from a combination of different fixture quantities, fixture types, and HOU.	Pro	To mitigate very high or low realization rates in the future, the SWE Team recommends that the implementation contractor ensure projects are completed without major modifications to the fixture types or quantities listed in the original project application before claiming savings.
PRJ-330859	Lighting	The SWE Team disagrees with the evaluator averaging two different savings calculation approaches to derive annual energy savings for a lighting project. In this case, total per-fixture savings were averaged with the results of a billing analysis to estimate annual energy savings for the project.	Eval	The SWE Team recommends using the savings-per-fixture calculation as the only source for annual energy savings, in accordance with the TRM and the Appendix C calculator.
PRJ-336851	Lighting	The SWE Team agrees with the evaluator's findings. Minor HOU adjustments were necessary in the evaluation due to site-discovered discrepancies.	Pro	The SWE Team recommends that the implementation contractor verify the lighting control system operation with the corporate client in advance of the site visit.
PRJ-214664	Lighting	The SWE Team agrees with the evaluation contractor's approach to the light quantity adjustments as the initial application did not match the site visit.	Eval	The SWE Team has no recommendations based on its review of this project.
PRJ-268757	Lighting	The discovery visit uncovered changes implemented after the application and the evaluation contractor adjusted the ex post savings to account for these lights.	Eval	The SWE Team has no recommendations based on its review of this project.
PRJ-209106	EMS System Replacement	The SWE Team was able to recreate the regression that was supplied by the evaluator with reasonably similar results. The increase in savings and realization rate is due to the more aggressive control set points implemented after the initial planning stages as well as improved ventilation control and heating benefits.	Pro	The SWE Team recommends that the EMS control sequence be requested in advance of the site visit so that the inspection is more time-efficient.
PRJ-223772	Lighting	As the ex ante used no controls, the evaluator adjusted the ex post to account for the occupancy sensors, and the SWE Team agrees with the approach.	Pro	The SWE Team recommends that the implementation contractor confirm with the evaluation contractor if a project is part of a multiple phase effort by a site or client.

Project ID	Technology	Finding	Type	Resolution
PRJ-209123	EMS System Replacement	The SWE Team was able to recreate the regression that was supplied by the evaluator with reasonably similar results. The increase in savings and realization rate is due to the more aggressive control set points implemented after the initial planning stages as well as improved ventilation control and heating benefits.	Pro	The SWE Team recommends that the EMS control sequence be requested in advance of the site visit so that the inspection is more time-efficient.
PRJ-265938	Lighting	The SWE Team agrees with the evaluator's on-site observations and calculations.	N/A	The SWE Team has no recommendations based on its review of this project.
PRJ-199676	Lighting	The SWE Team agrees with the evaluator's on-site observations and calculations.	N/A	The SWE Team has no recommendations based on its review of this project.

A.3.5 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. Table A-36 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-36: 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
Small C/I Equipment	CR_PRJ-260760	Custom-Certainty	525,448	60	On-Site Verification
Large C/I Equipment	CR_PRJ-166844	Lighting-2	275,712	48	On-Site Verification + Logging
Large C/I Equipment	CR_PRJ-167735	Lighting-Certainty	3,529,763	412	On-Site Verification + Logging

Project CR_PRJ-260760 involved the installation of two new 100 hp VFD air compressors and a cycling refrigerated air dryer, low pressure drop mist eliminator filter, and flow controller at a distribution center in Woodland, PA. The old compressors had been oversized for the situation and were inefficient. As-Built compressor amp monitoring was provided to the evaluator by the site, from which the typical kW demand profile and CFM output of the compressors was determined for each day of the week. Using the assumption that the CFM for the pre- and post-retrofit compressors remains the same, the demand of the baseline system was determined using CAGI compressor curves. The weekly energy and demand savings were then extrapolated to an entire year to get annual savings of 525,448 kWh and 60 kW.

Project CR_PRJ-166844 involved a lighting retrofit of nearly 300 fixtures at a hospital in Erie, PA. Interior T12 fluorescent bulbs were replaced with high-efficiency T8 bulbs. The evaluator deployed 12 lighting loggers in various locations for 33 days to measure actual HOU. It is primarily the difference between claimed and metered HOU that accounts for the low realization rate of 61%.

Project CR_PRJ-167735 involved a lighting retrofit of over 800 fixtures at a manufacturing facility in Erie, PA. High-intensity discharge (HID) and fluorescent fixtures were replaced with induction fixtures, resulting in 3,529,763 kWh of savings. A total of 18 light loggers were deployed, revealing 24/7 or close to 24/7 operation. This resulted in a high kWh realization rate of 126% and a kW realization rate of 171%. The SWE Team would have liked to have more photographs of the facility. The only three photos provided by the evaluator were of the site visit sheets.

A.4 PENN POWER

A.4.1 Project Files Review

The SWE Team requested that FirstEnergy make available for review the supporting documentation for 10 projects completed in PY6 from each of the four EDCs. In compliance with the request, FirstEnergy submitted documentation files for 115 projects completed across all four EDCs, including 20 specifically for the Penn Power territory.

The SWE Team reviewed eight projects in Penn Power's PY6 program across various measures, including process improvements, ductless heat pumps, HVAC units and dual enthalpy economizers, 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, with only minor errors unique to particular projects. Of the eight reviewed projects, two were found to contain errors. The details of the identified issues are presented in the following paragraphs.

Project CR_PRJ-255941 was a new construction ductless mini-split heat pump application submitted in PY6 Q2. The project file contained an invoice, cut sheet, W9, and a savings calculator. The savings calculator submitted does not follow the algorithms in the 2014 TRM for calculating savings associated with ductless heat pumps. Specifically, the kW savings calculation does not include the 25% load factor specified by the TRM. In addition, the equivalent full load hours (EFLH) value selected does not appropriately reflect the city and building type of the application. Table 3-68 of the 2014 TRM specifies that a hospital in Pittsburgh would have an EFLH of 1,177. An EFLH of 1,052 (which is what the savings calculator uses) is representative of a hospital in Williamsport, which is not the closest town to the facility in question.

Project CR_PRJ-293430 was completed in PY6 Q3 and claimed 10,692,842 kWh of savings. This equates to 37% of Penn Power's PY6 total reported annual savings. The project provided incentives for process improvements in which the customer completed upgrades to a facility that would allow for use of three hot strip mills where only two were previously functioning. The savings were calculated by comparing the electricity used by the plant to the amount of plant production. The plant efficiency was increased from almost 100 kWh/ton to 80 kWh/ton. A file labeled "Spec Sheet" within the project file states:

> *There are no manufacturer specification sheets for this project. The work performed to enable the 3rd furnace operation was structural on a large custom industrial furnace with no standard specifications. The scope of work done to #3 furnace is provided in "Material Description" section of invoices provided.*

The referenced invoices detail work completed on an existing gas-fired furnace in order to increase the furnace's efficiency. This includes work such as "roof repair" and "reline water piping with refractory." The executive summary and a report filed by the evaluation contractor both allude to a controls upgrade that allows for more efficient operation; however, no supplemental material (such as invoice or cut sheet) validate these claims. Further collaboration with the evaluation contractor revealed that the existing furnace was designed as a standby furnace, and that substantial upgrades to the whole facility were completed in order to incorporate the furnace into the day-to-day operation of the plant. Despite the fact that the furnace is a gas-fired unit, the use of three furnaces as opposed to two significantly reduced the electric usage of the facility. While the SWE Team views this as an eligible measure for Act 129, the project files are not indicative of the work completed on site.

In summary, the SWE Team review of Penn Power's PY6 project files revealed cause for concern in regards to clarity of project files and appropriate use of the TRM. The SWE Team provides the following recommendations to ensure the accuracy of the reported savings presented in upcoming program years:

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 organized documentation should be kept on record to properly capture each project's full scope of work within its project file.

A.4.2 Tracking Data Review

Penn Power listed five programs in its non-residential portfolio, all of which achieved energy savings and three of which achieved demand savings during PY6. The number of participants, gross reported energy impact, gross reported demand impact, and reported incentives are shown in Table A-37. The reported gross energy savings from non-residential programs was 30,160 MWh/yr, and the reported gross demand savings was 3.7 MW. The C/I Large Energy Efficient Equipment Program achieved the highest savings, accounting for 64% and 60% of the total energy and demand saving respectively.

Table A-37: Penn Power's PY6 Quarterly Reports Summary for Non-Residential Programs

Program	Number of Participants	MWh/yr	MW	Incentive ($1,000)
C/I Small Energy Efficient Equipment	127	8,498	1.0	$337
C/I Small Energy Efficient Buildings	1,238	2,350	0.4	$204
C/I Large Energy Efficient Equipment	21	19,172	2.2	$696
C/I Large Energy Efficient Buildings	8	27	0.0	$2
Government & Institutional	1	113	0.0	$14
Total	**1,395**	**30,160**	**3.7**	**$1,253**

In each quarter, FirstEnergy provided the SWE Team with a database of project activity for each of its operating companies. This database contained the key reporting metrics for each project, reporting savings for each quarter as well as additional detail on the types of efficient equipment installed at each site to generate savings. Table A-38 contains the tracked total participant counts, energy and demand savings, and incentives by program, from Penn Power's non-residential projects.

Table A-38: Penn Power's PY6 Tracking Database Summary for Non-Residential Programs

Program	Number of Participants	MWh/yr	MW	Incentive ($1,000)
C/I Small Energy Efficient Equipment	127	8,498	1.0	$355
C/I Small Energy Efficient Buildings	1,245	2,350	0.4	$140
C/I Large Energy Efficient Equipment	21	19,172	2.2	$717
C/I Large Energy Efficient Buildings	31	27	0.0	$0
Government & Institutional	1	113	0.0	$14
Total	**1,425**	**30,160**	**3.7**	**$1,226**

Table A-39 displays the variances between the reported figures and the information contained in the FirstEnergy EDCs' tracking databases.

Table A-39: Penn Power's Non-Residential Program Discrepancies

Program	Number of Participants	MWh/yr	MW	Incentive ($1,000)
C/I Small Energy Efficient Equipment	0	0	0.0	-$18
C/I Small Energy Efficient Buildings	-7	0	0.0	$64
C/I Large Energy Efficient Equipment	0	0	0.0	-$21

Program	Number of Participants	MWh/yr	MW	Incentive ($1,000)
C/I Large Energy Efficient Buildings	-23	0	0.0	$2
Government & Institutional	0	0	0.0	$0
Total	**-30**	**0**	**0.0**	**$27**

The total energy and demand impacts provided in the database summary match perfectly the figures reported in Penn Power's quarterly reports across all non-residential programs. The only differences observed relate to the participant counts and the incentive amounts provided for each program. Based on the SWE Team's audit findings, we recommend that Penn Power and its evaluation contractor memorialize and consistently apply the definition of "participant" for measures such as Power Direct kits. Although the observed differences are minimal, reported incentive payments should also be carefully compared to those listed in tracking data extracts to ensure consistency.

Variances do not necessarily indicate inadequate QA/QC or incorrect reported incentive amounts. This variation often is the result of CSPs or evaluation contractors discovering a mistake or obtaining additional information about a project after the close of the quarter and modifying the record in the program tracking system. The SWE Team understands that program tracking is a continuous process and historical corrections are expected and encouraged.

A.4.3 Sample Design Review

Penn Power's PY6 annual report provides detailed information about the sample design of the PY6 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.4.3.1 Small C/I Energy Efficient Equipment Program

In PY6, 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.

Over 90% of the PY6 program impact came from the equipment incentives. This component includes lighting projects, custom C/I projects, and prescriptive (HVAC and food service) projects. Custom C/I projects include air compressor projects, water pumping projects, general process improvements, and general space and process cooling improvements. 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 PY6 and the achieved precision values for each stratum are presented in Table A-40. The data show that Penn Power met the SWE Team requirements of 85%/15% confidence and precision for both energy and peak demand.

Table A-40: Penn Power's PY6 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	3	29.4%	2	2	29.4%	29.4%
Lighting – 3	16	31.2%	4	4	31.2%	31.2%
Lighting – 4	75	22.5%	9	9	22.5%	22.5%
Custom – Certainty	1	0.0%	1	1	0.0%	0.0%
Custom – 2	0	N/A	0	0	0.0%	0.0%
Custom – 3	4	62.4%	1	1	62.4%	62.4%
HVAC and DHW-1	0	N/A	0	0	0.0%	0.0%
HVAC and DHW-2	7	66.7%	1	1	66.7%	66.7%
Appliance Turn-in – 1	17	69.9%	1	1	69.9%	69.9%
Kitchen/Appliances-1	3	58.8%	1	1	58.8%	58.8%
Program Total	**126**	**8.3%**	**20**	**20**	**8.5%**	**10.3%**

A.4.3.2 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 C/I Small Efficient Equipment Program above. The sample design strategy and the achieved precision values for energy and demand are shown in Table A-41. The precision levels for energy and for demand met the SWE Team requirements.

Table A-41: Penn Power's PY6 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	1241	14.9%	23	9	23.9%	23.9%
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%
Custom-2	1	0.0%	1	1	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-3	2	0.0%	2	2	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	**1244**	**7.0%**	**26**	**12**	**10.8%**	**12.4%**

A.4.3.3 Large C/I Energy Efficient Equipment Program

This program had three components in PY6: equipment incentives, appliance recycling, and conservation kits to multifamily establishments. Equipment incentive measures contributed the majority of the gross energy savings for the 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 PY6 and the achieved precision values for each stratum are presented in Table A-42. The data show that Penn Power met the SWE Team requirements of 85%/15% confidence and precision for energy and peak demand for this program.

Table A-42: Penn Power's PY6 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	1	0.0%	1	1	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	11	35.5%	3	3	35.5%	35.5%
Custom-Certainty	5	0.0%	5	5	0.0%	0.0%
Custom-2	0	N/A	0	0	0.0%	0.0%
Custom-3	2	50.9%	1	1	50.9%	50.9%
HVAC and DHW-1	0	N/A	0	0	0.0%	0.0%
HVAC and DHW-2	2	50.9%	1	1	50.9%	50.9%

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	**21**	**3.8%**	**11**	**11**	**9.5%**	**8.3%**

A.4.3.4 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 C/I Small Efficient Equipment Program above. The sample design strategy and the achieved precision values for energy and demand are shown in Table A-43. However, the evaluator ended up evaluating a census of the population, and therefore the achieved precision was 0%. This precision satisfied the SWE Team requirements.

Table A-43: Penn Power PY6 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	31	20.2%	9	31	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	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	**31**	**0.0%**	**9**	**31**	**0.0%**	**0.0%**

A.4.3.5 Government and Institutional Program

This program had three categorical components in PY6: equipment incentives, appliance recycling (new for Phase II), and conservation kits to multifamily establishments. The evaluation contractor reviewed all rebated projects in PY6. The detailed information of the sample design and the achieved precision values for each stratum are shown in Table A-44.

Table A-44: Penn Power's PY6 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	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%
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	**1**	**0.0%**	**1**	**1**	**0.0%**	**0.0%**

The sample for the entire program was a census and therefore the precision was 0.0%, exceeding the SWE Team's requirements.

A.4.4 Ride-Along Site Inspections

Table A-45 summarizes the SWE Team's PY6 ride-along site inspections of Penn Power's non-residential project installations. The Penn Power PY6 site inspection findings are categorized in two types:

- Evaluation (Eval) findings are associated with ride-along site inspections and may reflect site activities or the evaluation contractor's savings calculations or reports.
- Process (Pro) findings are associated with project applications, documents, or implementation activities.

Table A-45: Penn Power's PY6 Non-Residential Site Inspection Findings

Project ID	Technology	Finding	Finding Type	Resolution
PRJ-377221	Lighting	The fixture counts and HOU employed in the verified savings analysis did not appear to match the data collected on-site. Also, baseline fixture wattages were changed without any notes or clarifying calculations.	Eval	It was not clear why this approach had been taken by FirstEnergy Companies' evaluation contractor, as there was little supporting documentation included in the analysis.
PRJ-250280	Lighting	The evaluator did ~~not~~ use the baseline wattages provided in the TRM, where available, and added a 30W baseline for some 5" traffic lights that were not in the TRM.	Eval	The SWE Team recommends that the evaluator change the baseline wattages to reflect the evaluator's previous method of scaling TRM wattages by surface area in cases where a traffic light is not listed in the TRM.

A.4.5 Verified Savings Review

The SWE Team reviewed a subset of Penn Power's sampled sites and, in general, found appropriate rigor in the evaluation contractor's M&V methods. Table A-46Table A-46: 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-46: 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 Equipment	CR_PRJ-233599	Custom-3	8,453	1	Billing Analysis and Energy Simulation
Large C/I Equipment	CR_PRJ-202876	Lighting-4	954,490	109	On-Site Verification + Logging
Large C/I Equipment	CR_PRJ-272721	Custom-Certainty	1,683,758	253	On-Site Verification + Metering or Logging

Project CR_PRJ-233599 involved the installation of an economizer and DC blower on a 46,000 Btu air-conditioning unit used for process cooling on an electrical shelter at the base of a cell tower in Mercer, PA. The retrofit of the blower fan reduced the energy use of the fan from 0.00084 kW/CFM to 0.00043 kW/CFM. A billing analysis was performed to verify the savings of the project, but the internal loads of the shelter were not constant pre- and post-retrofit, so an analysis was done on the bills of an identical project in a different part of the state. The regression was performed with heating and cooling degree-days as independent variables, which were then corrected with TMY3 values for the Mercer, PA location. The low kWh realization rate of 77% is a result of an overestimation of internal load used to develop ex ante savings.

Project CR_PRJ-202876 involved the replacement of metal halide fixtures with high-bay LED fixtures in a manufacturing facility in Sharon, PA. Two light loggers were deployed that metered for 45 days. One found that the lights operated for 8,760 hours per year, but the other one measured less usage. This second one metered a different section of lights that was not part of this project number, so it was not used. In addition to the higher than ex ante HOU, the evaluator discovered that the baseline fixtures were 1,000W metal halide rather than the 400W used in the ex ante analysis. This resulted in the extra-high 419% realization rate for kWh.

Project CR_PRJ-272721 involved replacing a DC motor, generator field, synchronous field supply, lubrication pumps, and cooling fans with a more efficient air-conditioner motor that doesn't require the ancillary equipment at a manufacturing facility in Farrell, PA. The existing motor was monitored at 1-second intervals for a typical day, from which the evaluator developed a system efficiency curve and loading profile. HOUs were determined using shift schedules.

A.5 WEST PENN

A.5.1 Project Files Review

The SWE Team requested that FirstEnergy make available for review the supporting documentation for 10 projects completed in PY6 from each of the four EDCs. In compliance with the request, FirstEnergy submitted documentation files for 115 projects completed across all four EDCs, including 36 specifically for the West Penn territory.

The SWE Team reviewed nine projects in West Penn's PY6 program across various measures, including pumps, chillers, EMSs, packaged terminal air conditioners, interior and exterior lighting, and retrocommissioning. 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. Of the nine reviewed projects, only two were found to be insufficiently documented. Details of these projects are provided in the following paragraphs.

Projects CR_PRJ-256787 and CR_PRJ-256999 were two of eight projects submitted in PY6 Q2 for the same customer. The tracking database provides details for the two projects as shown in Table A-47.

Table A-47: Select Project Details from West Penn's PY6 Tracking Database

Project ID	Measure	kW Savings	kWh Savings
CR_PRJ-256787	Custom – Small C/I	22.0	109,668
CR_PRJ-256999	Energy Efficient Exterior Lighting – Large C/I	0.0	368,384

The project files submitted for each ID are identical and include:

- An audit completed by the customer-chosen energy service company
- The evaluation contractor's report of the aggregated savings for all eight projects completed by the customer
- Aggregated billing data for all eight locations
- Cut sheets for a 15-hp Baldor motor and a Peerless pump
- VFD savings calculations

No lighting cut sheets or savings calculations were provided in either project file. The audit report details the suggested ECMs at each of the eight locations, each of which is unique with varying pump sizes and scopes of work. From the identical documents submitted, it is unclear which scope of work or location belongs to which project ID. Furthermore, the savings report submitted by the evaluation contractor contains the summary provided in Table A-48.

Table A-48: Customer Submitted Savings Report of Eight Aggregated Projects

Station	Savings	kW Reduction
1	230,116	30
2	132,935	17
3	separate rebate	N/A
4	25,282	10
5	128,798	33
6	109,688	22
7		
8		

Note that several line items are left blank and that only tracking data for CR_PRJ-256787 match a project on the evaluator's list. In summary, the apparent omissions and lack of organization make it impossible for the SWE Team to properly understand the two projects submitted.

Despite the inconsistency noted above, the SWE Team is pleased overall with West Penn's PY6 project files. The review process was almost seamless, identifying only one issue that seems to affect only two projects in the sample selected by the SWE Team, and possibly eight within the West Penn portfolio. At this time, the SWE Team only recommends that greater care be taken to ensure that each project file properly captures the project's full scope of work, particularly in the case of aggregated projects.

A.5.2 Tracking Data Review

West Penn listed five programs in its non-residential portfolio, all of which achieved energy and demand savings in PY6. The number of participants, gross reported energy impact, gross reported demand impact, and reported incentives associated with each program are shown in Table A-49. The reported gross energy savings from non-residential programs was 70,499 MWh/yr, and the reported gross demand savings was 8.8 MW. The C/I Large Energy Efficient Equipment Program was responsible for a large portion of the non-residential portfolio savings, accounting for 63% and 44% of the total energy and demand savings respectively.

Table A-49: West Penn's PY6 Quarterly Reports Summary for Non-Residential Programs

Program	Number of Participants	MWh/yr	MW	Incentive ($1,000)
C/I Small Energy Efficient Equipment	543	16,837	2.6	$1,087
C/I Small Energy Efficient Buildings	3,576	3,351	0.7	$202
C/I Large Energy Efficient Equipment	108	47,932	5.1	$2,173
C/I Large Energy Efficient Buildings	29	1,911	0.3	$129
Government & Institutional	12	468	0.1	$24
Total	**4,268**	**70,499**	**8.8**	**$3,615**

FirstEnergy provided the SWE Team with a database of project activity for each of its operating companies in each quarter. This database contained the key reporting metrics for each project reporting savings for each quarter as well as additional detail on the types of efficient equipment installed at each site to generate savings. Table A-50 contains the tracked total participant counts, energy and demand savings, and incentives by program for West Penn's non-residential projects.

Table A-50: West Penn's PY6 Tracking Database Summary for Non-Residential Programs

Program	Number of Participants	MWh/yr	MW	Incentive ($1,000)
C/I Small Energy Efficient Equipment	543	16,906	2.6	$1,122
C/I Small Energy Efficient Buildings	3,587	3,350	0.7	$48
C/I Large Energy Efficient Equipment	107	47,842	5.1	$2,242
C/I Large Energy Efficient Buildings	132	1,911	0.3	$123
Government & Institutional	13	489	0.1	$37
Total	**4,382**	**70,498**	**8.8**	**$3,571**

In Table A-51, the variances between the reported and the tracked figures are presented.

Table A-51: West Penn's Non-Residential Program Discrepancies

Program	Number Participants	MWh/yr	MW	Incentive ($1,000)
C/I Small Energy Efficient Equipment	0	-69	0.0	-$35
C/I Small Energy Efficient Buildings	-11	0	0.0	$154
C/I Large Energy Efficient Equipment	1	90	0.0	-$69
C/I Large Energy Efficient Buildings	-103	0	0.0	$6
Government & Institutional	-1	-21	0.0	-$13
Total	**-114**	**0**	**0.0**	**$44**

The SWE Team observed minor variances in the number of participants and in the incentive amounts. Offsetting differences in energy and demand impacts were noted among programs, likely due to reclassification of completed projects. Therefore, the SWE Team recommends that West Penn and its evaluation contractor conduct a thorough review of the tracking database to ensure that filed projects are accurately represented—especially projects that contribute toward the GNI compliance target. Variances do not necessarily indicate inadequate QA/QC or incorrect reported incentive amounts. This variation often is the result of CSPs or evaluation contractors discovering a mistake or obtaining additional information about a project after the close of the quarter and modifying the record in the program tracking system. The SWE Team understands that program tracking is a continuous process and historical corrections are expected and encouraged.

A.5.3 Sample Design Review

West Penn's PY6 final annual report provides detailed information about the sample design of the PY6 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.5.3.1 Small C/I Energy Efficient Equipment Program

In PY6, 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.

Over 99% of the PY6 program impact came from the equipment incentives. This component includes lighting projects, custom C/I projects, and prescriptive (HVAC and food service) projects. Custom C/I projects include air compressor projects, water pumping projects, general process improvements, and general space and process cooling improvements. 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 PY6 and the achieved

precision values for each stratum are presented in Table A-52. The data show that West Penn met the SWE Team requirements of 85%/15% confidence and precision for both energy and peak demand.

Table A-52: West Penn's PY6 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	1	0.0%	1	1	0.0%	0.0%
Lighting – 2	22	22.5%	7	7	22.5%	22.5%
Lighting – 3	62	25.6%	7	7	25.6%	25.6%
Lighting – 4	258	23.6%	9	9	23.6%	23.6%
Custom – Certainty	6	0.0%	6	6	0.0%	0.0%
Custom – 2	0	N/A	0	0	0.0%	0.0%
Custom – 3	39	34.1%	4	2	49.6%	49.6%
HVAC and DHW-1	0	N/A	0	0	0.0%	0.0%
HVAC and DHW-2	39	71.1%	1	1	71.1%	71.1%
Appliance Turn-in – 1	105	71.7%	1	1	71.7%	71.7%
Kitchen/Appliances-1	11	68.6%	1	1	68.6%	0.0%
Program Total	**543**	**11.6%**	**37**	**35**	**12.4%**	**11.8%**

A.5.3.2 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 C/I Small Efficient Equipment Program above. The sample design strategy and the achieved precision values for energy and demand are shown in Table A-53. The precision levels for energy and for demand met the SWE Team requirements.

Table A-53: West Penn's PY6 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	3575	17.4%	17	27	13.8%	13.8%
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	0	N/A	0	0	0.0%	0.0%
Custom-3	7	31.4%	3	3	31.4%	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	**3582**	**15.5%**	**20**	**30**	**12.7%**	**13.8%**

A.5.3.3 Large C/I Energy Efficient Equipment Program

This program had three components in PY6: equipment incentives, appliance recycling, and conservation kits to multifamily establishments. Equipment incentive measures contributed the majority of the gross energy savings for the 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 PY6 and the achieved precision values for each stratum are presented in Table A-54. The data show that West Penn met the SWE Team requirements of 85%/15% confidence and precision for energy and peak demand for this program.

Table A-54: West Penn's PY6 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	39.4%	2	2	39.4%	39.4%
Lighting-3	8	32.9%	3	3	32.9%	32.9%
Lighting-4	60	40.5%	3	3	40.5%	40.5%
Custom-Certainty	16	0.0%	16	16	0.0%	0.0%
Custom-2	10	45.5%	2	2	45.5%	45.5%
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	3	58.8%	1	1	58.8%	58.8%

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	**106**	**4.0%**	**31**	**31**	**4.4%**	**4.3%**

A.5.3.4 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 C/I Small Efficient Equipment Program above. The sample design strategy and the achieved precision values for energy and demand are shown in Table A-55. The precision levels for energy and for demand met the SWE Team requirements.

Table A-55: West Penn PY6 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	128	23.1%	9	3	41.1%	41.1%
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	0	N/A	0	0	0.0%	0.0%
Custom-3	2	50.9%	1	1	50.9%	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	**132**	**8.4%**	**12**	**6**	**4.2%**	**3.4%**

A.5.3.5 Government and Institutional Program

This program had three components in PY6: equipment incentives, appliance recycling, and conservation kits to multifamily establishments. West Penn's evaluator sampled 8 of the 13 projects completed in PY6. Information about the sample design and achieved precision values for each stratum is provided in Table

A-56. The achieved precision value for energy met the SWE Team requirements of 85%/15% confidence and precision level, but for demand it was slightly higher, at 17.1%.

Table A-56: West Penn's PY6 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	2	0.0%	2	2	0.0%	0.0%
Lighting-3	2	0.0%	2	2	0.0%	0.0%
Lighting-4	8	32.9%	3	3	32.9%	32.9%
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	1	0.0%	1	1	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	**13**	**7.2%**	**8**	**8**	**10.2%**	**17.1%**

A.5.4 Ride-Along Site Inspections

Table A-57 summarizes the SWE Team's PY6 ride-along site inspections of West Penn's non-residential project installations. The West Penn PY6 site inspection findings are categorized in two types:

- Evaluation (Eval) findings are associated with ride-along site inspections and may reflect site activities or the evaluation contractor's savings calculations or reports.
- Process (Pro) findings are associated with project applications, documents, or implementation activities.

Table A-57: West Penn's PY6 Non-Residential Site Inspection Findings

Project ID	Technology	Finding	Finding Type	Resolution
PRJ-377094	Lighting	The fixture counts and HOU employed in the verified savings analysis did not appear to match the data collected on-site. Also, baseline fixture wattages were changed without any notes or clarifying calculations.	Eval	It was not clear why this approach had been taken by FirstEnergy Companies' evaluation contractor, as there was little supporting documentation included in the analysis.
PRJ-192987	Lighting	The SWE Team agrees with the evaluation contractor but notes that the reported savings appear to be based on pre-project scope documents and not as-built documents.	Pro	In an effort to mitigate volatile realization rates, the SWE Team recommends the implementation contractor ensure the project savings are based on the latest version of project documents possible.
PRJ-315136	Lighting	Ex post findings were lower due primarily to FirstEnergy Companies' evaluation contractor's on-site logger findings.	Pro	In order to reduce the volatility of realization rates in the future, the SWE Team recommends that FirstEnergy Companies' implementation contractor focus more on ensuring accurate reported savings values through increased attention to key parameters such as equipment quantities and hours of operation.
PRJ-333715	Lighting	The SWE Team agrees with the evaluator's on-site observations and calculations.	N/A	The SWE Team has no recommendations based on its review of this project.
PRJ-349751	Lighting	The SWE Team agrees with the evaluator's on-site observations and calculations.	N/A	The SWE Team has no recommendations based on its review of this project.
PRJ-281063	Lighting	The SWE Team disagrees with the evaluator changing of the ex ante T12 baseline wattage, as not enough supporting information was provided to justify this change.	Eval	The SWE Team recommends using the application baseline wattage for the T12 fixtures unless additional information is provided to support ADM's recommended change.
PRJ-247947	Lighting	The SWE Team agrees with the evaluator's approach to the project given the significant discrepancies discovered on-site.	Eval	The SWE Team recommends that the implementation contractor provide more detail on the installed locations of the lights and improved communication.
PRJ-365609	Lighting	The SWE Team agrees with the evaluator's on-site observations and calculations.	N/A	The SWE Team has no recommendations based on its review of this project.
PRJ-224652	Lighting	The SWE Team agrees with the evaluator's on-site observations and calculations.	N/A	The SWE Team has no recommendations based on its review of this project.
PRJ-243378	Lighting	The SWE Team agrees with the evaluator's on-site observations and calculations.	N/A	The SWE Team has no recommendations based on its review of this project.
PRJ-212893	Lighting	The SWE Team agrees with the evaluator's on-site observations and calculations.	N/A	The SWE Team has no recommendations based on its review of this project.
PRJ-377094	Lighting	The SWE Team agrees with the evaluator's on-site observations and calculations.	N/A	The SWE Team has no recommendations based on its review of this project.

Project ID	Technology	Finding	Finding Type	Resolution
PRJ-352854	Lighting	The SWE Team agrees with the evaluator's on-site observations and calculations.	N/A	The SWE Team has no recommendations based on its review of this project.
PRJ-354138	Lighting	The SWE Team agrees with the evaluator's on-site observations and calculations.	N/A	The SWE Team has no recommendations based on its review of this project.

A.5.5 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. Table A-58 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-58: 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
Government	CR_PRJ-239595	Lighting-4	30,691	0	On-Site Verification
Small C/I Equipment	CR_PRJ-218586	Lighting-Certainty	667,699	208	On-Site Verification + Logging
Large C/I Equipment	CR_PRJ-256153	Custom-2	187,596	26	On-Site Verification + Metering or Logging
Large C/I Equipment	CR_PRJ-244366	Lighting-Certainty	1,408,728	182	On-Site Verification + Logging
Large C/I Equipment	CR_PRJ-239240	Lighting-Certainty	5,958,924	697	On-Site Verification + Logging

Project CR_PRJ-239595 involved the replacement of 102 mercury vapor streetlights with high-pressure sodium streetlights in Greensburg, PA. The evaluation consisted solely of an on-site verification of installation.

Project CR_PRJ-218586 involved the replacement of metal halide fixtures with T5 fixtures and occupancy sensors in a manufacturing facility in Waynesboro, PA. Nine light loggers were deployed for 31 days (one failed and did not collect data) and the metered HOUs were less than those used for the ex ante calculations. This was the main contributing factor to the low kWh realization rate of 69%.

Project CR_PRJ-256153 involved integration of an additional receiver into the compressed air system of a manufacturing facility in Brownsville, PA. The evaluator used amperage data monitored at the compressor from pre- and post-installation to develop power profiles for weekend and weekday use. The calculation of the ex ante savings used an algorithm incorrectly, therefore underestimating savings. This is the primary reason for the kWh realization rate of 157%.

Project CR_PRJ-244366 involved the replacement of over 600 metal halide fixtures with T8 fixtures (some with occupancy sensors) in an industrial facility in Mt. Pleasant, PA. The evaluator placed 8 light loggers to determine actual HOU, which greatly exceeded that used in the ex ante analysis. This higher HOU resulted in the kWh realization rate of 152%.

Project CR_PRJ-239240 involved a new construction lighting project at an industrial facility in Brackenridge, PA. Due to the security level of the facility, no photographs were allowed to be taken and no light loggers deployed. However, EMS data showed that operating hours were 8,760 and the evaluator confirmed installation of all light fixtures.

A.6 PECO

A.6.1 Project Files Review

During PY6, 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 the most part, PECO's project documentation was complete, well organized, and clearly labeled. However, the SWE Team noticed some oversights in savings assumptions that could lead to inaccurate savings.

A.6.1.1 Smart Equipment Incentives Program (C/I and GNI)

The SWE Team reviewed nine projects from PECO's Smart Equipment Incentives Program in PY6. Most of the project files contained application summaries, invoices, equipment specifications/cut sheets, incentive worksheets, and savings calculators. Overall, the SWE Team is impressed with the completeness, organization, and clarity of the supporting documents. However, there were three projects that contained discrepancies and lack of proper documentation.

Project PECO-13-05371 was a lighting measure that replaced incandescent bulbs with LEDs. The Appendix C calculator claimed that a total of 180 LEDs were installed, but the invoice showed that only 80 were purchased. It's unclear whether a second invoice was just omitted from the files or if the claimed quantity was incorrect. If the quantity is incorrect, this discrepancy would result in reported energy and demand savings that are overstated by over 50%. Also, the incentive on the application is different from the incentive that was ultimately recorded in the tracking database.

Project PECO-14-05762 involved installing VFDs on HVAC fans. The project application, invoice, and Appendix D calculator indicated that a total of five VFDs (two 2-hp, two 5-hp, and one 1-hp) were installed. However, the tracking database reported savings for four VFDs (two 3-hp and two 5-hp). The SWE Team recommends adjusting the kWh and kW savings in the tracking database.

Project PECO-14-05911 consisted of lighting measures implemented in an office building. The Appendix C calculator showed that the new lights were installed in four space types: common area, bathroom, cafeteria, and exterior. The common area and the bathroom used site-specific HOU values of 8,760 and 3,120 respectively. No source was provided for the custom HOU, so it is unclear how the site-specific HOUs were determined. In addition, the cafeteria space type used the TRM default CF for office buildings. The SWE Team emphasizes that the sources for the HOU and CF values must be consistent. Even though savings for occupancy sensors were claimed, it was difficult to determine the quantity of sensors purchased from the invoices.

A.6.1.2 Smart Construction Incentives Program

The SWE Team reviewed a sample of seven PY6 projects from the Smart Construction Incentives Program. Most of the projects contained savings calculators, invoices, application forms, and incentive worksheets. However, the supporting documents were not consistent across all projects. In general, lighting measures used accurate savings assumptions but lacked product specifications/cut sheets. The SWE Team also observed common errors in HVAC measures.

Project PECO-14-05478 was an HVAC measure that involved the installation of air source air conditioners. Supporting documents include an American Institute of Architects (AIA) document, invoice, savings calculator, and AHRI certificate of product ratings. While the supporting documents were sufficient to verify key assumptions used to calculate savings, the SWE Team noted a minor discrepancy. The HVAC calculator reported 1,435 kWh and 1.09 kW in savings, while the tracking database reported 1,435 kWh

and 1.25 kW for energy and demand savings, respectively. The SWE Team notes that the values in the calculator are incorrect because SEER ratings were not converted to Energy Efficiency Ratio (EER) when calculating peak demand savings. The SWE Team recommends revising the supplemental calculator to account for this error.

Project PECO-14-05811 involved both HVAC and lighting upgrades. Project files included application summary, application, invoices, incentives worksheet, lighting compliance certification, photos of nameplates, savings calculators, and a lighting plan. For the HVAC measures, the tracking database reported a total savings of 10,028 kWh and 4.7 kW, while the HVAC calculator reported 10,028 kWh and 7.6 kW in savings. The SWE Team notes that the calculator savings should be revised because SEER ratings were not converted to EER when determining peak demand savings. Finally, although Appendix E calculations seemed to be correct, there was no supporting information that would allow the SWE Team to verify wattages of the installed equipment.

Project PECO-14-06069 involved HVAC and lighting upgrades. The HVAC calculator did not convert SEER to EER for calculating peak demand savings. Also, the final incentive was provided for five air conditioner units, but the HVAC calculator and the EDC database only claimed savings for two air conditioner units. This potential misalignment between program costs and claimed savings should be investigated further by PECO program staff to ensure that energy and demand savings are not being left unclaimed. Finally, there were no product specification documents to verify the wattages of the installed lighting equipment.

A.6.1.3 Smart Business Solutions Program

Eight projects were chosen for document review from PY6. Project files mostly consist of financial summaries, energy savings reports, contracts, invoices, construction audits, product specifications, and lighting calculators. Overall, project documents were complete, well organized, and provided sufficient information for verification. All the lighting measures included Appendix C calculators, which produced savings that were consistent with the values presented in the tracking database. A majority of the lighting upgrade projects also included photos of the baseline equipment. However, the SWE Team did notice some deficiencies and inconsistencies in the project files.

Project 1370 included lighting upgrades and ASHC installations. The only documentation provided for the ASHC is a product brochure. There was no information on how savings were calculated, and the SWE Team is not sure if TRM algorithms were used. The SWE Team also noted that projects 1588 and 1844 lacked invoices of incentivized products.

Projects 1913, 1588, 2472, and 1844 used custom HOU values but default CF values in Appendix C calculators. There was no source for the site-specific HOU values, and it was not clear how the values were calculated. Finally, the SWE Team emphasizes that if site-specific data are used to determine the HOU, then the same data must be used to determine the site-specific CF. Similarly, if the default TRM HOU is used, then the default TRM CF must also be used in the savings calculations. In addition to the HOU and CF issues, the SWE Team found a discrepancy in the fixture codes used in Project 1913. The SWE Team noted that 32 fixtures were assigned the post-fixture code of F44SILL, which describes 30W lamps. However, the construction audit and manufacturer specifications indicated that the lamps were actually 32W. Therefore, the correct fixture code should be F44ILL/2, which results in 118W instead of 105W fixtures.

Although the SWE Team is impressed that all lighting measures included Appendix C calculators, the SWE Team recommends a more thorough evaluation of savings assumptions. In particular, site-specific values need to be supported by additional information such as customer interviews or logger data.

A.6.1.4 Smart Multi-Family Solutions Program – Non-Residential

The SWE Team reviewed seven projects in PECO's PY6 Smart Multi-Family Solutions Program. Project files included handwritten audit forms, direct installation service agreements, and database extracts of project information. Overall, project documentation was consistent and savings were calculated using the correct TRM algorithms and assumptions. However, there were a few areas that required improvements.

The SWE Team notes that some of the audit forms were difficult to read and poorly scanned. For example, half of the audit form in Project a0RC000000FSLEOMA5 was grayed out, making it completely illegible. For lighting installations in cooled spaces, PECO used an interactive energy factor (IF_{energy}) of 0.23 and an interactive demand factor (IF_{demand}) of 0.01 instead of the default IF values (IF_{energy}=0.14 and IF_{demand}=0.09) in the TRM. No explanation or documentation was provided regarding the source of these values.

To improve the quality and accuracy of the project files, the SWE Team recommends using electronic forms to collect data. Also, since lighting measures contribute to approximately 84% of total program kWh savings and 85% of total program kW savings, the SWE Team encourages the evaluation contractor to continue thoroughly auditing the supporting documentation in order to minimize inconsistencies and preserve transparency in savings assumptions.

A.6.2 Tracking Data Review

PECO reported savings impacts from six non-residential programs during PY6: Smart Equipment Incentives (SEI), Smart Construction Incentives (SCI), Smart Business Solutions (SBS), Smart Multi-Family Solutions (SMFS), Smart Appliance Recycling (SAR), and Smart Home Rebates (SHR). Impacts within each program were reported according to whether the participating customer was from the C/I sector or the GNI sector.

The gross reported energy savings of these programs was 138,763 MWh/yr, and the gross reported demand savings was 20.0 MW. Table A-59 provides the reported number of participants, energy and demand savings, and incentives from each non-residential program in PY6 based on PECO's quarterly reports. Demand impact figures were adjusted to reflect a peak LLF of 11.1% for C/I programs and 11.7% for GNI programs prior to reporting to account for T&D losses. The SWE Team did not analyze incentives for the non-residential participants in PECO's SAR and SHR programs since this information was not available in the quarterly reports.

Table A-59: PECO's Quarterly Reports Summary for Non-Residential Programs

Program	Number of Participants	MWh/yr	MW	Incentive ($1,000)
SEI (C/I)	788	81,048	11.8	$6,342
SEI (GNI)	226	25,645	2.8	$2,833
SCI	73	13,043	2.1	$1,654
SBS (C/I)	559	15,178	2.8	$0
SBS (GNI)	7	425	0.1	$0
SMFS (Non-Residential)	462	3,317	0.4	$0
SAR (Non-Residential)	90	99	0.0	N/A
SHR (Non-Residential)	65	8	0.0	N/A
Total	**2,270**	**138,763**	**20.0**	**$10,829**

Following each quarter in PY6, PECO submitted program tracking data to the SWE Team for review. Table A-60 provides the participant count, energy and demand impacts, and incentives by program according to the PECO tracking database extract.

Table A-60: PECO's PY6 Tracking Database Summary for Non-Residential Programs

Program	Number of Participants	MWh/yr	MW*	Incentive ($1,000)
SEI (C/I)	788	81,048	11.8	$6,342
SEI (GNI)	226	25,645	2.8	$2,833
SCI	73	13,043	2.1	$1,465
SBS (C/I)	559	15,177	2.8	$0
SBS (GNI)	7	425	0.1	$0
SMFS (Non-Residential)	462	3,318	0.4	$0
SAR	90	99	0.0	N/A
SHR	65	7	0.0	N/A
Total	**2,270**	**138,762**	**20.0**	**$10,640**

** Database demand impacts adjusted to reflect a peak loss factor of 11.1% for C/I programs and 11.7% for GNI programs*

The SWE Team compared the summary of PECO's quarterly extracts to the values in the quarterly reports and presented the findings in Table A-61.

Table A-61: PECO's Non-Residential Program Discrepancies

Program	Number of Participants	MWh/yr	MW	Incentive ($1,000)
SEI (C/I)	0	0	0.0	$0
SEI (GNI)	0	0	0.0	$0
SCI	0	0	0.0	$189[53]
SBS (C/I)	0	1	0.0	$0
SBS (GNI)	0	0	0.0	$0
SMFS (Non-Residential)	0	-1	0.0	$0
SAR	0	0	0.0	N/A
SHR	0	0	0.0	N/A
Total	**0**	**1**	**0.0**	**$189**

Table A-61 shows that participant counts, energy savings, and demand savings were in agreement across the submitted documents.

[53] This difference is due to the $189,000 in incentives paid to trade allies that was reported in PECO's PY6 quarterly reports, but not accounted for in the program tracking data.

There were two programs that reported savings but did not report an incentive paid: SBS and SMFS (non-residential). The quarterly reports indicated that 100% of the savings in these programs came from direct installs and not the prescriptive channel. Therefore, no incentives were paid out.

Overall, there are no major discrepancies between program savings and incentives presented in the quarterly reports and the values in the database extracts. However, the SWE Team recommends that information be reported in a consistent manner across all programs. For example, sector-level data (number of participants, energy and demand savings, and incentives) should be provided for all non-residential programs.

A.6.3 Sample Design Review

PECO's PY6 annual report provided detailed information about the sample design for the PY6 gross impact evaluation of non-residential programs: SEI (C/I), SEI (GNI), SBS, SMFS – Non-Residential, SCI, and Smart On-Site. The following sections summarize the sampling approaches used by the evaluation contractor, Navigant, to develop verified savings estimates as well as the SWE Team's audit of the approach.

A.6.3.1 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 and precision at the program level and used a similar method to PY5. A C_v of 0.5 was assumed for all strata for the sample design based on the PY4 C_vs for different strata: 0.23 for the large stratum, 0.31 for the medium stratum, and 0.38 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, Navigant used stratified ratio estimation to produce verified savings for the SEI Program. Based on Q1, Q2, and Q3 data, the strata boundaries were defined as follows:

- Stratum 1 - Large Stratum: The top 33% of reported kWh savings
- Stratum 2 - Medium Stratum: The middle 33% of reported kWh savings
- Stratum 3 - Small Stratum: The 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-62.

Table A-62: PECO's PY6 Sample Design Strategy – SEI C/I Program

Stratum	Population	Target Levels of Confidence & Precision	Target Sample Size	Achieved Sample Size
Large	14	85% / 15%	14	14
Medium	57	85% / 15%	29	28
Small	720	85% / 15%	25	25
Program Total	**791**	**85% / 15%**	**68**	**67**

The achieved precision values at 85% confidence level for both energy and peak demand are shown in Table A-63.

Table A-63: 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	0.64	18.6%	1.26	37.0%
Medium	0.34	7.0%	0.58	11.9%
Small	0.20	0.0%	0.34	0.0%
Idiosyncratic	0.00	0.0%	0.00	0.0%
Program Total		**6.6%**		**14.8%**

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. Its achieved precision for energy was 6.6% and for demand was 14.8%, exceeding the SWE Team requirements of confidence and precision levels as specified in the Evaluation Framework.

A.6.3.2 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. There were total of 73 projects in this program in PY6, which included 17 projects in the GNI sector. Forty-four samples were pulled from the population for evaluation. The sampling strategy used in PY6 for this program is shown in Table A-64.

Table A-64: PECO's PY6 Sampling Strategy – SCI Program

Stratum	Population	Target Levels of Confidence & Precision	Target Sample Size	Achieved Sample Size
Large Projects	7	85% /15%	6	6
Small Projects	54	85% /15%	27	27
Large Whole Building	7	85% /15%	6	6
Small Whole Building	5	85% /15%	5	5
Program Total	**73**	**85% /15%**	**44**	**44**

The achieved precision values for energy and demand are presented in Table A-65.

Table A-65: 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 Projects	0.33	8.6%	0.41	10.7%
Small Projects	0.74	14.9%	0.56	11.4%
Large Whole Building	0.06	1.5%	1.24	32.4%
Small Whole Building	0.07	0.0%	1.40	0.0%
Program Total		**4.4%**		**9.3%**

PECO was effective in adjusting its sampling for PY6 to avoid the low precision for specific strata seen in PY5. Its program total achieved precision for energy was 4.4% and demand was 9.3%, which exceed the SWE Team requirements of confidence and precision levels as specified in the Evaluation Framework. In PY5, PECO's evaluation contractor detailed several corrective actions that were implemented in PY6 to remedy this issue, and these served to improve the correlation between reported and verified impacts.

A.6.3.3 Smart Business Solutions Program

The SBS Program was launched in PY5. The participant sample design was 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 a total of 566 projects in PY6, which included 7 GNI projects (<2%). All projects were stratified into four groups: large, medium, small, and very small. The details of the sampling strategy for this program are shown in Table A-66.

Table A-66: PECO's PY6 Sampling Strategy – SBS Program

Stratum	Population	Target Levels of Confidence & Precision	Target Sample Size	Achieved Sample Size
Large	62	85% / 60%	5	5
Medium	130	85% / 60%	5	5
Small	307	85% / 60%	6	6
Very Small	67	85% / 60%	0	0
Program Total	**566**	**85% / 15%**	**16**	**16**

The achieved precision values for energy and demand are presented in Table A-67.

Table A-67: 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	0.37	21.0%	0.26	14.4%
Medium	0.22	13.9%	0.24	11.4%
Small	0.12	7.3%	0.19	12.6%
Very Small	N/A	N/A	N/A	N/A
Program Total		**8.7%**		**7.2%**

The SWE Team reviewed and approved Navigant's sampling plan in a memo dated April 28, 2015. The program total achieved precision for energy was 8.7% and for demand was 7.2%, which exceed the SWE Team requirements of confidence and precision levels as specified in the Evaluation Framework.

A.6.3.4 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 three groups: large, medium, and small. The stratification was based on the ex ante kWh savings recorded in the program tracking database. Table A-68 lists the details of the sampling strategy for this program in PY6.

Table A-68: PECO's PY6 Sampling Strategy - SMF Non-Residential Program

Stratum	Population	Target Levels of Confidence & Precision	Target Sample Size	Achieved Sample Size
Non-residential Participants	158	85% / 15%	30	40

The achieved precision levels for both energy and peak demand are shown in Table A-69. The results show that the samples represented the population in this program effectively and that the precision target was met.

Table A-69: Observed Coefficients of Variation and Relative Precisions – PECO's SMFNR 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	0.00	0.1%	0.00	0.0%
Medium	0.08	6.2%	0.08	6.1%
Small	0.00	0.0%	0.00	0.0%
Non-residential Participant Total		**2.1%**		**2.2%**

A.6.3.5 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. Forty-two of 236 GNI projects were selected as the final sample size for PY6 program evaluation. The projects were stratified into four groups: large, medium, small, and municipal lighting. The assumed Cv values for all strata were 0.5 based on PY4 results. The sampling strategy for the PY6 SEI GNI Program is presented in Table A-70. In each of the three stages—after Q2, after Q3, and after Q4—samples were pulled and the sample design was reviewed and adjusted to make sure it would achieve the targeted confidence and precision levels. Finally, samples were selected only from projects that represented the top 98% of overall program savings.

Table A-70: PECO's PY6 Sampling Strategy – SEI GNI Program

Stratum	Population	Target Levels of Confidence & Precision	Target Sample Size	Achieved Sample Size
Municipal Lighting	10	85% / 15%	5	5
Small	208	85% / 15%	23	23
Medium	16	85% / 15%	12	11
Large	2	85% / 15%	2	2
Program Total	**236**	**85% / 15%**	**42**	**41**

The achieved precision values for both energy and demand are listed in Table A-71. The results show that the samples represented the population in this program effectively and that the precision target was met. This represents a significant improvement over PY5, in which the precision for demand was 38%.

Table A-71: 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
Municipal Lighting	0.00	0.0%	0.00	0.0%
Small	0.14	4.2%	0.10	2.9%
Medium	0.31	8.2%	1.01	26.6%
Large	0.08	0.0%	N/A	0.0%
Program Total		**2.7%**		**8.8%**

A.6.3.6 Smart On-Site Program

No SOS projects were completed in PY6. There are nine projects in the pipeline targeting completion in Phase II.

A.6.4 Ride-Along Site Inspections

Table A-72 summarizes the SWE Team's PY6 ride-along site inspections of PECO non-residential project installations. The PECO PY6 site inspection findings are categorized in 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-72: PECO's PY6 Non-Residential Site Inspection Findings

Project ID	Technology	Finding	Finding Type	Resolution
PECO-14-05772	VFD	The SWE Team found the evaluator's calculator modifications and report to be easy to follow and generally well executed.	N/A	The SWE Team has no recommendations based on its review of this project.
PECO-13-05234	Lighting	The SWE Team agrees with the evaluator's on-site observations as well as the savings methodology used.	N/A	The SWE Team has no recommendations based on its review of this project.
PECO-14-05550	Lighting	The SWE Team agrees with the evaluator's on-site observations as well as the savings methodology used.	N/A	The SWE Team has no recommendations based on its review of this project.
PECO-13-04873	Chiller Optimization	The SWE Team noted some general concerns with the evaluator's methodology. This included changing cooling degree day base temperatures throughout the billing analysis and assuming the cooling system yields year-round savings without fully documenting the reasoning.	Eval	The SWE Team recommends the evaluator adhere to standard practices and protocols, such as the IPMVP Option C in this case, or provide sufficient documentation supporting any deviances.
PECO-13-05364	Dehumidification	The SWE Team noted some general concerns with the evaluator's methodology and documentation, including inconsistencies in weather data and lack of collected data during the winter months when savings are expected to be largest.	Eval	The SWE Team recommended the evaluator use consistent source data and/or document variations in the data. Also, when project savings are expected to be largest during a certain portion of the year, the SWE Team recommends the evaluator plan site visits and data collection timing to best capture those savings when possible.
PECO-14-05669	EMS System Replacement	Demand savings were based on dividing the year's total kWh savings by 8760, despite having hourly kW data showing fluctuations in the demand.	Eval	The SWE Team recommends that evaluators leverage meter data when possible, and certainly when the demand is dynamic.
PECO-14-06121	Lighting, HVAC, and refrigeration	The evaluator's verified lighting HOU did not appear to reflect the schedule gathered on-site.	Eval	The SWE Team recommended the evaluator update the lighting HOU to reflect site-gathered data accurately, and not use hard-coded values in savings calculations to make catching calculation errors easier.
PECO-15-07086	Lighting	The evaluator elected to use TRM deemed HOU on a project which it had site-specific data.	Eval	The SWE Team recommended the evaluator change its savings calculations to reflect the site-specific data that was gathered on-site.
PECO-14-06090	Lighting	The SWE Team noted two areas where the Appendix C space cooling type should have	Eval	The SWE Team recommends this cooling status of the areas in question be corrected, to estimate the true interactive effects.

Project ID	Technology	Finding	Finding Type	Resolution
		been "unconditioned" instead of "cooled," per the site contact.		
PECO-14-06094	Lighting	The verified savings were lower than reported values generally due to lower verified HOU from site gathered data. Otherwise, retrofitted equipment and controls were verified as reported and reported energy savings calculations appeared accurate.	Eval	The SWE Team had no recommendations based on its review of this project.

A.6.5 Verified Savings Review

The SWE Team requested a subset of Navigant's sample for review. Table A-73 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.

Table A-73: M&V Methods and Verified Savings for PECO's SWE Team Sample

Program	Stratum	Project Number	Verified Energy Savings (kWh)	Verified Demand Reduction (kW)	M&V Method
SEI	C/I - Large	PECO-14-06040	6,090,914	799	IPMVP Option B
SEI	C/I - Medium	PECO-14-05873	5,348,853	612	IPMVP Option A
SEI	C/I - Medium	PECO-13-05128	660,790	97	IPMVP Option A
SEI	C/I - Medium	PECO-14-06503	497,027	0	Basic Rigor Option 1: Verification Only Analysis
SCI	Large Projects	PECO-14-06026	1,894,861	195	Enhanced Rigor Option 1: Engineering Model With Key Parameter Measurement
SCI	Small Projects	PECO-14-06446	46,552.00	5	Basic Rigor Option 2: Simple Engineering Model Without Measurement

Project number PECO-14-06040 involved the replacement of three 1,500-hp, 2,300-V, and 1,200-RPM synchronous motors with three 4,250-hp, 4,160-V, and 3,600-RPM induction motors driven by VFDs that are used to maintain process pump pressure in an industrial facility in Coatesville, PA. Navigant acquired pre- and post-usage data from the applicable transformer and used a linear regression relationship between the daily production output in tons, and the average daily kWh consumption to determine verified savings.

Project number PECO-14-05873 involved the installation of a new Atlas Copco gearbox in a manufacturing facility's compressed air system in Coatesville, PA. The new gearbox allowed the company to operate one motor for longer without the help of the backup motor. Navigant acquired 8 months of pre- and 5 months of post-data on the compressor units, including: pipeline airflow, pipeline pressure, unit 1 amperage, and unit 2 amperage. Using this data, Navigant normalized the hourly power usage of the motors for pipeline flow and pipeline pressure levels using a multiple regression analysis. The primary factor behind the unusually high kWh realization rate of 2,175% is that the ex ante analysis did not include unit 2 in the baseline. The gearbox installation affects the energy use of both units, due to the primary/backup configuration of the system, and Navigant correctly analyzed the system as a whole.

Project number PECO-13-05128 involved the installation of VFDs on 14 cooling tower fans in an office building in Philadelphia, PA. Twelve of the motors were 50-hp and the remaining were 100-hp. The measures were prescriptive; however, the expected savings were greater than the 250,000 kWh threshold for motors and VFDs, so the run hours were verified through metering. Amp loggers were installed on six fan motors and additional trend data was obtained for six months before and after installation. Using the

metered HOU and TMY3 weather files, annual savings were calculated. The kWh realization rate of 193% is due largely to the difference in ex ante and metered HOU.

Project number PECO-14-06026 involved energy efficient lighting, refrigeration, and HVAC features in a new construction retail facility in Philadelphia, PA. The installed lighting includes T8 linear fluorescent, LED, and T5 fixtures in interior and exterior spaces. Refrigeration measures involve ASHC and ECM evaporator fan motors. Finally, the HVAC measure involves air-source air conditioners that were more efficient than required by code. The site-specific M&V plan states that light loggers will be installed for a sample of fixtures because "the ex-ante savings for the lighting measure exceed the metering threshold in the PA evaluation framework." Initially, it appeared to the SWE that light loggers were not deployed and verified savings were adjusted with lighting HOU "based on interview estimates." The SWE Team thus made the recommendation that they would like the evaluator to adhere to the site-specific M&V plan, especially when logging requirements are predetermined by the Evaluation Framework and TRM thresholds. However, after further clarification from Navigant, the SWE learned that it was EMS trend data, and not those reported lighting HOU, that were the basis for the ex post analysis. The SWE appreciates this clarification and has removed the recommendation from the PECO section in the body of the report.

Project number PECO-14-06446 involved the installation of energy efficient lighting fixtures as a part of a new construction project for a restaurant in Ardmore, PA. Due to the relatively low expected savings values, the energy savings from this project were verified through a phone interview. Navigant verified all of the lighting installations in all locations, but found that the HOUs were nearly double than those listed as default for "Restaurant" in the TRM. The higher HOU, additional lighting controls not accounted for in ex ante, and more efficient exterior fixtures than specified in ex ante combine to give the high kWh realization rate of 257%.

A.7 PPL

A.7.1 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 PY6. Several projects were selected from each quarter within each program. Project files included project-level savings calculation workbooks, applications, invoices, inspection forms, and specification sheets.

A.7.1.1 Master Metered Low-Income Multifamily (MMMF) Housing Program

The SWE Team reviewed eight of the sample projects selected in PY6. Project documents consisted of financial summaries, energy savings reports, product specifications, construction audits, billing summaries, energy savings workshop surveys, and Appendix C calculators. In general, project files were complete, organized, and clear. The information reported in the Appendix C calculators, PPL's tracking database, and the "Construction Audit" were mostly consistent across all projects. Also, savings were accurately calculated with appropriate TRM default assumptions. However, the SWE Team recommends several improvements that can further increase the accuracy of savings and completeness of project files.

First, the energy and demand savings values presented in the "Energy Savings Measures Report" differ from the values reported in the Appendix C calculator and PPL's tracking database. Also the "Financial Summary Report" provides the total project incentive but does not break down the incentive by measure like the tracking database. In addition, although the project files included a "Pricing Worksheet," the quantity of equipment that was priced often differed from the quantity of equipment installed. The SWE

Team recommends including finalized invoices of purchased equipment in PPL's project files. The SWE understands that the reported values can differ from EEMIS. Savings for deemed measures such as low-flow showerheads and faucet aerators were calculated accurately.

The SWE Team also noted specific issues with Project 806832 and Project 795720. Project 806832 used site-specific HOU values and TRM default CFs to calculate energy and demand savings for multifamily common areas. There was no source for the site-specific HOU values, and it was not clear how the values were calculated. The SWE Team emphasizes that if site-specific HOU is used, then site-specific CF must also be used to determine kW savings. For Project 795720, the tracking database and Appendix C stated that 37 HPS (150 W) outdoor lights were replaced by 37 LED (30W) parking-lot lights. Appendix C calculated a savings of 21,449 kWh and 5.6 kW, while the tracking database claimed savings for 15,600 kWh and 0 kW. Since exterior lights have a CF of 0, the SWE Team recommends correcting Appendix C calculations.

A.7.1.2 Prescriptive Equipment Lighting Program

The SWE Team selected seven sample projects for review in PY6. Project documents included Appendix C calculators, logger analyses workbooks, rebate applications, invoices, billing data, spec sheets, and post-inspection reports. In general, data from the project files were consistent with PPL's tracking database and project documents were complete. However, the SWE Team did note some project deficiencies and inconsistencies.

The most common mistake that the SWE Team observed was the inconsistent use of HOU and CF values to calculate lighting savings. Project PPL-13-08408, Project PPL-13-09467, and Project-13-09235 used site-specific HOU and TRM default CF to determine kW savings. The SWE Team recommends using the facilities' operating schedules to determine a site-specific CF for more accurate savings. For Project PPL-13-10768, lighting loggers were installed to determine site-specific HOU and CF for the warehouse lights and sales floor nightlights. However, instead of using all site-specific values to calculate savings, a mixture of site-specific values and TRM default values were used. For the warehouse lights, site-specific HOU of 2,557 was used instead of the TRM default value of 2,316. But the TRM default CF of 54% was applied instead of the site-specific CF of 62.5%. For the nightlights, TRM default values (HOU=8,760 and CF=100%) were used instead of site-specific values (HOU=8,643 and CF=42.6%) that were determined from lighting logger data and customer interview. The inconsistent application of assumptions creates an appearance that the HOU and CF values were chosen to yield the greatest amount of savings instead of the most consistent and accurate results. Cadmus retroactively corrected this deficiency after receiving the SWE's RASIRs. All projects in the evaluation sample apply site-specific CFs when site-specific HOUs are required.

A.7.1.3 Prescriptive Equipment Non-Lighting Program

The SWE Team reviewed six projects from the Prescriptive Equipment Non-Lighting Program. Most of the projects consisted of refrigeration measures that involved retrofitting existing shaded-pole evaporator fan motors with ECMs. Project documents included applications, customer billing data, spec sheets, and summary reports. For the most part, TRM default savings were applied correctly and project files were consistent with the tracking database.

A.7.1.4 Custom Incentives Program

Four projects were chosen for document review from PY6. Project files mostly consist of applications, pre- and post-inspection reports, savings workbooks, scope of work, invoices, and product specifications. Overall, the SWE Team was impressed with the level of completeness, clarity, and organization of the

project files. Data from the project files was also consistent with the data reported in PPL's tracking database.

A.7.2 Tracking Data Review

In PY6, PPL reported impacts from seven programs: Appliance Recycling, Custom Incentive, Master Metered Multifamily Housing (MMMF), Prescriptive Equipment, Residential Home Comfort (RHC), Residential Retail, and School Benchmarking. In PPL's tracking databases, all program impacts are classified in one of five sectors: Residential, Low-Income, Small C/I, Large C/I, and Government/Non-Profit. Since PPL's quarterly reporting does not include sector-level insight, the SWE Team did not break the reported participation and impacts out by sector.

Table A-74 provides the participant count, energy and demand savings, and incentive amount by program, according to the PPL quarterly reports. The Prescriptive Equipment Program achieved the highest energy and demand savings, accounting for 53% and 49% of the total savings, respectively.

Table A-74: PPL's PY6 Quarterly Reports Summary for EE&C Programs

Program	Number of Participants	MWh/yr	MW	Incentive ($1,000)
Appliance Recycling	8,074	6,792	1.2	$281
Custom Incentive	69	23,170	2.6	$1,345
MMMF	49	1,574	0.2	$231
Prescriptive Equipment	3,694	94,666	11.8	$16,623
RHC	4,269	3,888	1.5	$1,148
Residential Retail	171,116	48,987	7.0	$5,003
School Benchmarking	15	0	0.0	$0
Total	**187,286**	**179,077**	**24.3**	**$24,631**

Following each quarter in PY6, PPL submitted program tracking data to the SWE Team for review. Table A-75 provides the participant count, energy impact, demand impact, and incentives by program according to the PPL tracking database extracts.

Table A-75: PPL's PY6 Tracking Database Summary for EE&C Programs

Program	Number of Participants	MWh/yr	MW	Incentive ($1,000)
Appliance Recycling	8,074	6,792	1.2	$306
Custom Incentive	69	23,170	2.6	$1,654
MMMF	49	1,574	0.2	$82
Prescriptive Equipment	3,732	94,666	11.8	$14,313
RHC	4,271	3,888	1.5	$1,558
Residential Retail	174,960	48,987	6.9	$6,216
School Benchmarking	6	0	0.0	$0

Program	Number of Participants	MWh/yr	MW	Incentive ($1,000)
Total	**191,161**	**179,077**	**24.2**	**$24,129**

The SWE Team compared the summary of PPL's quarterly extracts to the values in the quarterly reports and presented the findings in Table A-76.

Table A-76: PPL's Non-Residential Program Discrepancies

Program	Number of Participants	MWh/yr	MW	Incentive ($1,000)
Appliance Recycling	0	0	0.0	-$25
Custom Incentive	0	0	0.0	-$309
MMMF	0	0	0.0	$149
Prescriptive Equipment	-38	0	0.0	$2,310
RHC	-2	0	0.0	-$410
Residential Retail	-3,844	0	0.1	-$1,213
School Benchmarking	9	0	0.0	$0
Total	**-3,875**	**0**	**0.1**	**$502**

The reported energy and demand impacts from the quarterly reports are consistent with the data provided in the tracking databases. However, the SWE Team found variances in the reported participation counts and incentive amounts. The main source for the discrepancy observed in the number of participants is the Residential Retail Program. For the lighting component of the program, PPL notes that the number of participants is calculated by dividing the total number of bulbs distributed through the program by a bulb-per-participant value estimated for each program year. Since the bulb-per-participant value was not provided in PPL's PY6 quarterly reports, the SWE Team used the PY5 value of 6.4 (LEDs/participant). The SWE Team recommends that PPL provide this value in its quarterly reports.

The SWE Team also observed variances in reported incentive amounts across all programs. In its quarterly reports, PPL provides a single value for incentives given to customers and trade allies. But because PPL's tracking databases do not distinguish between types of incentives, the SWE Team could not determine an accurate estimate. Finally, PPL calculates the incentive for each quarter based on the total amount of incentives paid in that quarter. Therefore if incentives were awarded for a project in Q3 but paid in Q4, the incentives would have counted toward Q4. This method was not documented clearly, and as a result, the SWE Team could not reproduce the incentive values provided in the quarterly reports.

The SWE Team understands that the number of participants and the amount of incentives can be calculated differently for each EDC. However, clear and detailed definitions and calculation methods are needed to improve the transparency of the tracking databases and quarterly reports.

A.7.3 Sample Design Review

PPL's PY6 annual report provides detailed information about the sample design and selection for the PY6 gross impact evaluation of non-residential programs. Four PPL non-residential programs reported savings in PY6: 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.7.3.1 Custom Incentive Program

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, or installing equipment measures or systems not covered by the Prescriptive Equipment Program or the Pennsylvania TRM. A threshold of 500,000 kWh/year savings was used to delineate the small and large strata for the Custom Incentive Program. The large stratum has 12 projects in PY6, 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-77.

Table A-77: PPL's PY6 Sampling Strategy – Custom Incentive Program

Stratum	Population	Target Levels of Confidence & Precision	Target Sample Size	Achieved Sample Size
Small	57	85% / 15%	10	10
Large	12	85% / 15%	Census	12
Program Total	**69**	**85% / 15%**	**22**	**22**

The achieved precision values for energy and demand are listed in Table A-78.

Table A-78: 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	0.30	21.0%	0.36	30.0%
Large	0.0	0.0%	0.0	0.0%
Program Total		**5.0%**		**7.0%**

The achieved precision values of 5% for energy and 7% for demand at the 85% confidence level met the SWE Team requirements of 85/15 as specified in the Evaluation Framework. This is a significant improvement from PY5, in which the energy and demand precision were 21% and 18%, respectively.

A.7.3.2 Master Metered Low-Income Multifamily Housing Program (MMMF)

This is a new program that started at the beginning of Phase II. Twenty-four projects were selected from the total population of 49 projects that were completed in PY6 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 is shown in Table A-79. During the evaluations from each of the strata listed below, Cadmus measured four specific program components: appliance recycling, 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-79: PPL's PY6 Sampling Strategy – MMMF Program

Stratum	Population	Target Levels of Confidence & Precision	Target Sample Size	Achieved Sample Size
EEMIS Database	49	All available	49	All available
Projects	49	85%/15%	23	24
Tenant Units within Sampled Projects	1,133	90%/20%	262	262
Program Total	**49 projects, 1,133 tenant units**			

The achieved precision values for energy and demand are listed in Table A-80.

Table A-80: 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
Appliance Recycling	N/A	0.0%	N/A	0.0%
Common Area Lighting	0.13	2.9%	0.06	1.6%
Direct Install - Apartments	0.45	13.9%	0.44	13.6%
Direct Install – Common Area	0.34	11.0%		0.0%
Program Total		**5.8%**		**6.1%**

The program total achieved precision for energy and demand met the SWE Team requirements. This is an improvement over PY5, when the demand precision was 16%.

A.7.3.3 Prescriptive Equipment Program

The Prescriptive Equipment Program targets customers from the small C/I, large C/I, GNI, and agricultural sectors. Similar to PY4, 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 are: large, medium-small, small-medium, and small.

For the equipment measures, Cadmus revised the sample plan according to the final number of measures rebated in PY6, and the sample plan targeted +/- 10% precision at the 90% confidence level, targeting greater precision than the minimum level required by the Phase II Evaluation Framework. The sampling strategy and corresponding evaluation activities for the non-lighting stratum is shown in Table A-81.

Table A-81: PPL's PY6 Sampling Strategy – Prescriptive Equipment Program, Non-Lighting

Stratum	Population	Target Levels of Confidence & Precision	Target Sample Size	Achieved Sample Size	Evaluation Activities
Equipment	16 unique account numbers; 9 unique customers	90% / 10% at the stratum level	16	16	Records review
			0	0	Site visits
			As many as possible	3	Online surveys
Program Total	**16**		**16**	**16**	16 projects; more than one activity can be conducted per project

The sample design for the lighting measures also targeted +/- 10% precision at the 90% confidence level, and stratified ratio estimation was used to estimate savings for the program. Cadmus increased the PY5 error ratio of 0.17 to 0.30 to calculate sample sizes for the PY6 lighting projects and improve the probability of meeting the desired precision. The detailed sampling strategy for lighting projects is shown in Table A-82.

Table A-82: PPL's PY6 Sampling Strategy – Prescriptive Equipment Program, Lighting

Substratum	Population	Target Levels of Confidence & Precision	Target Sample Size	Achieved Sample Size
Small	2,539	N/A	N/A	5
Small-Medium	733	N/A	N/A	4
Medium-Small	322	N/A	N/A	4
Large	84	N/A	N/A	20
Total	**3,678**	**90% / 10%**	**28**	**33**

The achieved precision values for both energy and peak demand for the Prescriptive Equipment Program are presented in Table A-83. The table shows that PPL exceeded the requirement of 85%/15% confidence and precision level for this program. The GNI sector contributed gross savings of 25% 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 PY6 annual report, in accordance with the Evaluation Framework. The observed coefficients of variation and relative precisions are provided in Table A-84.

Table A-83: 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	0.12	2.4%	0.28	6.1%

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
Equipment	N/A	N/A	N/A	N/A
Program Total	**0.12**	**2.4%**	**0.28**	**6.1%**

Table A-84: 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	0.28	8.2%	0.24	16.6%

A.7.3.4 Continuous Energy Improvement Program

The Continuous Energy Improvement (CEI) Program is a pilot program that targets school districts, for which PPL provides technical support for schools 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 this is the first year that savings were reported. The sampling strategy of this program is presented in Table A-85.

Table A-85: PPL's PY6 Sampling Strategy – CEI Program

Stratum	Population (School District)	Target Levels of Confidence & Precision	Target Sample Size	Achieved Sample Size
School District	8	N/A	8	8
Program Total	**8**	**N/A**	**8**	**8**

The achieved precision values for energy and demand are listed in Table A-86.

Table A-86: 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	29.0%	N/A	28%
Program Total	N/A	29.0%	N/A	28%

This program was evaluated using IPMVP Option C (whole-facility billing analysis) and the precision was calculated using the standard error of the regression coefficients that determine savings. The calculation of precision that results is difficult to control and is primarily influenced by two factors: model specification and sample size. Both of these factors were constrained in this first pilot run of the program, and the evaluator expects the precision to improve as more site-specific information is provided to the evaluation team and there are more schools from each of the eight districts participating in PY7 to include in the analysis.

A.7.4 Ride-Along Site Inspections

Table A-87 summarizes the SWE Team's PY6 ride-along site inspections of PPL's non-residential project installations. The PPL PY6 site inspection findings are categorized in 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-87: PPL's PY6 Non-Residential Site Inspection Findings

Project ID	Technology	Finding	Finding Type	Resolution
PPL-13-07733	Lighting	The SWE Team found the evaluator's work and corresponding report to be easy to follow and generally well executed.	N/A	The SWE Team has no recommendations based on its review of this project.
PPL-14-05212	Lighting	The SWE Team agrees with the evaluator's on-site observations and calculations.	N/A	The SWE Team has no recommendations based on its review of this project.
PPL-13-08335	Lighting	The SWE Team feels that the EDC evaluator's approach to this project was well thought out and that the subsequent calculations and report were thorough and, as a result, agrees with the evaluator's on-site observations and the subsequent calculations.	N/A	The SWE Team has no recommendations based on its review of this project.
PPL-14-04224	Lighting	The SWE Team agrees with the evaluator's on-site observations and calculations.	N/A	The SWE Team has no recommendations based on its review of this project.
PPL-13-08408	Lighting	The SWE Team questioned the evaluator's approach concerning aggregating meter data to form a single usage group, peak demand window definition, and short light metering duration.	Eval	The evaluator provided clarification concerning the aggregation of meter data and adjusted the peak demand savings calculation to reflect the PJM coincident peak demand window. While the evaluator noted that a longer metering period would be ideal, the extra customer burden and the confidence in the already collected data did not warrant further metering.
1191084	MMMF - Lighting, Dir. Installs	The SWE Team found the evaluator's work and corresponding report to be easy to follow and generally well executed.	N/A	The SWE Team has no recommendations based on its review of this project.
1190623	MMMF - Lighting, Dir. Installs	The SWE Team found the evaluator's work and corresponding report to be easy to follow and generally well executed	N/A	The SWE Team has no recommendations based on its review of this project.
PPL-13-08364	VFD	The SWE Team noted a discrepancy between pre- and post-retrofit equipment run times and suggested the evaluator take into account operational differences due to the measure.	Eval	The SWE Team and evaluator discussed the SWE Team's findings and agreed that while no run-time adjustment is needed, there were some calculation errors that affected savings, which were corrected in determining the final project verified savings.
PPL-13-09251	Compressed Air	The SWE Team agreed with the evaluator's methodology but noted some minor calculation errors in the evaluator's analysis.	Eval	The SWE Team and evaluator generally agreed on revised savings estimates once the errors were corrected.
PPL-13-07618	VFD	The SWE Team agrees with the evaluator's on-site observations and calculations.	N/A	The SWE Team has no recommendations based on its review of this project.

A.7.5 Verified Savings Review

The SWE Team requested a subset of projects in Cadmus's sample for review. Table A-88 shows the energy and demand savings for the subset of projects chosen for SWE Team review, as well as the M&V method selected for evaluation.

Table A-88: Verified Savings and Evaluation Methods of PPL's PY6 Sampled Projects

Program	Project Number	Verified Energy Savings (kWh)	% of Program Energy Savings	Verified Demand Reduction (kW)	% of Program Demand Reduction	M&V Method
Custom Incentive	1581	6,357,242	29.04%	772.2	31.47%	IPMVP Option A
Custom Incentive	1605	3,148,106	14.38%	359.13	14.63%	IPMVP Option B
MMMF	795720	45,742	3.0%	5.11	3.52%	Simple Verification
MMMF	1171253	174,377	11.26%	16.17	11.13%	Simple Verification
Prescriptive Equipment – Lighting	PPL-13-07631	3,142,321	3.54%	134.14	.96%	Site Visit, Records Review
Prescriptive Equipment – Lighting	PPL-13-08076	2,754,592	3.1%	216.51	1.55%	Site Visit, Records Review
Prescriptive Equipment – Non-Lighting	PPL-13-08117	149,898	37.48%	17.26	37.14%	Desk Review

Project 1581 generated 6,357,242 kWh in energy savings, accounting for over 29% of the total PY6 energy savings achieved by PPL's C/I Custom Incentives Program. The project involved several improvements to a VFD controlled compressor that is part of a gas transfer station. Primarily, the improvements involved modifications to the compressor rotor and diffusers to allow for increased performance and controllability, as well as to increase the gas transfer capability of the unit. Cadmus conducted on-site verification of the installed equipment but did not follow the original SSMVP due to its high-voltage nature so that metering was not a safe option. Instead, an analysis of the SCADA system was performed using information gathered at the post-installation site visit and a review of the compressor performance curves. The initial reported savings were drastically underreported in the application due to the improper analysis of the performance curves; this was discovered in the evaluation by Cadmus and corrected to give the final kWh and kW savings numbers. The final evaluation used a standard engineering algorithm and customer-supplied performance information to develop an acceptable declaration of verified savings for the compressor station.

Project 795720 consisted of direct-install lighting measures in the tenant areas and common areas of a multifamily, low-income complex. The project generated 45,742 kWh in total energy savings that represented 3.0% of energy savings for the MMMF program in PY6. The measures included screw-in LEDs and T8's in the tenant and common spaces, interior and exterior. Cadmus conducted a site visit and interviewed facility staff to verify light operation and installation quantity, making various adjustments to the original savings numbers in the verification. Cadmus verified that the HOU in the reported savings

numbers were incorrectly assuming that the tenant spaces used 5,950 hours per year as opposed to the correct 949.

Project PPL-13-08076 generated 2,754,592 kWh in energy savings, accounting for just 3.1% of the prescriptive lighting portion of the program in PY6. The project included replacement of incandescent, metal halide, T12, and T8 fluorescent fixtures with LED, T5, and T8 fixtures. Additionally, occupancy sensors were added to over 1,000 fixtures. Cadmus used a combination of on-site interviews, verification, and metering data from the implementer's study to confirm that minor adjustments were needed for verification of the HOU and energy savings factor, as well as logging used to capture the operation of the new occupancy sensors.

Project PPL-13-08117 generated 149,848 kWh of energy savings, accounting for over 37% of the energy savings in the prescriptive, non-lighting portion of the program. The project involved the installation of 220 ECM motors in walk-in and reach-in refrigeration applications. Cadmus submitted a final verification file showing the details of the ex ante and ex post analysis and equipment model numbers, but no substantial project description or methodology narrative.

In general, the SWE Team agrees with Cadmus's evaluation methodologies and savings calculations where sufficient supporting documentation was presented for review. In its PY5 Annual Report, the SWE Team recommended that Cadmus provide more detailed documentation and more consistently record the evaluation work and corresponding outcomes. The SWE Team reemphasizes this recommendation.

APPENDIX B | AUDIT ACTIVITY DETAIL – TOTAL RESOURCE COST TEST

This appendix typically provides additional details about the SWE audits of each EDC's Total Resource Cost (TRC) Test calculations. For this PY6 report, the SWE Team's reviews can be described within the body of the report. See below for hyperlinks to the relevant sections of the report for each EDC.

B.1 DUQUESNE

Details of the SWE Team's audits of TRC Test calculations for Duquesne PY6 programs are provided in Section 4.2 of this annual report.

B.2 MET-ED

Details of the SWE Team's audits of TRC Test calculations for Met-Ed PY6 programs are provided in Section 5.2 of this annual report.

B.3 PENELEC

Details of the SWE Team's audits of TRC Test calculations for Penelec PY6 programs are provided in Section 6.2 of this annual report.

B.4 PENN POWER

Details of the SWE Team's audits of TRC Test calculations for Penn Power PY6 programs are provided in Section 7.2 of this annual report.

B.5 WEST PENN

Details of the SWE Team's audits of TRC Test calculations for West Penn PY6 programs are provided in Section 8.2 of this annual report.

B.6 PECO

Details of the SWE Team's audits of TRC Test calculations for PECO PY6 programs are provided in Section 9.2 of this annual report.

B.7 PPL

Details of the SWE Team's audits of TRC Test calculations for PPL PY6 programs are provided in Section 10.2 of this annual report.

APPENDIX C | AUDIT ACTIVITY DETAIL – PROCESS EVALUATION

This appendix provides detail 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.

C.1 DUQUESNE

C.1.1 Residential Programs

Navigant reported on process evaluations for five residential programs: Residential Energy Efficiency Program (REEP), Residential Appliance Recycling Program (RARP), School Energy Pledge Program (SEP), Whole House Energy Audit Program (WHEAP), and Low Income Energy Efficiency Program (LIEEP).

For the process evaluations of the above programs, Navigant reviewed program documents and data and surveyed program participants and nonparticipants. A larger-scale process evaluation was conducted in PY5 for all residential programs with the exception of WHEAP. PY6 was the first year of implementation for WHEAP; consequently, Navigant also conducted in-depth interviews with program and implementation staff and auditors. The document review informed Navigant's identification of program goals and activities and development of program theory and logic models. The research issues addressed varied among programs, but generally included the effectiveness of program administration, implementation, and delivery, including participant and contractor satisfaction, challenges, and barriers.

For each program, a brief program description, summary of the process evaluation findings, and a review (audit) of the annual report follow below. The SWE Team notes two general comments about the findings, conclusions, and recommendations for the process evaluations of Duquesne programs: (1) many recommendations were drawn from key findings rather than from conclusions. Connecting findings to conclusions and then to recommendations would help the reader better judge the quality of the recommendations; and (2) two of the numbers reported for the percentage of savings achieved or budget expended differ between the more high-level annual report and the accompanying process evaluation. For example, the REEP annual report states the program expended 81% of its budget, while the analogous process evaluation report states that 79% of the budget was expended.

C.1.1.1 Residential Energy Efficiency Program

C.1.1.1.1 Brief Overview of the Program and Its Success

The REEP 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"). In PY6, REEP achieved 123% of its energy savings goals and spent 81% of its targeted budget.

C.1.1.1.2 Summary of the Process Evaluation Findings

Navigant reviewed the 2014 Pennsylvania TRM and program materials and surveyed 43 "rebate" participants and 26 "kits" participants, for 69 surveyed participants. Navigant used interview data from PY5, when it conducted a larger-scale process evaluation, to draw findings for the program, noting that in-depth interviews with program and implementation staff conducted in PY5 remain relevant to findings

in PY6. To gain greater insights into the lighting industry, Navigant conducted a residential lighting Delphi panel with 13 industry experts and an online general population survey.

Navigant reported that rebate participants most commonly learned about the rebates online, at retail stores, or from contractors. Navigant noted that customers cited learning of REEP via bill inserts in PY5 18% of the time, whereas in PY6 participants cited learning of the program from bill inserts 7% of the time. Participants were generally satisfied with the program; however, satisfaction across all aspects of the program dropped from the first half of the year (Q1-Q2) to the second half of the year (Q3-Q4). Navigant notes that customers stating dissatisfaction with the program cited difficulties with the application process and time taken to obtain the rebate. Participants indicated that they likely would recommend the program to others. Similar to PY5, the most common improvements participants recommended were higher rebates and more advertising. A minority of customers were dissatisfied with the application process, noting that their applications were initially rejected due to perceived minor errors.

Customers who received energy efficiency kits most commonly learned about the kits through bill inserts, family and friends, and online. Navigant noted that television advertisements were a prominent means of REEP kit awareness in PY5, with 26% of participants responding, whereas in PY6 only one participant noted hearing about the kits via television advertisement. Satisfaction generally was high; participants rated the products' energy savings lower than other program aspects. While most participants indicated that they likely would recommend the program to others, the average likelihood rating in PY6 was lower than in PY5 (3.7 vs. 4.2), with four 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; the most frequently reported recommendation (n=6) was to offer different products in the kits.

C.1.1.1.3 Summary of the Process Evaluation Audit

Navigant generally summarized findings well and drew well-reasoned findings. Particularly notable practices included investigating differences in satisfaction ratings between Q1/Q2 and Q3/Q4 for REEP rebate participants and asking rebate participants whether they actually had recommended the program to others (in addition to asking about their likelihood of doing so). Navigant clearly and succinctly summarized the findings from participant surveys.

Navigant reported means for participant satisfaction and influence ratings. While this practice is acceptable when sample sizes are large, when sample sizes are small (sample sizes in these two tables ranged from 1 to 13), other reporting methods can provide a more accurate description of responses (such as reporting the percentage of respondents who provided a rating of 5). Navigant compared differences in mean satisfaction ratings between participants surveyed in the first and second halves of the year. This additional analysis could have benefitted from the addition of statistical analyses to bolster the finding that satisfaction with the program dropped in the second half of the year. Navigant reports the sample sizes and average rating, but does not report either the variability (SD) or a statistical assessment of the ratings difference. While sample sizes are small, the analysis could have benefitted from this additional level of detail.

C.1.1.2 Residential Appliance Recycling Program

C.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 uses the same implementation contractor (JACO) as do the other appliance recycling programs

across Pennsylvania. In addition, the program collaborates with other Duquesne programs such as the LIEEP and the PAPP. The RARP achieved 191% of its PY6 gross savings goals, spending 380% of its planned budget; however, Navigant reported that the planned budget understated RARP implementation costs. These costs will be adjusted in PY7.

C.1.1.2.2 Summary of the Process Evaluation Findings

Navigant reviewed the 2014 Pennsylvania TRM and program materials and surveyed 63 participants. Navigant used interview data from PY5, when it conducted a larger-scale process evaluation, to draw findings for the program, noting that in-depth interviews with program and implementation staff conducted in PY5 remain relevant to findings in PY6. The PY6 process evaluation focused on program awareness and satisfaction.

Most participants first learned of RARP through friends and family or television advertisements. Navigant noted the program benefited from word-of-mouth promotion. Navigant also asked participants about other sources of program awareness, with friends and family, television, and bill inserts cited most often. Participants noted high program satisfaction with all program aspects, with an average of 4.0 or greater on the 5-point scale across all program aspects—including time to receive the rebate (4.4) and incentive amount (4.3). Navigant probed for reasons for dissatisfaction from the few participants who expressed dissatisfaction with any aspect of the program. Navigant reported that dissatisfied participants' major cause for dissatisfaction was the incentive amount, with five participants noting that other utilities or organizations offered $50 rather than $35. The most common improvements participants recommended were increased marketing and larger rebates. Navigant noted that almost a quarter of respondents indicated the program was fine as is.

Bolstering Navigant's earlier finding that the program benefited from word-of-mouth promotion, over half of surveyed participants reported that they recommended the program to another person in the last year. In addition, participants noted they were likely to recommend the program to another person in the future. Participants most often reported the incentive as their reason for participating in the program.

C.1.1.2.3 Summary of the Process Evaluation Audit

PY6's evaluation activities were more limited in scope than in PY5. However, Navigant used these limited resources to shed light on important research topics, and generally summarized findings well and drew well-reasoned findings.

C.1.1.3 School Energy Pledge Program

C.1.1.3.1 Brief Overview of the Program and Its Success

The SEP is designed to teach students about energy efficiency through in-school assemblies and lesson materials. 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 achieved 7% of the targeted PY6 energy savings at a cost of 30% of the budget.

C.1.1.3.2 Summary of the Process Evaluation Findings

Navigant surveyed 31 program participants to assess program satisfaction and NTG. Navigant used interview data from PY5, when it conducted a larger-scale process evaluation, to draw findings for the program, noting that in-depth interviews with program and implementation staff conducted in PY5

remain relevant to findings in PY6. The PY6 process evaluation activities focused on assessing participant satisfaction and NTG.

Participating parents' surveys indicated high satisfaction with all aspects of the programs (ranging from 3.9 to 4.8). Participants were least satisfied with energy savings (3.9) and most satisfied with the overall program (4.8). As found in PY5, the information provided by their children was the most influential factor in a family's decision to participate, followed, in order, by free products, desire to help the school, desire to save energy, and desire to reduce their energy bill. When asked how Duquesne could improve the program, participants suggested the program provide general information about the kit, more information about how to use the kit, and include different items in the kit.

C.1.1.3.3 Summary of the Process Evaluation Audit

Navigant summarized findings adequately. The evaluation activities for this program were limited in scope, and Navigant did not have enough information to draw wide-ranging conclusions from this evaluation effort. Navigant attempted to survey 69 SEP participants but was able to survey only 31, because the total participant population was much smaller than anticipated. In order to attain 31 completes, Navigant contacted 88% of the population frame, suggesting this population is hard to reach and has a potentially high non-response bias.

SEP achieved only 7% of its PY6 goals, spending 30% of its budget. While the recommendations mention this issue, the process report did not directly address it. The SWE Team recognizes that this issue was not identified as a research area in the evaluation plan; however, exploring this issue could provide Duquesne with some insights and recommendations to improve program goal achievement. Navigant might consider exploring the reasons for underperformance in PY7.

C.1.1.4 Whole House Energy Audit Program

C.1.1.4.1 Brief Overview of the Program and Its Success

The WHEAP provides both comprehensive and walk-through residential home energy audits to 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-to-one with participating customers and provide customers with tailored findings from the audit. WHEAP directly installs low-cost measures such as CFLs, energy efficiency nightlights, faucet aerators, low-flow showerheads, smart strips, and pipe wrap. PY6 was the program's first year of implementation.

The program provides comprehensive audits at reduced cost to market-rate customers, and at no cost to low-income customers by Building Performance Institute (BPI) certified auditors. 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 walkthrough audit to the customer.

C.1.1.4.2 Summary of the Process Evaluation Findings

Navigant conducted a review of the program database; interviewed Duquesne program managers, CSP program administrators, other subcontractors to the CSP, and in-home auditors; and surveyed program participants. Based on these data, several key findings emerged:

1) WHEAP achieved 31% of its goals and spent 140% of its budget; however, Navigant noted that a large number of customers initially identified as market-rate customers qualified as low-income customers. Duquesne's Low-Income Energy Efficiency Program (LIEEP) claimed savings garnered from these customers rather than WHEAP. Also, while the program provides a conduit to REEP rebate-eligible equipment, the savings claimed by WHEAP are limited to direct-install measures only.

2) Since WHEAP was limited to claiming the direct-install savings, any additional auditor actions such as changing settings on energy-using equipment while conducting the audit remain unclaimed. Furthermore, the program used TRC deemed savings that assumed a post-EISA baseline lamp, for all CFLs installed, which could underestimate savings if 60 W incandescent bulbs were replaced.

3) While auditors provided Keystone loan information to audit customers, no customer used the loan program for additional energy upgrades. Navigant noted that other loan offerings on the market provide more attractive financing alternatives.

4) Bill inserts effectively drove potential customers to the program.

5) According to one auditor interviewed, the program could potentially have installed 25% more energy efficiency lamps if dimmable CFL or LED lamps were included in the direct-install measure mix.

6) The original low-income WHEAP offering included a set of larger whole-house measures. Costs for these larger projects were high relative to WHEAP's program budget. These projects were rejected, leading to some homeowner and contractor dissatisfaction. The CSP stopped seeking bids for these larger whole-house measures but Duquesne indicated that it was not notified.

7) The utility tracking system did not successfully incorporate the data field designating projects as low-income or market rate when the transfer of data from the CSP to the utility occurred. This error led to discrepancies between the number of low-income and market-rate projects.

C.1.1.4.3 Summary of the Process Evaluation Audit

Navigant nicely synthesized data from its in-depth interviews and drew well-reasoned findings and recommendations from these data. Additionally, Navigant's analysis of participant sign-up rates corresponding with bill inserts was well done.

The methods used in the analysis of the participant surveys are methods better suited to analysis of surveys with larger sample sizes. Navigant stratified participants into large or small projects (projects with more than 1 MWh/yr of claimed savings were classified as large projects, projects with less than 1 MWh/yr were classified as small). Using this stratification, Navigant surveyed a total of 17 participants, 6 large and 11 small. These sample sizes are too small to allow for accurate comparisons between strata, or for accurate mean estimates of satisfaction or influence ratings. What appear to be differences in recommendation responses, or satisfaction ratings between strata, may be due to sampling error. While Navigant does not attempt to draw statistical comparisons between strata, reporting findings by strata leads the reader to draw comparisons between the strata. Finally, while it maintains consistency in the report to include pie charts depicting participant recommendations to improve the program, the SWE Team recommends avoiding the use of pie charts when the largest response category contains three mentions.

C.1.1.4.4 Residential Market Intelligence

In addition to comparing survey responses across all residential program participants, Navigant conducted two additional data collection activities, a residential lighting Delphi panel and a general population survey. Navigant conducted these additional data collection activities to inform program evaluation activities, particularly upstream lighting NTG and the state of the lighting market in Duquesne territory.

C.1.1.4.5 Summary of the Process Evaluation Findings

The residential lighting Delphi panel comprised 13 lighting professionals. The Delphi panel was conducted in two parts: panelists reviewed research data and provided their initial estimate of free-ridership. Findings from the Delphi panel are described in more detail in the impact evaluation sections of this audit

report (see Section 4.3.3). Panelists then conducted an initial review of each panelist's responses, and then provided a modified estimate. Navigant also conducted a large online general population survey with 1,547 survey respondents. Survey respondents had purchased program discounted CFLs or LEDs in the last three to six months.

The general population survey yielded the following high-level findings:

1) Respondents reported bulb life and light quality as the most important factors when purchasing lightbulbs.

2) CFL awareness is very high (98%), and LED lighting awareness is also high (66%).

3) Socket penetration has increased since PY5; 14% of customers do not have CFLs installed, and 46% have no LEDs in sockets.

4) About two-thirds of respondents were satisfied with LED light quality and lifetime expectancy of bulbs.

5) Understanding of LED features remains low, with 10% of respondents reporting they knew LEDs lasted more than 15 years. Also, about half of respondents were aware of LEDs' energy savings potential. Respondents noted that knowing these attributes would most likely lead them to purchasing more LEDs in the future.

Navigant compared surveyed participant responses from the five market-rate surveys and the LIEEP survey conducted for PY6. Navigant found that awareness of the new program, WHEAP, was low (about 28%). Kit and rebate market survey respondents generally had the highest level of awareness of Duquesne program offerings.

C.1.1.4.6 Summary of the Process Evaluation Audit

Navigant generally summarized findings well and drew well-reasoned conclusions. Particularly notable practices included comparing changes in awareness of CFL and LED bulbs across PY evaluation years. Navigant clearly and succinctly summarized the comparative findings from participant surveys.

C.1.2 Low-Income Programs

C.1.2.1 Overview of the Program and Its Success

Duquesne LIEEP is not a separate program but encompasses existing program activities as they affect low-income customers, specifically: (1) REEP, RARP, SEP, and WHEAP when implemented with low-income customers; (2) the efficiency projects done in coordination with public entities through its PAPP; and (3) the installation of smart strips by the LIURP. Together, the above activities achieved 56% of the PY6 gross energy savings target, while spending 46% of the PY6 target budget.

C.1.2.2 Summary of the Process Evaluation Findings

For the market-rate REEP, RARP, SEP, and WHEAP process evaluations, Navigant surveyed program participants. Many of the process findings described in sections above are relevant to their analogous low-income program. For the LIEEP, Navigant surveyed 7 kit recipients, 15 RARP participants, 12 refrigerator replacement participants, 6 SEP participants, 8 smart strip recipients, and 35 whole-house participants (via the WHEAP)—all low-income customers.

Navigant conducted an expanded process evaluation for the WHEAP for both market-rate and LI customers. As with the market-rate program, Navigant found that the WHEAP provides customers with savings beyond those reported by the program. Furthermore, Navigant noted that auditors provide additional assistance to low-income customers, providing them with information on bill payment assistance or other community programs. The low-income component of the WHEAP is limited in which

savings it can claim since certain measures installed through Smart Comfort cannot be claimed in the low-income component of the WHEAP.

Navigant reported evidence that a few customers whose refrigerators were replaced were not satisfied with their new refrigerators, while smart strip recipients were very satisfied with LIEEP and Duquesne representatives. Navigant reported that the program awareness and satisfaction findings from the surveys of low-income participants were similar to the overall findings summarized in the sections above.

C.1.2.3 Summary of the Process Evaluation Audit

The SWE Team's comments regarding the Navigant process evaluations of REEP, RARP, and SEP generally apply to the LIEEP components. The SWE Team offers these two additional comments. As in other process evaluation sections, Navigant reported mean satisfaction ratings by LIEEP component (e.g., kits, WHEAP, RARP, refrigerator replacement). This analytical and reporting method works well when sample sizes are large. However, many of the LIEPP components (kits, SEP, refrigerator replacement, and smart strips) comprised fewer than 10 respondents. The SWE Team recommends that the evaluator note that these statistics should be interpreted with caution.

Navigant reported that several respondents were dissatisfied with the refrigerator replacement component of LIEEP. The respondents' dissatisfaction may or may not be due to an issue with the program and, in any case, Navigant obtained only 12 survey completes for this component out of a population of 402 refrigerator recipients. The SWE Team recommends probing into this issue in the next process evaluation by increasing the target confidence and precision for the refrigerator replacement stratum. Increasing the confidence and precision target for this stratum should allow Navigant to investigate whether the dissatisfaction reported in PY6 indicates a larger process issue or is due to the small sample size surveyed in PY6.

C.1.3 Non-Residential Programs

Instead of conducting individual evaluations for each subprogram, Navigant conducted in-depth interviews with program and implementation staff for the Commercial program and the Industrial program. Navigant conducted a full process evaluation for two new programs the Small Commercial Direct install (SCDI) and the Multifamily Housing Retrofit (MFHR) programs. These evaluations included in-depth interviews with staff and CSPs and interviews with trade allies and participant surveys. Depending on the depth of the evaluation, Navigant generally included program performance with regard to savings estimates and goals; input from program staff and implementer; and assessment of customer or market actor program satisfaction, participation, challenges, and recommendations. For each program, a brief program description, summary of the process evaluation findings, and a review (audit) of the annual report follow below.

C.1.3.1 Commercial and Industrial Program Group

C.1.3.1.1 Brief Overview of the Program and Its Success

Duquesne provides a commercial program to targeted market segments such as office, 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 program. 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 offerings, the industrial program consists of three targeted programs for primary metals, chemical products, and mixed industrial companies. All other industrial customers fall under the umbrella industrial program offering. As with the targeted commercial program, the industrial program promotes specific technologies and targets specific market segments.

C.1.3.1.2 Summary of the Process Evaluation Findings

Navigant conducted an abbreviated process evaluation of the program in PY6. For PY6, Navigant relied on document review and in-depth interviews with the program manager and CSP staff. From these interviews, only a few noteworthy findings emerged:

1) EnerNOC expanded its trade ally network for the CSP for the chemical and mixed industrial sector programs.
2) CSPs reported issues with the PMRS, noting that they now have to go through an additional step to query the database. Generally, CSPs reported dissatisfaction with the PMRS, particularly when working with larger projects.
3) All CSPs now pre-meter large projects to establish accurate baselines.
4) Project documentation on the PMRS has improved when compared with PY5.

C.1.3.1.3 Summary of the Process Evaluation Audit

The SWE Team determined that the reporting followed the SWE guidelines. 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.

C.1.3.2 Small Commercial Direct Install Program

C.1.3.2.1 Brief Overview of the Program and Its Success

Designed to overcome small commercial customer barriers to participation in energy efficiency programs, the SCDI program targets small businesses with 300 kW or less of peak load not otherwise served by Duquesne programs. The program most commonly installs energy efficiency lighting and refrigeration controls measures at no cost to customers. The program began in November 2014 and met its goals by May 2015.

C.1.3.2.2 Summary of the Process Evaluation Findings

Since SCDI was a new program at Duquesne in PY6, Navigant conducted an expanded process evaluation. Navigant reviewed program materials, the 2014 Pennsylvania TRM and the project tracking system; conducted interviews with Duquesne program staff, the program CSP, and trade allies working with the CSP; and surveyed program participants. Navigant also conducted a best practices assessment for this evaluation. From these evaluation activities, Navigant found:

1) The program expended its funds and met its goals earlier than expected. The CSP estimates that a large fraction of the eligible market remains available to serve.

2) The PMRS restricts the CSP's ability to streamline or automate part of their process. Consequently, the CSP does not use Duquesne's PMRS. Trade allies reported long delays in payment due to the data tracking system.

3) Participants were generally satisfied with Duquesne and the program. Likewise, program trade allies were generally satisfied. Trade allies identified the time it took to obtain payment as the part of the program that could most use improvement.

4) Participants identified four major barriers to participation: lack of awareness, the complicated nature of the program, the cumbersome paperwork, and difficulty qualifying for the program.

5) A subset (2 of 7) of trade allies interviewed reported it might be easier to recruit participants if there were a modest co-payment from the customer.

6) Participants reported wanting information that is more detailed from Duquesne, and indicated the program needs more promotion to increase awareness.

C.1.3.2.3 Summary of the Process Evaluation Audit

Navigant conducted a document review, interviewed market actors, including seven of the eight trade allies participating in the program, and surveyed 35 program participants for this evaluation. Overall, the process evaluation discussion was succinct and highlighted findings that should be of value to the administrator and implementer. Particularly notable are Navigant's use of rating bubble graphics to showcase respondents' ratings of various program components and the use of bar charts rather than means to report satisfaction ratings. The recommendations were clear and actionable and supported by findings.

C.1.3.3 Multifamily Housing Retrofit Program

C.1.3.3.1 Brief Overview of the Program and Its Success

The MFHR program is a turn-key program that provides a one-stop-shop for master metered buildings—typically common areas—with income-qualified occupants. Low-income dwellings can be included in the program if they are mastered metered as well. The program provides audits, technical assistance, property aggregation, contractor negotiation, and equipment bulk purchasing. The CSP scopes and costs out the project and works with Duquesne and the customer to portion out the costs. The CSP also provides customers with a zero-interest 12-month financing option to decrease first cost barriers. The program achieved 151% of its savings goals, expending about 60% of its budget.

C.1.3.3.2 Summary of the Process Evaluation Findings

Since MFHR was a new program at Duquesne in PY6, Navigant conducted an expanded process evaluation. Navigant reviewed program materials, the 2014 Pennsylvania TRM and the project tracking system, conducted interviews with Duquesne program staff and the program CSP, and surveyed program participants. Navigant also conducted a best practices assessment for this evaluation. From these evaluation activities, Navigant found:

1) The program is well documented and tracked.
2) Customer eligibility and applications are reviewed and processed manually by the CSP and Duquesne staff.
3) Similar to other implementers, the MFHR CSP noted that the program tracking system is outdated and makes streamlining paperwork and project approval difficult.
4) This is a turn-key program that provides customers with a single point of contact. The CSP also installs the measures, so participants do not have to find a separate contractor.
5) A minority of participants visited the program website. Of the small proportion that did visit the website, about a quarter of participants reported the website provided useful information.
6) Participants are generally highly satisfied with the program and Duquesne. The few dissatisfied participants noted a lack of direct contact with Duquesne, or that a contractor was unprofessional.
7) To improve the program, participants suggested more proactive communication from Duquesne, and more detailed energy efficiency information. Participants also noted the program needs more promotion to increase awareness.
8) The CSP estimated it would have served only a small segment of the potential market at the end of the program.

C.1.3.3.3 Summary of the Process Evaluation Audit

Navigant conducted a document review, interviewed Duquesne and CSP program staff, and surveyed 16 program participants for this evaluation. Overall, the process evaluation discussion was succinct and highlighted findings that should be of value to the administrator and implementer. As noted earlier for the SCDI program evaluation, Navigant made good use of rating bubble graphics to display respondents' ratings of various program components and of bar charts rather than means to report satisfaction ratings. The recommendations were clear and actionable and supported by findings.

The SWE Team notes that the population sizes differ between Table 10-5 and Table 10-7 of the Duquesne PY6 annual report. The SWE Team recommends Navigant clarify reasons the discrepancy in the text. Also, Table A-1 in the process evaluation report notes that Navigant attempted to contact a total of 23 MFHR participants, yet in the annual report Navigant reports attempting a census—comprising either 39 or 104 program participants, depending on Table 10-5 or Table 10-7. The SWE Team recommends clarifying whether the MFHR participant survey attempted a census or used a sample.

C.2 FIRSTENERGY EDCS

FirstEnergy implemented a common set of energy efficiency programs across its four Pennsylvania EDCs—Met-Ed, Penelec, Penn Power, and West Penn—and FirstEnergy's evaluation consultants, ADM Associates and Tetra Tech, used the same evaluation methods and identified the same findings and recommendations for all four EDCs. This section thus presents a common description of the programs, evaluation methods, findings, and recommendations for the four FirstEnergy EDCs.

C.2.1 Residential Programs

Tetra Tech reported on process evaluations for three residential programs: the Residential Appliance Turn-In Program, the Energy Efficient Products Program, and the Residential Home Performance Program. Tetra Tech presented a summary of the process evaluation methods and findings, as well as the recommendations from the impact and process evaluations, in the PY6 annual report and more detailed information on the process evaluation methods and results in a series of memoranda submitted as part of Tetra Tech's response to the SWE PY6 data request. Throughout this appendix, the SWE Team's reference to the Tetra Tech report includes the PY6 annual report and/or the additional memoranda; where needed, this appendix refers more specifically to one or the other source.

For the process evaluations of the above programs, Tetra Tech interviewed utility and implementer staff and program-affiliated contractors and surveyed program participants. The staff interviews helped Tetra Tech identify design and implementation updates, program goals and activities, and key researchable issues. For the Residential Appliance Turn-In Program, Tetra Tech identified program awareness and marketing, customer satisfaction, and free-ridership as the key researchable topics. For the other two residential programs, Tetra Tech identified the same researchable topics: program infrastructure and participant satisfaction; program communication and processes; free-ridership and spillover; familiarity with LED bulbs; and demographics.

Tetra Tech's evaluation plan for Phase II identified additional researchable questions beyond those they identified in the PY6 annual evaluation plan, particularly for appliance turn-in. Since the evaluation plan was for all of Phase II, it is not necessary to address each researchable question in each year, but Tetra Tech should address all researchable questions in the PY7 evaluation that are not addressed in the PY6 evaluation. (There was no PY5 evaluation.) Some of the researchable questions it identified in the Phase II evaluation plan require a nonparticipant survey, which Tetra Tech did not carry out in PY6. Below, the SWE Team has identified some areas where the process evaluation has departed from the evaluation plan.

For each program, a brief program description, summary of the process evaluation findings, and a review (audit) of the annual report follow below. The SWE Team notes general comments about Tetra Tech's descriptions of the process evaluations of residential programs: (1) the descriptions of the research methods lacked detail—they did not identify the number of program or implementer staff interviewed or provide some important details on participant surveys; (2) although recommendations generally seemed reasonable, it was not clear in many cases how the recommendations followed from the key findings presented—the annual report did not present conclusions drawn from the findings to tie them to the recommendations; while the separate process evaluation memoranda often had a "conclusions" section and a table tying findings to recommendations, the recommendations reported in the memoranda often did not overlap completely with those in the annual report.

C.2.1.1 Residential Appliance Turn-In Program

C.2.1.1.1 Brief Overview of the Program and Its Success

The Residential Appliance Turn-In Program provides residential customers with a cash incentive and disposal of up to two large older inefficient appliances (refrigerators or freezers) and two room air conditioners per household per calendar year. In PY6, the Residential Appliance Turn-In Program was under budget for all four EDCs Table C-1. Penelec was the only FirstEnergy EDC to meet or exceed its savings targets as projected in its EE&C Plan, achieving 103% of target energy savings.

Table C-1: FirstEnergy Residential Appliance Turn-In Program Successes

EDC	Percent of Target Budget Spent	Percent of Energy Savings Target Achieved
FE: Met-Ed	88%	98%
FE: Penelec	57%	103%
FE: Penn Power	48%	90%
FE: West Penn	74%	91%

C.2.1.1.2 Summary of the Process Evaluation Findings

Tetra Tech interviewed an unspecified number of program and implementer staff and surveyed 46 program participants. Tetra Tech reported the following key findings:

1) Bill inserts continue to be the most common source of program information, particularly among self-identified low-income respondents.
2) Program satisfaction remains high.

C.2.1.1.3 Summary of the Process Evaluation Audit

The process evaluation of the Residential Appliance Turn-In Program appears to have been consistent with Tetra Tech's Phase II evaluation plan. The discussion was succinct and highlighted findings that should be of value to the administrator and implementer. The various EDC-specific reports incorporated the required tables showing the sampling strategy and status report on process and impact recommendations, although the sampling tables did not include information on the number of staff interviewed.[54] The recommendations were clearly stated and actionable. However, the SWE Team has the following observations about the reporting of this process evaluation.

The description of the research activities conducted in general provided sufficient detail to determine what the evaluator did, although some additional details would have been useful. The reports do not

[54] The report template circulated to the EDCs' contractors states that the report should describe "the process evaluation methodology for each program including sampling strategy and achieved sample *for each data collection activity*" (emphasis added).

identify the number of staff interviewed. The process evaluation memorandum states that the evaluators conducted "web and phone surveys," but it does not explain what that means. Presumably, as was the case with the evaluation of the Energy Efficient Products Program, the survey collected some responses by phone and some by web. However, other interpretations are possible, such as that the evaluator called respondents to recruit them to a web survey. Assuming that the participant survey sample consisted of a phone stratum and a web stratum, a discussion of the possible method effects (including an empirical assessment) would have been valuable.

While the EDC-specific reports generally provide detailed results, they do not describe any findings from the staff interviews other than that they did not identify researchable topics. Some additional details would be valuable.

Further, while Tetra Tech reported surveying from 39 to 51 program participants for the various EDCs, the descriptions of two key findings in each EDC-specific report reference 168 and 170 respondents, respectively. It appears that these numbers refer to the total number of respondents across the four FirstEnergy EDCs rather than to the sample for the specific EDCs; if so, the various reports should make that clear and should explain why they report findings across the four EDC territories in some cases for this program but not others.

Finally, the SWE Team reviewers did not find explanations for all of the evaluator's recommendations. The PY6 annual reports list three recommendations: (1) reduce reported savings for room air conditioners to 150 kWh per unit; (2) consider using bill inserts to address recycling concerns outside of the program; and (3) consider adding a message to the rebate check that provides information about other FirstEnergy EDC programs. The process evaluation memorandum shows the third recommendation and adequately explains the basis of that recommendation, but it does not show the first two recommendations. Of the first two recommendations, the second one reasonably follows from the process findings: the evaluators should have included that recommendation, and the justification for it, with the third recommendation, in the process evaluation memorandum. The SWE Team reviewers could not find any explanation at all of the first recommendation.

C.2.1.2 Energy Efficient Products Program

C.2.1.2.1 Brief 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, and refrigerators), energy efficient HVAC equipment (e.g., central air conditioners, air source heat pumps, ground source heat pumps, and mini-split heat pumps), and energy efficient water heaters (including heat pump water heaters 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 PY6, the Energy Efficient Products Program was under budget for all four EDCs Table C-2. Met-Ed was the only FirstEnergy EDC to fall short of its savings targets as projected in the EE&C Plan, achieving 97% of target energy savings.

Table C-2: FirstEnergy EDC Residential Energy Efficient Products Program Successes

EDC	Percent of Target Budget Spent	Percent of Energy Savings Target Achieved
FE: Met-Ed	72%	97%
FE: Penelec	34%	110%
FE: Penn Power	35%	106%

FE: West Penn	73%	107%

C.2.1.2.2 Summary of the Process Evaluation Findings

Tetra Tech interviewed an unspecified number of program and implementer staff; conducted in-depth interviews with four participating HVAC contractors and surveyed an additional 51; and surveyed 101 program participants. Tetra Tech reported the following key findings:

1) Participants were highly satisfied with the program overall. Contractors reported slightly lower overall program satisfaction than program participants, with lowest satisfaction levels for technical support and program training.
2) Participants most commonly identified retailers and contractors as how they heard about the Appliance and HVAC subprograms, respectively, and contractors estimated less than 25% of their customers knew about the program before they introduced it. However, customers identified utility mail and web contact as the preferred approaches for hearing about programs in the future.
3) Participants largely reported understanding program eligibility requirements.
4) Contractors prefer to receive program information through personalized means, such as one-on-one meetings or direct calls with their CSP representative.
5) A substantial minority (20%) of surveyed contractors rate the paperwork requirements as "difficult."
6) About half of the contractors responding to the survey reported receiving the contractor newsletter; 3 of 51 were aware of the CSP contractor portal.

C.2.1.2.3 Summary of the Process Evaluation Audit

The process evaluation of the Residential Energy Efficient Products Program appears to have been largely consistent with Tetra Tech's Phase II evaluation plan, with exceptions noted below. The discussion was succinct and highlighted findings that should be of value to the administrator and implementer. The various EDC-specific reports incorporated the required tables showing the sampling strategy and status report on process and impact recommendations, although the sampling tables did not include information on the number of staff or contractors interviewed. The recommendations stated in the PY6 annual report were clearly stated and actionable. However, the SWE Team has the following observations about the reporting of this process evaluation.

The description of the research activities conducted in general provided sufficient detail to determine what the evaluator did, although some additional details would have been useful. The reports do not identify the number of staff interviewed. One aspect of the reporting of the contractor survey methodology was confusing. The process evaluation memorandum states that surveyed contractors were asked to identify the EDC territories in which they did business and that they were able to select more than one EDC. However, the memorandum presents a pie chart of the distribution of survey respondents by EDC. As the portions of a pie chart sum to 100%, the implication appears to be that no survey respondent reported working in more than one EDC territory. Clarification of this point would be useful.

The process evaluation memorandum states that the evaluators conducted a web and phone survey of participants and contractors, collecting some responses by phone and some by web. Some additional information on how the evaluator implemented the participant and contractor web surveys would have been valuable, such as how many follow-ups, if any, went to each invitee and what inducements, if any, were offered. In addition, a discussion of the possible method effects (including an empirical assessment) on process-related survey responses, such as the evaluators presented for NTG findings, would have been valuable.

One final observation regarding the presentation of methods is that the text of the various EDC-specific PY6 annual reports states that the participant survey used the PY5 sample frame, but the accompanying tables referred to PY6. This is not a major issue but was somewhat confusing.

While the process evaluation memorandum provided a generally detailed presentation of results, the SWE Team reviewers noted some areas where additional detail would be valuable. None of the reports describe any findings from the staff interviews other than that they did not identify researchable topics, although the memorandum stated that interviews addressed the effectiveness of the program's current operations. Further, neither the PY6 annual report nor the process evaluation memorandum reported on some topics addressed in the participant survey: participants' concerns about high-efficiency models; ease of finding a participating contractor; participation in other FirstEnergy EDC programs; and recommendation of the program to others. Moreover, the PY6 annual report "key findings" does not include some interesting findings described in the process evaluation memorandum, such as that non-energy benefits constituted the most commonly reported topic that HVAC and water heating contractors discussed with customers.

One interesting finding was that just under half of participants said they heard about the HVAC program from a contractor, but contractors reported that less than 25% of customers knew about the program before they mentioned it. The latter suggests that contractors thought they were the source of program information in more than 75% of cases, not in less than half as the participant survey suggests. A discussion of this apparent contradiction would have been valuable.

As noted, there were exceptions to the observation that the process evaluation was consistent with the evaluation plan. First, the evaluation did not achieve the target number of surveyed contractors, which should have been achievable given the size of the sample frame. Although the overall achieved sample (across the four EDC territories) was large enough to meet the required confidence and precision levels, a small percentage of the respondents reported working in one specific EDC territory (Penn Power), and so that EDC territory was not well represented in the sample. The various EDC-specific reports should explain why they were unable to achieve the target number of contractors.[55] Second, the reports do not mention a benchmarking review, which the evaluation plan indicated was planned for PY6.

Finally, while the recommendations shown in the PY6 annual reports were clearly stated and actionable, the PY6 annual reports did not show how those recommendations followed from the findings and conclusions. The process evaluation memorandum, dated 10 days before the PY6 annual reports, does present conclusions and an appendix table relating recommendations to key findings. However, there is not complete overlap between the recommendations made in the PY6 annual reports and those shown in the appendix table of the process evaluation memorandum. Therefore, the SWE Team reviewers cannot determine that *all* of the recommendations in the PY6 annual report follow from evaluation findings.

C.2.1.3 Residential Home Performance Program

C.2.1.3.1 Brief 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

[55] The evaluation also did not meet the target for Appliance participants, but the achieved sample was sufficient to meet the required confidence and precision.

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. FirstEnergy EDCs did not carry out evaluations of the new home or HER components for PY6.

In PY6, the Residential Home Performance Program was under budget for all four EDCs Table C-3. All four FirstEnergy EDCs significantly exceeded savings targets as projected in the EE&C plans.

Table C-3: FirstEnergy EDC Residential Home Performance Program Successes

EDC	Percent of Target Budget Spent	Percent of Energy Savings Target Achieved
FE: Met-Ed	87%	178%
FE: Penelec	49%	151%
FE: Penn Power	42%	181%
FE: West Penn	78%	227%

C.2.1.3.2 Summary of the Process Evaluation Findings

Tetra Tech interviewed an unspecified number of program and implementer staff and nine energy auditors and surveyed 116 program participants. Tetra Tech reported the following key findings:

1) Program participants were highly satisfied with the program overall.
2) Participants reported wanting to be notified about future program options via email.
3) Most participants were familiar with LEDs and were using them in their homes.[56]
4) Auditors welcomed the opportunity for business through the program and were enthusiastic program promoters.
5) Auditors reported receiving inquiries about the program because of marketing efforts by FirstEnergy EDCs, specifically bill inserts and HERs.
6) Auditors reported that "solving a problem" for the customer is more effective than focusing on deficiencies of the house itself or pointing out how much money the customer will save.
7) Auditors reported mixed satisfaction with field use of the Surveyor tool, with some reporting confusion and frustration with some characteristics of the Surveyor.
8) Auditors reported that the follow-through with audit recommendations can be low because of the rebate structure for recommended upgrades.
9) Auditors reported that it is difficult to identify the requisite 350 kWh in savings if a home has non-electric heating and/or water heating.
10) Auditors were pleased with the support provided by the ICSP and with their interaction with ICSP staff.

C.2.1.3.3 Summary of the Process Evaluation Audit

The process evaluation of the Residential Home Performance Program appears to have been consistent with Tetra Tech's Phase II evaluation plan, with one possible exception noted below. The discussion was generally succinct and highlighted findings that should be of value to the administrator and implementer. The reports incorporated the required tables showing the sampling strategy and status report on process and impact recommendations, although the sampling table did not include information on the number of staff or contractors interviewed. The recommendations were clearly stated and actionable. While the PY6 annual report did not show how those recommendations followed from the findings and conclusions, the

[56] As noted in detail below, the report does not actually provide sufficient detail to determine whether this is in fact the case.

process evaluation memorandum for the audits component, dated about the same time as the PY6 annual report, presents conclusions and an appendix table relating recommendations to key findings. There are some slight variations between the recommendations made in the PY6 annual report and those shown in the appendix table of the process evaluation memorandum, but generally the reports satisfy the requirements relating to recommendations. However, the SWE Team has the following observations about the reporting of this process evaluation.

First, the PY6 annual report's discussion of the program itself was in some respects confusing. The lead paragraph to the overall Home Performance Program section and the lead paragraph to the process evaluation subsection use somewhat different language to refer to program components. The overall lead paragraph also refers to receiving kits by completing online or phone audits or submitting an online or phone request but does not clarify how "requests" differ from "audits." The process evaluation section of the PY6 annual report refers to an "opt-in kit" component, without explaining what that means or how it relates to earlier discussion. The process evaluation memorandum makes it clearer that the opt-in kit component encompasses all the ways of receiving the kit other than the school education component; however, it does not indicate any distinction between "requests" and "audits." [57]

The description of the research activities conducted in general provided sufficient detail to determine what the evaluator did, although some additional details would have been useful. Similarly, while the process evaluation memorandum provided a generally detailed presentation of results, the SWE Team reviewers noted some areas where additional detail or clarification would be valuable.

The reports do not identify the number of staff interviewed nor do they describe any findings from the staff interviews other than that they did not identify researchable topics, although the memorandum stated that interviews addressed the effectiveness of the program's current operations.

Of greater concern is the discussion of LED awareness and satisfaction in the memoranda for audits and kits. Both memoranda state that the analysis within that section includes only survey respondents who indicated they had some level of familiarity with LEDs, but they do not state anywhere what that number of respondents was. Therefore, it is not possible to evaluate the reported key finding statement that most participants were familiar with LEDs and were using them in their homes. It is essential to know how many survey respondents reported familiarity with LEDs and were therefore included in the further analysis of participants' satisfaction with LEDs and observations about market price fluctuations. This point may in fact be academic, however, as it appears that many of the respondents may have been confusing LEDs with CFLs, which the report authors acknowledge; this raises questions about the reliability of any of the findings from that section.

Another concern is that the Evaluation Methodology section and Program Sampling section of the PY6 annual report indicate that findings from the school kit survey were consistent with those for the Home Energy Audit kit results. Presumably this refers to impact-related findings (counts of installed items). By contrast, the process evaluation memorandum for the kits program components cited several points where the two groups differed. Someone who reads only the PY6 annual report and not the memorandum could conclude that the two surveyed groups did not differ on the process questions.

As noted, there was one possible exception to the observation that the process evaluation was consistent with the evaluation plan. The reports do not mention a benchmarking review, which the evaluation plan indicated was planned for PY5. However, FirstEnergy EDCs carried out no process evaluations in PY5.

[57] Note that the PY6 Annual Report also has some formatting issues. The formatting of the heading for Program Sampling (Section 4.2.2) is slightly different from that for Evaluation Methodology (Section 4.2.1), and the following section, labeled "One Site Inspections" (presumably, meant to be "On-site Inspections ") is also numbered 4.2.1.

Given that fact, the reports should explain why the benchmarking review was not carried out in PY6 and should state when it will be done.

C.2.2 Low-Income Program

C.2.2.1 Brief Overview of the Program and Its Success

The Low-Income Program provides basic to comprehensive whole building measures at no cost to low-income households and educates customers about their home's energy use and ways to save energy. The program has three components: Direct Install and Low Income, Low Use (LILU) Direct Delivery, and Giveaway Kits. The Direct Install component comprises the WARM Plus, WARM Extra Measures, and WARM Multifamily programs, which provide an on-site home energy audit; no-cost direct install of a range of energy efficiency measures; and removal of old, inefficient refrigerators and freezers. Through the LILU Direct Delivery Kits component, CFLs, LED nightlights, a furnace whistle, and for those with electric water heating, aerators, aerator adapters, and an energy saving showerhead were directly mailed to income-qualified customers. The LILU Giveaway component distributed CFLs and limited numbers of faucet aerators, furnace whistles, and energy savings showerheads to low-income customers at community events. FirstEnergy EDCs did not carry out evaluations of the LILU components for PY6.

In PY6, the Residential Low-Income Program was under budget for all four EDCs Table C-4. Two of the four FirstEnergy EDCs significantly exceeded savings targets as projected in the EE&C plans, while two fell short of targets.

Table C-4: FirstEnergy EDC Residential Low-Income Program Successes

EDC	Percent of Target Budget Spent	Percent of Energy Savings Target Achieved
FE: Met-Ed	64%	88%
FE: Penelec	63%	82%
FE: Penn Power	41%	141%
FE: West Penn	88%	130%

C.2.2.2 Summary of the Process Evaluation Findings

Tetra Tech interviewed an unspecified number of program and implementer staff, contractors, and auditors and surveyed 149 program participants. Tetra Tech reported three key findings:

1) Household and contractor satisfaction with the low-income programs was high. LILU kit participants were highly satisfied with kit contents and the instructions for installation.
2) The WARM Plus, Multifamily, and WARM Extra Measures program components led to additional energy saving activities in the household, in order of most mentioned to least: turning off the lights when leaving the room, washing laundry in cold water, turning down the thermostat in the winter, unplugging electronics and appliances when not in use, sealing up leaky windows or doors, installing more CFLs, changing the furnace filter, and lowering the water heater temperature.
3) More than 40% of households reported that direct-install measures received through the WARM Extra Measures, WARM Plus, and Multifamily subprograms were not installed or only partially installed by the energy specialist or auditor.

C.2.2.3 Summary of the Process Evaluation Audit

The process evaluation of the Low-Income Program appears to have been consistent with Tetra Tech's Phase II evaluation plan. The discussion was succinct and highlighted findings that should be of value to the administrator and implementer. The reports incorporated the required tables showing the sampling

strategy and status report on process and impact recommendations, although the sampling table did not include information on the number of staff or contractors interviewed. The recommendations were clearly stated and actionable. However, the SWE Team has the following observations about the reporting of this process evaluation.

The reports do not provide any detail about findings from the staff interviews, even though the evaluators reported that the interviews assessed the effectiveness of the programs' current operations and explored possible ways to implement the programs more cost effectively.

The SWE Team notes that, while the various EDC-specific PY6 annual reports report the same high-level findings, the process evaluation memorandum reports results for all four EDC territories. The results from the survey were generally similar across the EDC territories, but they were not identical. Thus, the various EDC-specific PY6 annual reports all state that "more than 40 percent" of survey respondents reported that the energy specialist or auditor did not install or only partially installed direct-install measures. In fact, the memorandum shows and comments on variability among the EDC territories with regard to this percentage. It would be valuable for the evaluators to state whether the variability among the EDC territories in this, or any other findings, was statistically significant.

Finally, while the two recommendations shown in the PY6 annual report were clearly stated and actionable, the PY6 annual report did not show how both those recommendations followed from the findings and conclusions, and the recommendations in the PY6 annual report did not completely overlap with those in the process evaluation memorandum, dated three months earlier. The first recommendation in the PY6 annual report, to enhance QA reviews for contractors who were least likely to install the direct-install measures, follows from the findings. While the reports state that the second recommendation, regarding fewer 9W globes, is based on the fact that customers are slower to install those than other lamps in the kits, neither the PY6 annual reports nor the memorandum show that finding. The process evaluation memorandum presents conclusions and an appendix table relating recommendations to key findings. That table shows the first recommendation from the PY6 annual reports as well as a second recommendation, to consider coupons for certain energy efficiency products, that is not in the PY6 annual reports, but it does not include the recommendation to provide fewer 9W globes. The SWE Team suggests that the memorandum be revised to be consistent with the PY6 annual reports.

C.2.3 Non-Residential Programs

Tetra Tech reported on process evaluations for three non-residential programs: the C/I Energy Efficient Equipment Programs for Small and Large Businesses and the Government and Institutional Program. In PY6, FirstEnergy EDCs did not carry out evaluations of its C/I Energy Efficient Buildings Programs.

The three evaluated programs are similar, and the evaluation consultant carried out the same evaluation activities, using the same methodologies, and reported the same findings for all three. Therefore, we have reviewed these evaluations as a single evaluation.

C.2.3.1 Brief Overview of the Program and Its Success

The C/I Energy Efficient Equipment Programs for Small and Large Businesses and the Government and Institutional Program all provide prescriptive and custom incentives for high-efficiency lighting, HVAC, motors and drives, and specialty equipment. They also offer appliance recycling in a similar manner to the residential appliance recycling program. The main difference between the two programs, other than the size of businesses targeted, is that the program for large businesses also distributed conservation kits consisting of CFLs and smart power strips to several master-metered multifamily communities. The process evaluations did not appear to encompass the appliance recycling or multifamily components.

In PY6, all FirstEnergy non-residential programs were under budget, except for the West Penn Large C/I Equipment Program. The various programs varied in the degree to which they met savings targets. The Large C/I Equipment Program was the most successful, having exceeded targets for all four EDCs. The Small C/I Buildings Program and Large C/I Buildings Program had variable success across the four EDCs, both exceeding the target for one EDC and falling short for three—the large program was the more variable of the two, achieving 25% or less of the target for three EDCs but 286% of the target for one. The Small C/I Equipment Program and the Government and Institution Program both fell short of the target for all four EDCs Table C-5.

Table C-5: FirstEnergy EDCs Non-Residential Program Successes

Program	Percent of Target Budget Spent	Percent of Energy Savings Target Achieved
FE: Met-Ed		
Small C/I Equipment	53%	53%
Small C/I Buildings	39%	61%
Large C/I Equipment	77%	148%
Large C/I Buildings	20%	8%
Government and Institutional	20%	17%
FE: Penelec		
Small C/I Equipment	30%	68%
Small C/I Buildings	32%	83%
Large C/I Equipment	29%	188%
Large C/I Buildings	31%	286%
Government and Institutional	24%	30%
FE: Penn Power		
Small C/I Equipment	39%	94%
Small C/I Buildings	44%	195%
Large C/I Equipment	49%	431%
Large C/I Buildings	30%	2%
Government and Institutional	37%	63%
FE: West Penn		
Small C/I Equipment	58%	68%
Small C/I Buildings	41%	50%
Large C/I Equipment	124%	206%
Large C/I Buildings	27%	25%
Government and Institutional	36%	36%

C.2.3.2 Summary of the Process Evaluation Findings

Tetra Tech interviewed an unspecified number of program and implementer staff and surveyed 43 small business participants, 12 large business participants, and 18 government and institutional participants, for a total of 73 participants. Tetra Tech reported the following key findings:

1) Participants reported high levels of satisfaction with all aspects of the program; more than 90% of customers said they would likely participate in the program again in the future; very few reported any participation obstacles related to program processes; and two-thirds of customers have recommended the program to colleagues in their industry.
2) Mean ratings for all aspects of program satisfaction were higher in Phase II than Phase I, except satisfaction with the incentive offered, which decreased marginally.
3) Respondents indicated their preferred methods of communication about the program are via email newsletters (67%) and direct mail from their EDC (30%), but more than half (54%) learned about the program through their contractor.
4) For most (~80%) of respondents, budget and financial plans fell into two planning periods: one year or less (about 45%) and five years or longer (35%). Responses differed among strata—large C/I customers were most likely to report a five-plus-year planning period (47%), while small C/I and GNI customers were most likely to report one-year planning periods (50% and 53%, respectively).
5) The budget cycle affects project implementation. Of the 45% of respondents who indicated that they had business or production cycles that affect planning and implementation of efficiency projects, more than half of respondents (53%) have budget and financial planning cycles that affect project planning and implementation.
6) The quality of participant data files was improved relative to Phase I, resulting in better survey completion rates.

C.2.3.3 Summary of the Process Evaluation Audit

The process evaluation of the Low-Income Program appears to have been consistent with Tetra Tech's Phase II evaluation plan, with some important exceptions noted below. The discussion was succinct and highlighted findings that should be of value to the administrator and implementer. The reports incorporated the required tables showing the sampling strategy and status report on process and impact recommendations, although the sampling tables did not include information on the number of staff interviewed. Most of the recommendations were clearly stated and actionable. However, the SWE Team has the following observations about the reporting of this process evaluation.

As with the process evaluations of the other FirstEnergy EDC programs, the reports do not identify the number of staff interviewed, nor do they provide any detail about findings from the staff interviews.

A second concern is that the PY6 annual reports present a finding at the same high level in the memorandum as in the annual report, without sufficient detail to evaluate the authors' interpretation. Specifically, both sources state that large C/I customers most commonly reported a business planning period that spans more than[58] five years (47%), while small C/I and GNI customers most commonly reported planning in one-year increments (50% and 53%, respectively). Comparing the two groups on two different metrics (percentage reporting a five-plus-year planning interval and percentage reporting a one-year planning interval), with neither one constituting a clear majority of either group, makes it difficult to know how the two groups really compare. While the evaluators reported the percentages of the combined sample that reported both planning horizons, which provides some context, it would have been more valuable to show the percentages of both groups that reported each planning interval.

Another, less critical, concern relates to the discussion of how business and production cycles affect project planning and implementation. The process evaluation memorandum reports that 45% of surveyed participants reported that their facility has a production schedule or business cycle that affects project implementation, with those respondents divided among those reporting a budget cycle (53%), production/output cycle (19%), staffing/occupancy cycle (16%), and "seasonal" cycle (7%). This seems to

[58] Or perhaps "at least five years." The report uses both terminologies.

imply that all respondents reported only one type of cycle that affected project implementation. Were those exclusive choices? It would help to have that made explicit.

The evaluators report that satisfaction levels are higher in Phase II than Phase I; it would be valuable to report the inferential statistics (*t* and *p* values).

As noted, there were important exceptions to the observation that the process evaluation was consistent with the evaluation plan. First, the evaluation plan indicated that the process evaluation for PY6 would include interviews with nonparticipant trade allies, but the reports provide no mention of such an activity. As the evaluation plan indicated, interviews with nonparticipant trade allies would provide valuable information to help the program reach additional trade allies, thereby expanding its penetration, and to provide insights on the program's low participation with customers replacing motors and drives. Therefore, the evaluators should explain why they did not include that activity in the PY6 evaluation.

In addition, the participant survey sampling appeared to fall below what the evaluation plan anticipated. The evaluation plan describes a single plan for "nonresidential programs" (p. 74), with a target of 70 survey completions each for prescriptive and custom lighting measures per utility territory. Given the total number of prescriptive and custom projects done in PY6 across the three evaluated programs, the number of survey completions of both types—6 custom and 67 prescriptive projects—is more than adequate.

Finally, while most of the recommendations shown in the PY6 annual reports were clearly stated and actionable, the PY6 annual reports and process evaluation memorandum (dated about one month earlier than the report) present recommendations in a somewhat confusing manner. The PY6 annual reports presented six recommendations: two that applied only to the small C/I equipment program, three that applied to the large C/I equipment program and the government and institutional program, and one that applied only to the government and institutional program. The annual reports did not show how those recommendations followed from the findings and conclusions. The process evaluation memorandum, dated about one month before the PY6 annual reports, does present conclusions and an appendix table relating some of the recommendations to key findings. However, the appendix table in the memorandum shows only the three recommendations for the large C/I equipment program (which the report also shows for the government and institutional program). The memorandum shows the two recommendations specific to the small C/I equipment program in a separate "recommendations" section, together with one of the three recommendations for the large C/I equipment program, with findings-based explanations for the recommendations, but that section is separated from the appendix table by five pages. This organization of the recommendations is confusing.

The SWE Team does wonder whether there is adequate justification for the recommendation to consider providing small C/I equipment program participants a referral bonus or recruitment award based on the finding that two-thirds of participants reported recommending the program to colleagues. With an already-high referral rate, it is not clear that the recommended bonus/award would be cost-effective, especially given that participant surveys often show that colleague referrals are not a large source of program awareness. The SWE Team suggests that the evaluator should provide additional support for why this recommendation would be cost-effective.

Finally, the recommendation that the government and institutional program consider stipulating 1,000 hours as the annual indoor lighting HOU for all program participants appears to derive from a statement in the impact evaluation methodology section of the annual report (p. 90). Some additional details to support this recommendation seem warranted.

C.3 PECO

C.3.1 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 (contractors, installers, manufacturers, used appliance dealers or junk removal services, and participating teachers); conducted field observations of programs delivered through the retail channel; and surveyed program participants and nonparticipants. The document and program data review informed identification of program goals, activities, and updates, an, in some instances, development of program theory and logic models. The research issues addressed by the primary data collection activities (in-depth interviews, surveys, and field observations) 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 PY6 annual report also varied among programs, but generally included program performance with regard to savings estimates and goals; input from program utility staff and implementers; and assessment of customer and market actor program satisfaction, participation, challenges, and recommendations.

For each program, a brief program description, summary of the process evaluation findings, and a 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 quality of the recommendations.

C.3.1.1 Smart Home Rebates Program

C.3.1.1.1 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.[59] 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. In PY6, the SHR program exceeded its expected TRC of 1.3. Reported SHR gross energy and demand savings were 87,316 MWh/yr and 13.8 MW, respectively. These savings were a significant portion of the total energy and demand savings in PECO's overall portfolio.

C.3.1.1.2 Summary of the Process Evaluation Findings

Navigant employed several data collection methods to gather information for the process evaluation. For lighting measures, Navigant conducted a general population survey of 602 customers, a conjoint web panel with 898 customers, a program marketing materials review, 50 mystery shopping trips at participating retail locations, and in-depth interviews with the program manager, implementer, and eight lighting manufacturers. For non-lighting measures, Navigant conducted 11 in-depth interviews with HVAC installers, an online Delphi panel with 16 HVAC installers, 100 mystery shopping trips at participating retail locations, 200 telephone surveys with program participants, and an online focus group with 17 PECO

[59] Almost all (99%) reported savings 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.

customers who purchased qualifying HVAC equipment. Based on these data, several key findings emerged:

1) In PY6, customers exhibited high awareness of LED and CFL measures. Awareness of LED measures, in particular, increased from 58% in PY5 to 85% in PY6.

2) Overall adoption of CFLs and LEDs was low in the population. About 19% and 2% of all sockets in the PECO territory were occupied by CFLs and LEDs, respectively.

3) Manufacturers and retailers reported that national and local incentive programs mitigated risks from introducing new lighting technologies and reduced retail prices sufficiently to secure early CFL and LED adoption but that price is ceasing to be a barrier as LED prices will continue to decline with or without a program subsidy. They also noted that as EISA phases out traditional incandescent options, consumers could purchase lower-priced bulbs, such as halogens. This could be a disadvantage to higher efficiency lighting options, as the shelf share of efficient lighting products has not changed significantly from PY2 to PY6. In this context, availability could be a barrier.

4) Delphi panelists estimated that less than 50% of the market has adopted high-efficiency heating and cooling equipment. Surveyed HVAC installers estimated an even lower penetration of this equipment among low-income segments, as they typically serve the more affluent and educated residential segments. The less affluent and less educated customers have not benefited as much from program rebates, resulting in high free-ridership among current customers, as noted by both participant survey respondents and HVAC installers who were interviewed or included in the Delphi panel.

5) Mystery shopping trips documented the erosion of sales staff's enthusiasm and knowledge for selling energy efficient appliances through the SHR program. The percentage of sales associates who could direct customers to an SHR-qualified model declined from 91% in PY5 to 41% in PY6. Sales associates could explain the rebate process (prompted and unprompted) in 48% of visits; in PY5, 65% mentioned the process without prompting.

C.3.1.1.3 Summary of the Process Evaluation Audit

Navigant completed all the PY6 activities listed in the evaluation plan as well as several additional activities: conjoint web panel study, Delphi panel, and price elasticity and long-term market effects modeling.

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 general population survey and conjoint web panel study and a stratified random sampling approach for the mystery shopping trips and participant survey, focusing on two strata: lighting and non-lighting 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 conclusions, 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, conclusions, and recommendations, except in two areas:

1) There was limited detail associated with in-depth interviews of lighting manufacturers, program manager, and program implementer.

2) There were no references to the statistical test(s) used to evaluate the strength of differences reported between PY5 and PY6. It would have been useful to know, for example, whether the

difference in sales staffs' knowledge of rebates and the qualifying product as well as their enthusiasm toward energy efficiency were statistically significantly different from PY5 to PY6.

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 conclusions or findings.

C.3.1.2 Smart House Call Program

C.3.1.2.1 Brief Overview of the Program and Its Success

The SHC program is built around direct-install and contractor-installed measures. Electric heat rate customers 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 a set of recommendations for the homeowner to consider. Those who opted 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 Phase II SHC gross energy and demand savings were 3,825 MWh/yr and 0.56 MW, respectively. Most of these savings occurred in PY6 (2,870 MWh/yr and 0.44 MW).

C.3.1.2.2 Summary of the Process Evaluation Findings

Navigant conducted a program marketing materials review, a program database review, and in-depth interviews with the program manager, implementer, six contractors, and six energy advisors. Based on these data, several key findings emerged:

1) PECO implemented a considerable marketing effort in PY6 across a wide variety of channels. Overall, the program experienced success from this marketing effort.

2) Marketing materials, in particular, helped program staff build relationships with participating contractors. Almost all of the contractors reported that they used the program marketing materials to promote the program with their customers. Further, contractors generally expressed satisfaction with the marketing and print program materials that they received for the program and did not suggest any improvements or changes.

3) The SHC program influences participation in additional PECO Smart Ideas programs. About 25% of participants in the SHC program also participated in the Smart AC Saver program, and 5% to 10% also participated in the SHR program.

4) Both energy advisors and contractors stated that they were not well oriented to the specific additional Smart Ideas programs for which SHC participants may be eligible. Further, energy advisors noted that they were not encouraged to adequately follow-up with customers who have received an audit to encourage them to pursue contractor-installed measures.

5) Energy advisors reported that there is room in the program to expand the list of measures that qualify for program incentives because nearly half of participants express an intent to pursue additional measures that go beyond what is incentivized under the program.

C.3.1.2.3 Summary of the Process Evaluation Audit

Navigant completed all the PY6 activities listed in the evaluation plan except interviews with contractors training to be energy advisors. Instead, Navigant interviewed six contractors who were energy advisors and did not provide an explanation in the annual report on why they made this change. The SWE Team, nevertheless, is not concerned with this deviation from the plan since Navigant has addressed evaluation research questions.

For the in-depth interviews with program staff, implementers, and other program actors, the sampling was purposive. There is limited detail on how Navigant selected market actors to interview.

The SWE Team also determined that the reporting followed most of 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.

C.3.1.3 Smart Appliance Recycling Program

C.3.1.3.1 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.[60] An independent implementation contractor, JACO, operates the program and handles all of the application and pickup processes, collects data about participants and their appliances, and recycles the collected units in its regional facility. There were two notable changes to the program in PY6: PECO increased the incentive from $35 in PY5 to $50 in PY6 and increased the amount of customer outreach done for the program. As a result, in PY6 the residential component of the SAR program experienced strong participation. Q4 of PY6 had the highest number of appliances recycled in a single quarter since the inception of the program.

C.3.1.3.2 Summary of the Process Evaluation Findings

Data sources for the process evaluation included a telephone survey of 125 program participants and in-depth interviews with the program manager and five used appliance dealers and junk removal service companies. Based on these data, four key findings emerged:

1) According to the appliance dealers, the SAR program has had a limited effect on the secondary retail market. None of the refrigerators recycled by the program were less than nine years old, and appliance dealers would not have considered these units for their inventories.

2) The SAR program, however, has had an effect on the disposal market for refrigerators and freezers. Navigant interviewed two of the larger junk hauling services in PECO territory, and they reported that the number of refrigerators that they picked up decreased over the past year, which is when PECO increased the rebate and program marketing.

3) Satisfaction with all aspects of program delivery to participants remained high.

4) Program marketing and the program incentive increased in PY6, leading to increased participation and savings.

C.3.1.3.3 Summary of the Process Evaluation Audit

Navigant completed all the PY6 activities listed in the evaluation plan except interviews with retailers associated with recycled units. Instead, Navigant interviewed five used appliance dealers and junk removal service companies and did not provide an explanation in the annual report on why it made this

[60] Although the program serves both residential and non-residential customers, most of the recycled units and savings come from the residential sector. Almost all (99%) reported savings occurred in the residential sector.

change. The SWE Team, nevertheless, is not concerned with this deviation from the plan since Navigant has addressed evaluation research questions.

For the data collection task requiring sampling, the SWE Team determined that the sampling approach for that task 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, focusing on two strata: refrigerators and freezers. Navigant achieved a sample size of 75 for refrigerators and 50 for freezers (a total sample of 125). This sample provided 85/15 confidence/precision per stratum. The sample, however, overrepresented the freezer measures, which may or may not be an issue. [61] The annual report does not discuss how overrepresentation of freezer measures affects process evaluation participant findings.

The SWE Team also determined that the reporting followed most of the SWE guidelines. The annual report included descriptions of the methods, summary of findings and conclusions, 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, conclusions, and recommendations, except in one area: there was no detail associated with the participant survey findings; the report included only a high-level summary of participant survey responses. For example, Navigant reported that participants were highly satisfied with the program, but there were no statistics in the annual report or in supporting documentation provided to the SWE Team that showed the percentage of participants who were satisfied with the program sign-up, appliance pickup, or any other aspect of the program.

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 conclusions or findings.

C.3.1.4 Smart Usage Profile Program

C.3.1.4.1 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, Opower, enrolls participants in the program based on a randomized control trial (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.

C.3.1.4.2 Summary of the Process Evaluation Findings

Navigant conducted a program materials and database review, 200 telephone surveys with program participants and nonparticipants, and in-depth interviews with the program manager and implementer. Based on these data, four key findings emerged:

1) Many of program outcomes were accomplished. The majority (89%, n=472) of the treatment households recalled receiving the mailed HERs. Navigant also found statistically significant savings among treatment households, confirming that the program is being implemented, that treatment

[61] The proportion of freezer measures in the sample was much higher than the proportion of freezer measures in the population.

households are regularly receiving HERs, and that they are, on average, taking energy saving actions as a result.

2) Among respondents who rated their satisfaction with the mailed HERs, 62% were satisfied (4 or higher, on a scale of 1–5). Participant satisfaction with the mailed reports was lower than the typical range of 68% to 70% in other HER program evaluations conducted by Navigant. This appeared to be the exception, as for most of the customer engagement metrics explored in the participant survey, including recall rates and time spent reading the reports, the SUP program was performing within typical ranges expected for this program type. Although discussion of typical ranges of performance metrics for this program type is limited, nearly all respondents (91%) who received a report recalled the report, and 76% indicated that the report either correctly or incorrectly compared their home with other homes, indicating these respondents have read the report.

3) The majority of email recipients (those who also received an email report, not just mailed report) did not recall receiving the email reports from PECO. Of 70 survey respondents currently receiving the electronic HERs, 27% recalled receiving them. This finding calls into question the importance of the emails and their larger role in program processes.

4) According to the SUP Program Theory and Logic Model, the "My Usage" section of the PECO web portal is intended to extend the SUP program information to participants as well as nonparticipants. A significantly lower proportion of participants compared with nonparticipants reported visiting the portal—56% compared with 75% of nonparticipants. This finding suggests that participants may already be getting what they need from the printed reports and do not need to turn to the portal for additional information or resources, which goes against the current understanding of program logic.

C.3.1.4.3 Summary of the Process Evaluation Audit

Navigant completed all the PY6 activities listed in the evaluation plan.

For the data collection task requiring sampling, the SWE Team determined that the sampling approach for that task 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 customer survey, focusing on two strata: program participants and nonparticipants. Navigant achieved sample sizes that provided 85/15 confidence/precision per stratum.

The SWE Team also determined that the reporting followed most of 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.

C.3.1.5 Smart Energy Saver Program

C.3.1.5.1 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. PECO also expects that parents and guardians will be educated about energy efficiency through their

student's participation in the program. This can affect energy usage behavior in the student's home. In addition to changing behavior through education, the SES program encourages the installation of low-cost, energy efficient measures provided to each student through the PECO Smart Energy Saver Kits at no cost. During Phase II, the SES program has distributed 12,919 full or slimmed-down kits and achieved residential sector energy and demand savings of 6,232 MWh/yr and 0.5 MW.

C.3.1.5.2 Summary of the Process Evaluation Findings

Navigant conducted a program materials review, a review of the returned student, teacher, and parent installation surveys, in-depth interviews with the program manager and implementer, and 15 surveys with participating teachers. Based on these data, four key findings emerged:

1) Multiple teachers indicated that many of the students in their classrooms have parents with low levels of English comprehension. These teachers struggle to get any homework assignment back, including installation surveys.

2) Among the 15 surveyed teachers, two indicated that they required some type of parental consent before the students were sent home with the kits. The teachers who indicated that they had required some level of parental consent also indicated that they had kits left over at the end of the program. These teachers had concerns over sending the kits back to the program because they felt it may reflect poorly on them and their schools and may limit their ability to receive kits in the future. Navigant noted that it is imperative for the program to fully understand which kits are making it into students' homes and which are not, to accurately track savings.

3) One teacher had asked all students to fill out the student installation surveys, even those who had not taken kits home. Additionally, a few teachers indicated that they had their students complete the installation surveys in the classroom rather than at home with their parents. These findings indicate that the SES program functions differently in practice than the assumed design. Note that since no data on how the installation survey is completed are currently collected on a broader scale, the evaluation could not explore whether these survey completion methods have any impact on the quality of the data being collected and savings estimations.

4) The PY6 SES program also saw low levels of participant engagement, which was measured by the returned surveys through each of the various channels. Navigant assumed that if program participants returned surveys through program channels, then they were seen as engaged in program activities. Navigant estimated a 32% return rate on student surveys, a 25% return rate on teacher satisfaction surveys, and a 2% return rate on parent satisfaction surveys.

C.3.1.5.3 Summary of the Process Evaluation Audit

Navigant completed all the PY6 activities listed in the evaluation plan. For the in-depth interviews with program staff, implementer, and teachers, the sampling was purposive.

The SWE Team determined that the reporting followed the SWE guidelines. The annual report included descriptions of the methods, summary of findings and conclusions, 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, conclusions, and recommendations, except in one area: there was no detail associated with the program manager and implementer interviews.

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 or findings. Nevertheless, some of the in-depth interview findings lacked sufficient detail to determine how many respondents commented about specific issues to determine the importance of those issues.

C.3.1.6 Smart Builder Rebates Program

C.3.1.6.1 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 PY6, the program was expanded to allow gas-heated homes. 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.

C.3.1.6.2 Summary of the Process Evaluation Findings

Navigant conducted a program materials review and in-depth interviews with the program manager and implementer. Based on these data, one key finding emerged: current incentive levels are insufficient to attract new builders to the program. The largest participant in the program decided to stop building ENERGY STAR homes because the incentives were insufficient.

C.3.1.6.3 Summary of the Process Evaluation Audit

Navigant completed all the PY6 activities listed in the evaluation plan except surveys with participating and nonparticipating builders. These surveys will be conducted in PY7 because there are only three builders participating in the program.

In-depth interviews with EDC and implementation staff were purposive.

The SWE Team determined that the reporting followed the SWE guidelines. The annual report included descriptions of the methods, summary of findings and conclusions, 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, conclusions, 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 conclusions and findings.

C.3.1.7 Smart A/C Saver Program – Residential

C.3.1.7.1 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. Total verified gross savings were 55 MW for the residential SACS program, which was 71% of the PY6 target of 78 MW. There are no energy savings goals for the SACS program.

C.3.1.7.2 Summary of the Process Evaluation Findings

Navigant conducted an abbreviated process evaluation of the program in PY6, relying on reviews of the tracking database and of program marketing materials and an in-depth interview with the program manager. This research indicated that while the program has seen some level of attrition since the incentive reduction at the end of Phase I, the program did not experience the 19% drop in participation predicted by the Willingness-to-Accept survey conducted in PY4. Rather, the program has seen a consistent drop in participation of approximately 1.4% per year since the end of PY4. Navigant attributes

this drop to customer home sales, customer moves, and the reduced incentive—the effects of which have been offset by PECO's enrollment of new customers during the program year.

C.3.1.7.3 Summary of the Process Evaluation Audit

Navigant completed all of the PY6 activities listed in the evaluation plan except surveys with program participants. The evaluator has not included an explanation in the annual report or supporting documentation as to why program participant surveys were dropped in PY6.

For the in-depth interview with program staff, the sampling was purposive.

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. Note that there were no recommendations for the residential SACS program. The report included sufficient detail for the SWE Team (and other readers) to assess the methods and findings. Since Navigant conducted an abbreviated process evaluation in PY6, the report provided no information about participants' experiences with the program.

Overall, the process evaluation discussion was succinct and highlighted findings that should be of value to the administrator and implementer.

C.3.1.8 Smart Multi-Family 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.

C.3.1.8.1 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 (MF) buildings and assist MF residents and building owners/managers in acting on those opportunities. The program is designed for both MF property owners and 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 or for common areas. The prescriptive path offers incentives to MF 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.

C.3.1.8.2 Summary of the Process Evaluation Findings

Navigant conducted in-depth interviews with the program manager and implementer and surveyed 85 program participants (both tenants and landlords). Based on these data, several key findings emerged:

1) Ten percent of surveyed tenants reported that they were not informed of the program prior to installation. Some of them cited this as a reason for dissatisfaction with the program overall.
2) Twelve percent of surveyed tenants reported dissatisfaction with the equipment, with the majority citing CFLs as the source of dissatisfaction. Residential tenants cited both CFL color quality and delayed brightness as the reasons for their dissatisfaction.
3) Through discussions with the evaluation team during on-site visits, landlords requested information on the installed equipment's make and model in order to replace in kind.
4) There has been zero participation in the prescriptive channel to date. However, there have been multiple repeat landlord participants in the program who have taken advantage of the free direct-install aspect of the program within this program year and from the previous program year.
5) About 40% of landlords recalled receiving a list of incentivized energy efficiency equipment recommended through the program. The majority of landlords are not aware of, or able to recall, incentivized offerings through the program's prescriptive channel.

C.3.1.8.3 Summary of the Process Evaluation Audit

Navigant completed all of the PY6 activities listed in the evaluation plan.

For the data collection task requiring sampling, the SWE Team determined that the sampling approach for that task 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: tenants, residential landlords, and non-residential landlords. Navigant achieved sample size that provided 85/15 confidence/precision per overall program.

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.

C.3.2 Low-Income Programs

C.3.2.1 Low-Income Energy Efficiency Program

C.3.2.1.1 Brief Overview of the Program and Its Success

The Low-Income Energy Efficiency Program (LEEP) provides income-eligible customers a variety of measures intended to reduce their electricity bills. There are four LEEP components and associated target markets:

1) **Market for Component 1**: PECO 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 monthly average usage of 600 kWh per month for electric base load for non-electric heating customers and 1400 kWh per month for electric heating customers
2) **Market for Component 2**: PECO customers who participate in PECO's LIURP during PY5-PY7
3) **Market for Component 3**: PECO residential electric 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**: PECO 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.

LEEP components 2, 3, and 4 saw an increase in savings from PY5 to PY6.

C.3.2.1.2 Summary of the Process Evaluation Findings

Navigant conducted 125 surveys with program participants, ride-along observations of 24 participant homes, and in-depth interviews with the program manager and implementer. Based on these data, several key findings emerged:

1) Among LEEP survey participants, 26% reported that they had undertaken additional actions that were not recommended by a program representative after participating in the LEEP. Most of the actions

taken were no- or low-cost actions. These actions show that LEEP participants may be open to taking additional no- or low-cost energy saving actions.

2) Of homes visited during the ride-along surveys, 75% had unfinished basements with no floor insulation and up to 25% had windows that did not shut properly or were broken. Lack of floor insulation and properly functioning windows can result in a heat loss or increased heating use.

3) The first-year ISR for Component 3 CFLs fell to 47% in PY6, down from 71% in PY5. Of participants' homes visited during the ride-along surveys, 13% declined the offered CFLs.

C.3.2.1.3 Summary of the Process Evaluation Audit

Navigant completed most of the PY6 activities listed in the evaluation plan.

For the data collection task requiring sampling, the SWE Team determined that the sampling approach for that task 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 component 1, 3, and 4. Navigant achieved sample sizes that provided 85/15 confidence/precision per stratum. The sample, however, overrepresented Component 3 participants. The annual report does not discuss how overrepresentation of these participants affects process evaluation participant findings.

The SWE Team also determined that the reporting followed most of 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.

C.3.3 Non-Residential Programs

Navigant reported on process evaluations for six non-residential programs: Smart A/C Saver (SACS), Smart Equipment Incentives (SEI), Smart Construction Incentives (SCI), Smart Multifamily Solutions (SMF Solutions), Smart On-Site (SOS), and Smart Business Solutions (SBS).

For the process evaluations of the above programs, Navigant reviewed program documents and databases; interviewed utility and implementation staff as well as 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, and in some instances, verification of program theory. 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 PY6 annual report also varied among programs, but generally included program performance with regard to savings estimates and goals; input from the program staff and implementer; and assessment of customer, contractor, or market actor program satisfaction, participation, challenges, and recommendations.

For each program, a brief program description, summary of the process evaluation findings, and a 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.

C.3.3.1 Smart A/C Saver (SACS) Program – Commercial

C.3.3.1.1 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. The commercial SACS program experienced a drop in participation in PY6. Due to its efforts to backfill participants from a list of customers who had requested to join the program, PECO limited this drop in participation to approximately 8.7%.

C.3.3.1.2 Summary of the Process Evaluation Findings

Navigant conducted an abbreviated process evaluation of the program in PY6. For PY6, Navigant relied on a review of tracking databases, a review of program marketing materials, and an in-depth interview with the program manager. From this research only one noteworthy finding emerged: because there is not a separate line for capacity payments in the program finances tracking spreadsheet, it is difficult to easily verify program costs.

C.3.3.1.3 Summary of the Process Evaluation Audit

Navigant completed all of the PY6 activities listed in the evaluation plan except surveys with program participants. The evaluator has not included an explanation in the annual report or supporting documentation as to why program participant surveys were dropped in PY6.

For the in-depth interviews with program staff, the sampling was purposive.

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. Please note that since Navigant conducted an abbreviated process evaluation in PY6, the report provided no information about participants' experiences with the program.

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.

C.3.3.2 Smart Equipment Incentives Program

This program applies to the C/I and the GNI sectors.

C.3.3.2.1 Brief Overview of the Program and Its Success

The SEI C/I program targets the C/I segment, while the SEI GNI program targets the GNI segment. The program offers incentives for projects with prescriptive measures (e.g., lighting and VFDs) and custom projects. A main goal of SEI in Phase II is to encourage the installation of efficient non-lighting equipment.

C.3.3.2.2 Summary of the Process Evaluation Findings

Navigant conducted a program marketing materials and database review, 45 surveys with participating customers (26 with C/I participants and 19 with GNI participants), and in-depth interviews with program managers, including PECO account managers, implementation staff, and market actors (five distributors, four industry groups, and three non-lighting contractors). Based on these data, several key findings emerged:

1) Contractors and PECO account managers stated that rebates for non-lighting and custom projects are not enough to change decision-making because it is too costly and labor intensive to verify savings unless the size of the project is significantly large. Participants stated that the major challenge to implementing projects is budget and the incentive amount they receive from the program is only enough to cover the additional costs they have to incur to be eligible to participate.

2) The interviews with distributor's present evidence that the program is changing energy efficient equipment stocking practices and that it has increased the amount of energy efficiency projects implemented within PECO's service territory. The majority (60%) of participants stated that SEI did affect the type of energy efficient equipment their organizations decided to buy and that PECO can be more influential during the planning phase of the project cycle.

3) Based on interviews with contractors and program participants, the wait time after submitting a pre-application is a barrier to completing projects within the planned project timeline.

4) Customer satisfaction with the program continues to be high (96% of C/I participants were satisfied or very satisfied with the program in PY6).

5) Surveyed participants and contractors complained about aspects of the application process: Contractors generally said that PECO's paperwork requirements are more burdensome than other utility programs, and participants said the hardest part of the process is establishing a project baseline and said they want more help from PECO in figuring out the application's engineering requirements.

6) Two-thirds of the interviewed contractors said that marketing is boring and outdated.

7) Customers who were brought into the program by trade allies and contactors knew of the program shift requiring pre-applications, but the customers whose main point of contact was through PECO's account managers did not know about the change early enough.

C.3.3.2.3 Summary of the Process Evaluation Audit

Navigant completed all of the PY6 activities listed in the evaluation plan except a focus group with participating contractors. Instead, Navigant completed in-depth interviews with non-lighting contractors, distributors, and industry groups and did not provide an explanation in the annual report on why it made this change. The SWE Team, nevertheless, is not concerned with this deviation from the plan since Navigant has addressed evaluation research questions.

For the data collection task requiring sampling, the SWE Team determined that the sampling approach for that task 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 program participants and GNI program participants. Navigant achieved sample sizes that provided 85/15 confidence/precision per stratum (or program).

The SWE Team determined that the reporting followed most of the SWE's guidelines. The annual report included descriptions of the methods, summary of findings and conclusions, 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, conclusions, and recommendations relating to participant surveys only. There was limited information on in-depth interviews with program staff and market actors.

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 or findings.

C.3.3.3 Smart Construction Incentives Program

C.3.3.3.1 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 as well as buildings undergoing major renovation, which is defined as construction that involves the complete removal, redesign, and replacement of two or more major building systems. The target markets for the 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. Overall, the PY6 program achieved gross realization rates of 1.10 for energy and 1.02 for demand.

C.3.3.3.2 Summary of the Process Evaluation Findings

Navigant conducted a program marketing materials review, 21 surveys with participating customers, and in-depth interviews with six architectural, engineering, construction, or energy management firms. Based on these data, several key findings emerged:

1) Respondents stated that the incentive amount they receive from the program covers only the additional cost they have to incur to be eligible to participate. In addition, they stated that the two major challenges to implementing projects are budget and the difficulty of measuring energy savings.

2) About 55% of respondents said the program did not affect what energy efficient equipment their organization decided to purchase. About 47% of respondents stated they would have done the project if the program were not available; this is consistent with the high level of free-ridership found in the NTG analysis.

3) The evaluation team found that the timeline of new construction projects does not always align well with project application timeline requirements. For example, a project application may be due before the building design is finalized, limiting program participation. Most new construction projects take more than a year to be completed.

4) Most respondents (70%) stated their organization is considering installing additional energy efficient equipment in the next 12 months. Future types of projects being considered include new/ongoing construction projects, lighting, chillers, VFD controls, refrigeration, and HVAC.

5) Seventy-five percent of respondents said they are very satisfied or somewhat satisfied with the program. This satisfaction level for the SCI program is lower than the levels found in other PECO programs. Most importantly, 15% of respondents stated they were not at all satisfied with the SCI program. The main reasons for dissatisfaction were that the respondents anticipated a higher rate of return and that the application requirements were cumbersome and of little value to them.

C.3.3.3.3 Summary of the Process Evaluation Audit

Navigant completed all of the PY6 activities listed in the evaluation plan.

For the data collection task requiring sampling, the SWE Team determined that the sampling approach for that task 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: small-usage, medium-usage, and large-usage program participants. Navigant achieved sample sizes that provided 85/15 confidence/precision per overall program.

The SWE Team determined that the reporting followed some of the SWE's guidelines. Although the annual report included descriptions of the methods, summary of findings and conclusions, and a table of recommendations with a description of whether PECO was implementing or considering those recommendations, the annual report and supporting documentation included insufficient detail for the SWE Team (and other readers) to assess the methods, findings, conclusions, and recommendations. Very few detailed findings from in-depth interviews and participant surveys were included in the annual report or supporting documentation.

Overall, the recommendations were clear and actionable and appear to be supported by conclusions or findings.

C.3.3.4 Smart Multi-Family 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.

C.3.3.4.1 Brief Overview of the Program and Its Success

The purpose of the SMF Solutions program is to increase awareness of energy savings opportunities in MF buildings and assist MF residents and building owners/managers in acting on those opportunities. The program is designed for both MF property owners and 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 or for common areas. The prescriptive path offers incentives to MF 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.

C.3.3.4.2 Summary of the Process Evaluation Findings

Same findings as those reported in Appendix C.3.1.8.2 above.

C.3.3.4.3 Summary of the Process Evaluation Audit

Same findings as those reported in Appendix C.3.1.8.3 above.

C.3.3.5 Smart On-Site Program

C.3.3.5.1 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. No SOS projects were completed in PY6.

C.3.3.5.2 Summary of the Process Evaluation Findings

Navigant conducted in-depth interviews with two program managers and five project developers. Based on these interviews, three key findings emerged:

1) PECO faces substantial risk of a regulatory penalty due to delays in CHP project completion, over which PECO currently has little or no control.

2) There are numerous factors beyond PECO's control that can delay the completion of CHP projects. One factor that PECO does have control over is the interconnection process.

3) Many customers with viable applications for CHP are unaware of the opportunity.

C.3.3.5.3 Summary of the Process Evaluation Audit

Navigant completed all of the PY6 activities listed in the evaluation plan except interviews with equipment manufacturers and surveys with participants. The evaluator has not included an explanation in the annual report or supporting documentation as to why equipment manufacturer interviews were dropped in PY6. Surveys with participants were not conducted because no participants were recruited into the program in PY6.

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. 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.

C.3.3.6 Smart Business Solutions Program

C.3.3.6.1 Brief Overview of the Program and Its Success

The SBS program is a direct-install program. It is designed to encourage and assist small business owners to improve the efficiency of their existing facilities through turn-key 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. The implementer delivering this program completed 566 projects in PY6, including seven projects in the GNI sector.

C.3.3.6.2 Summary of the Process Evaluation Findings

For process evaluation, Navigant relied on data from two primary research activities: in-depth interviews with the program manager and implementer and in-depth interviews with three installers (i.e., implementation staff who install equipment at participating business locations).[62] Three key findings emerged from these research efforts:

1) SBS program implementation diverged significantly from the EE&C Plan from the beginning of Phase II, because PECO's contract with SmartWatt (SW) was based on the program funding level and saving goal in the original EE&C Plan and was not updated to align with the revised plan that was filed in March 2014.

[62] Navigant also conducted participant and nonparticipant surveys. Due to major changes in the program design, survey findings are no longer applicable and thus were not reported in the annual report.

2) The implementer's administrative fee is determined as a fixed multiplier of the estimated annualized savings from each project, which could create a perverse incentive for the implementer to inflate savings.

3) From the installers' perspectives, the program is operating well; there are no consistent problems, and participant feedback is almost entirely favorable. The only recommendations installers offered to improve the program were to offer additional measures and to provide installation crews with a small inventory of the most common bulbs and ballasts to replace units that malfunction upon installation.

C.3.3.6.3 Summary of the Process Evaluation Audit

Navigant completed all of the PY6 activities listed in the evaluation plan.

There was only one data collection process-evaluation-related task that required sampling. Because of program changes, the data collected from this task were not meaningful. Thus, the sampling description was not included in the annual report.

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.

C.4 PPL

C.4.1 Residential Programs

Cadmus reported on process evaluations for four residential programs: Appliance Recycling, Residential Energy-Efficiency Behavior & Education Program, Residential Home Comfort, and Residential Retail Program (Residential Lighting and Efficient Equipment).

For the process evaluations of the above programs, Cadmus reviewed program documents and data; interviewed utility and implementation staff, retail partners, builders, vendors, and other market actors or observers such as plumbers or contractors; 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.

The conclusions were overall well supported by the findings; the evaluator presented findings in a clear manner.

For each program, a brief program description, summary of the process evaluation findings, and a 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:

1) Including the number of interviews is helpful. This was not always done.

2) The report identified the number of completed interviews and surveys with participants and retailers but did not always indicate the contact protocols (how many calls were made to each sample element and how many attempts). This is useful to include, particularly for programs that used a census method.

C.4.1.1 Appliance Recycling Program

C.4.1.1.1 Brief Overview of the Program and Its Success

The Appliance Recycling Program attempts to achieve residential energy savings through financial incentives and the free pickup and recycling of inefficient and older refrigerators, freezers, and room air conditioners. The Appliance Recycling Program did not meet its PY6 energy savings and participation goals, but it did meet the goal for demand savings. In PY6, the program achieved 62% of its 25,224 MWh/yr three-year energy savings goal, 87% of its 3.50 MW demand savings goal, and 61% of its three-year goal of 36,920 recycled units.

C.4.1.1.2 Summary of the Process Evaluation Findings

In PY6, Cadmus conducted 140 participant surveys, 146 nonparticipant surveys, and 86 cross-program[63] surveys. Cadmus completed two interviews with program staff and implementers and an unspecified number of interviews with retail partners.

The program did not achieve its savings and participation goals; there was a 32% drop in the number of appliance units recycled in PY6. This is attributed to a scaled-back approach to marketing which may have yielded fewer customer touches and ultimately fewer customers participating in the program. Demographic data from the participant surveys suggest that a sizeable proportion of participants may be parents with children who have recently gone off to college.

C.4.1.1.3 Summary of the Process Evaluation Audit

The evaluation is consistent with the evaluation plan with the exception of the retail partner interviews, which were not completed in PY6. The evaluator attempted to complete interviews with the program's retail partners but was unsuccessful despite making multiple attempts. A useful addition would be to include the number of contact attempts made in the evaluation activities section.

The methodology section adequately explains the evaluation activities and analyses and includes the required sampling information and tables. For the data collection tasks requiring sampling, Cadmus achieved sample sizes that provided 85/15 confidence/precision per survey sample per program.

Program findings are clearly summarized, with recommendations following conclusions and ample evidence supporting the recommendations. The report also included a table of recommendations with a description of whether PPL was implementing or considering those recommendations.

C.4.1.2 Residential Energy-Efficiency Behavior & Education Program

C.4.1.2.1 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 energy savings home improvements and behaviors. The program does not provide any financial incentives for participating. Customers receive a HER sent by mail every other month or by email 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 energy savings action steps.

[63] Cadmus conducted a survey of customers participating across various PPL programs, including the Appliance Recycling Program, to determine the proportion of participants who are low-income.

An RCT is used to determine who receives reports. Customers are randomly assigned to either a treatment group (recipients of HERs) or a control group (non-recipients). The control group is used as a comparison for measuring the treatment group's energy savings resulting from the program. The ICSP for this program is Opower, and Opower selects eligible customers for the program and produces and distributes the home energy reports. (Cadmus provides the random assignment of customers into the treatment and control groups). The Residential Energy-Efficiency Behavior & Education Program exceeded its PY6 planned MWh/yr savings and participation, achieving 96% of its 30,749 MWh/yr three-year planned savings target and 102% of its three-year planned participation target of approximately 128,000 customers.

C.4.1.2.2 Summary of the Process Evaluation Findings

In PY6, Cadmus interviewed four program staff and implementers. Cadmus completed surveys with 361 customers in the treatment group and 180 in the control group. Database and records quality control review also informed the process evaluation. The process evaluation findings are summarized below:

1) For 12 out of the 13 energy savings improvements or behaviors investigated with the surveys, no significant differences between treatment and control group respondents existed.

2) The HERs indicated gradual influence over time in customers' decision to make energy savings improvements.

3) HERs provided a small uplift in participation in other PPL programs.

4) Survey responses showed high overall readership of the paper HERs, although the time and level of attention that participants paid to the reports varied.

5) The paper HERs showed higher customer engagement than the email reports.

6) The home energy reports did not provide a boost to overall customer satisfaction. The evaluator found no significant differences in mean ratings between treatment and control group respondents.

C.4.1.2.3 Summary of the Process Evaluation Audit

The research activities were consistent with the PY6 evaluation plan.

The methodology section adequately explains the evaluation activities and analyses and includes the required sampling information and tables. For the data collection tasks requiring sampling, Cadmus achieved sample sizes that provided 85/15 confidence/precision per survey sample per program. Cadmus increased the survey completion quotas for the treatment group and control group to improve the statistical power of detecting differences between the two groups and the two waves of the program implementation,[64] and clearly explained the statistical tests and level of significance throughout the findings.

Program findings are clearly summarized, with recommendations following conclusions and ample evidence supporting the recommendations. The report also included a table of recommendations with a description of whether PPL was implementing or considering those recommendations.

C.4.1.3 Residential Home Comfort Program

C.4.1.3.1 Brief Overview of the Program and Its Success

The Residential Home Comfort Program attempts to achieve residential energy savings by offering energy savings products and rebates for new construction and existing homes. The program offers a wide range

[64] PPL Electric and the ICSP implemented this program in two waves titled Legacy and Expansion waves. The evaluation followed the program implementation. The report provided insufficient information about these waves.

of energy efficient products, rebates, education, and services that allow customers to customize solutions to increase their home's energy efficiency. The program has five program components:

1) **New homes** 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 efficient products.
    b. **The HERS approach** offers builders a rebate of $0.30 per kWh saved (up to $2,000) for homes built with any combination of a specific package of products.
2) **Manufactured homes** 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) **Audit** provides customer rebates for professional comprehensive home energy audits or a less comprehensive audit for $50. It also offers thermal imagery guns and technical training to BPI-certified contractors who conduct program audits to improve audit diagnostics.
4) **Weatherization**, based on recommendations from an audit, provides rebates for ceiling and wall insulation.
5) **Energy efficient equipment** provides rebates for installation of high-efficiency air source heat pumps, ductless heat pumps, and in-ground pool pumps.

C.4.1.3.2 Summary of the Process Evaluation Findings

In PY6, Cadmus gathered input from a wide variety of stakeholders for the process evaluation:

1) Program staff and implementer interviews (n=2)
2) Participant surveys (n=179)
3) Cross-program surveys (n=148)
4) Fuel-switching survey (n=29)
5) Manufactured homes buyers (n=2)
6) Builder and vendor interviews
    a. Participant builders (n=2)
    b. Nonparticipant builders (n=2)
    c. Manufactured homes retailers (n=4)
    d. Manufactured homes manufacturers (n=4)

The following findings emerged from the evaluation:

1) Overall, the program is meeting goals for energy savings and demand reductions.
2) The cost of an audit is a barrier to participation for some customers.
3) Ductless heat pumps are popular with customers, with a majority opting for SEER 18 or higher.
4) The limited-time offer of increased rebate for air source heat pumps was very successful in increasing installation of systems with an efficiency rating of SEER 16 or higher.
5) The manufactured home component is struggling to generate interest.
6) Builders may need more rebate options and continuing education to support the new construction component.

C.4.1.3.3 Summary of the Process Evaluation Audit

The evaluation is consistent with the evaluation plan. The methodology section adequately explains the evaluation activities and analyses and includes the required sampling information and tables. For the data collection tasks requiring sampling, Cadmus achieved sample sizes that provided 85/15 confidence/precision per survey sample per program.

Program findings are clearly summarized, with recommendations following conclusions and ample evidence supporting the recommendations. The report also included a table of recommendations with a description of whether PPL was implementing or considering those recommendations.

C.4.1.4 Residential Retail Program (Residential Lighting and Efficient Equipment)

C.4.1.4.1 Brief Overview of the Program and Its Success

The Residential Retail Program is made up of two components: upstream lighting and rebated equipment. The same ICSP manages both components. The upstream lighting component offers incentives to manufacturers to discount the price of energy efficient screw-in LEDs sold in stores. The ICSP also distributes energy efficient lighting information and information about 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 heat pump water heaters. This component also includes efficient fossil-fuel water heaters eligible for rebates under the fuel-switching pilot. The ICSP provides educational and promotional materials to participating retailers and maintains a call and rebate-processing center.

The program allows customers to easily obtain discounted ENERGY STAR–qualified energy efficient lightbulbs (only LEDs in PY6) and efficient equipment sold in retail stores. The program also strives to achieve widespread visibility through independent and regional retailers that carry the eligible ENERGY STAR products, and to educate customers on new technologies for lightbulbs, such as LEDs, and the impact that EISA will have on energy efficient lightbulbs. The full list of stipulated program objectives is found in PPL's revised EE&C Plan (Docket No. M-2012-2334388) approved by the Pennsylvania PUC on June 05, 2015, p. 47.

The PY6 Residential Retail Program reported 3,481 equipment-rebate participants and an estimated 173,399 upstream-lighting participants who purchased 1,069,869 discounted bulbs. The program achieved 103% of its planned PY6 MWh/yr savings, based on verified gross savings. It achieved 86% of the planned MW target, based on verified gross savings.

C.4.1.4.2 Summary of the Process Evaluation Findings

Cadmus conducted two interviews with the program staff and implementer and nine interviews with licensed plumbers or contractors. Cadmus completed surveys with 150 participants and 66 cross-participants.[65]

The following findings emerged from the evaluation:

1) PY6 rebate-processing times have not improved over PY5. Participants' reporting of processing times were sometimes inconsistent in tracking data receipts and invoices. The ICSP has replaced its rebate processing contractor in PY7 and will monitor processing times.

[65] Cadmus conducted a survey of customers participating across various PPL programs, including the Residential Retail Program, to determine the proportion of participants who are low-income.

2) General population surveys indicate potential for increased adoption of LEDs by residential customers. Conversely, more small business customers are purchasing LEDs and fewer appear to be purchasing halogen or incandescent bulbs.
3) Customers are still sensitive to LED price. Most customers indicated a willingness to pay between $5 and $7 for an LED.
4) CFL disposal behavior remains relatively unchanged from prior years, with over half of customers disposing of CFLs in the trash, in spite of more recycling bins in diverse locations.

C.4.1.4.3 Summary of the Process Evaluation Audit

The evaluation is consistent with the evaluation plan. The evaluator identified timely issues that directly impact the program, such as customer dissatisfaction with rebate processing time, and the ICSP has acted on these findings.

The methodology section adequately explains the evaluation activities and analyses and includes the required sampling information and tables. For the data collection tasks requiring sampling, Cadmus achieved sample sizes that provided 85/15 confidence/precision per survey sample per program.

Program findings are clearly summarized, with recommendations following conclusions and ample evidence supporting the recommendations. The report also included a table of recommendations with a description of whether PPL was implementing or considering those recommendations.

C.4.2 Low-Income Programs

Cadmus reported on process evaluations for four low-income programs: E-Power Wise, the Student and Parent Energy-Efficiency Education program, Low-Income Winter Relief Assistance Program (WRAP), and Master Metered Low-Income Multifamily Housing Program. The Low-Income Energy-Efficiency Behavior & Education Program launched in late PY6 and will be evaluated in PY7 when data are available.

For the process evaluations of the above programs, Cadmus reviewed program documents and data; interviewed utility staff, implementer, and staff at community-based organizations; and surveyed program participants and nonparticipants, including teachers and parents. 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.

For each program, a brief program description, summary of the process evaluation findings, and a review (audit) of the annual report follow below. The conclusions are well supported by findings in general; the evaluator is careful to state when they could not reach a conclusion based on the data collected and notes that this is an area of future investigation.

C.4.2.1 E-Power Wise Program

C.4.2.1.1 Brief Overview of the Program and Its Success

The E-Power Wise Program is a program that educates low-income customers about energy efficiency. The program targets PPL 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). The E-Power Wise Program uses a “train-the-trainer” model, in which the program ICSP, which for this program is the Resource Action Program, Inc. (RAP), trains community-based organization staff to provide energy workshops in the locations that are accessible to low-income customers. Customers attending the sessions receive free

energy efficient products and a take-home kit. The program also mails an energy savings kit to eligible customers. The program exceeded both its planned MWh/yr and MW savings for PY6.

C.4.2.1.2 Summary of the Process Evaluation Findings

In PY6, Cadmus completed two interviews with the E-Power Wise Program manager from PPL and the ICSP, and five interviews with the community-based organizations. Cadmus analyzed 605 customer surveys returned from the energy savings kits. This represents 17% of the total participation. Cadmus also reviewed a database and conducted QA/QC of the program records.

Based on these data, several key findings emerged:

1) The ICSP and PPL continue to provide a well-managed program; PPL and ICSP program managers speak each week and work together to ensure that kit distribution remains steady throughout the program year.
2) Installation rates for water-saving devices continue to struggle. Participants cited personal preference for not installing the showerheads.
3) Confusion about how to use the furnace whistle and incompatible heating types has resulted in low installation rates. The evaluation found that many customers have baseboard heating and cannot use the furnace whistle.
4) Agency staff who may interact with low-income populations may not have a clear understanding of other Act 129 program offerings available in addition to E-Power Wise.
5) Some agencies expressed concerns about the saturation of energy savings kits.

C.4.2.1.3 Summary of the Process Evaluation Audit

The process evaluation activities were consistent with the evaluation plan. Program findings are clearly summarized, with recommendations following conclusions and ample evidence supporting the recommendations. The E-Power Wise program had very detailed supporting information for the recommendations that drew on multiple sources, such as customer feedback in surveys as well as interviews with program staff. The methodology section adequately explains the evaluation and includes the required information and tables.

C.4.2.2 Student and Parent Energy-Efficiency Education Program

C.4.2.2.1 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 in low-income neighborhoods. All participants receive educational materials and a take-home energy efficiency kit of low-cost items they can install at home. Participating students are in the second through twelfth grades; 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.

In PY6, the Student and Parent Energy-Efficiency Education Program achieved 124% of its planned MWh/yr savings target, 43% of its planned MW savings target, and 101% of its annual participation target.

C.4.2.2.2 Summary of the Process Evaluation Findings

Cadmus conducted four interviews with the program manager and the implementer and administered three participant surveys: a classroom teacher survey (n=145), a teacher workshop survey (n=61), and a

parent workshop survey (n=53). There was not a survey with classroom parents in PY6. Cadmus instead analyzed the parent postcard surveys returned to the ICSP (n=1,485) to obtain feedback about the program. The following findings emerged from the evaluation:

1) The program exceeded its PY6 savings and participation goals, but did not reach its planned demand savings goal. The program ran very smoothly in PY6, with no reported issues in delivery.
2) The ICSP's targeted marketing and personalized outreach efforts increased program awareness and helped increase participation.
3) Lower installation rates for water products were observed than for lighting products. The benchmarking study investigated this finding and found that partnering with another utility in the same region to reach customers who were serviced by two different utilities may increase installation rates for water products.
4) The PY6 program did not meet its Key Performance Indicator plan for workshop and classroom participation as measured by the number of Home Energy Worksheets (HEWs) returned. Respondents suggested reducing the paperwork involved with the HEWs or switching to an online survey.

C.4.2.2.3 Summary of the Process Evaluation Audit

The evaluation is consistent with the evaluation plan.

The methodology section adequately explains the evaluation activities and analyses and includes the required sampling information and tables. For the data collection tasks requiring sampling, Cadmus achieved sample sizes that provided 85/15 confidence/precision per survey sample per program.

Program findings are clearly summarized, with recommendations following conclusions and ample evidence supporting the recommendations. The report also included a table of recommendations with a description of whether PPL was implementing or considering those recommendations.

C.4.2.3 Low-Income Winter Relief Assistance Program (WRAP)

C.4.2.3.1 Brief Overview of the Program and Its Success

The WRAP targets customers whose income is at or below 150% of the FPL. WRAP staff works alongside PPL's Universal Services Program (USP), which targets customers who are at or below 200% of the FPL. WRAP and USP are intended to operate seamlessly so that customers are not aware from which program they are receiving services. WRAP and USP 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.

WRAP provides low-income customers with three types of service: 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 an electric water heater). Baseload products include energy education, 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.

PPL provides all services and products to income-qualified customers at no cost. This program has exceeded participation, energy savings, and demand reduction goals for the program year.

C.4.2.3.2 Summary of the Process Evaluation Findings

Cadmus conducted the following research activities in PY6:

1) Program staff and implementer interviews (n=1)

2) Participant surveys (n=71)

3) Database and QA/QC review (n=200)

4) Review of WRAP Intake forms (n=92)

The following findings emerged from the process evaluation:

1) Overall, the program offers a comprehensive and customized weatherization service to its low-income customers.

2) Customers are satisfied with the program and are acting on energy savings strategies recommended by the program's energy educators.

3) As both USP and WRAP continue to run in tandem, it will take increased initiative, creativity, and teamwork to identify and reach the remaining income-eligible population and maintain current participation levels.

4) The new tracking system provides improved data collection and program tracking.

C.4.2.3.3 Summary of the Process Evaluation Audit

The evaluation is consistent with the evaluation plan.

The methodology section adequately explains the evaluation activities and analyses and includes the required sampling information and tables. For the data collection tasks requiring sampling, Cadmus achieved sample sizes that provided 85/15 confidence/precision per survey sample per program.

Program findings are clearly summarized, with recommendations following conclusions and ample evidence supporting the recommendations. The report also included a table of recommendations with a description of whether PPL was implementing or considering those recommendations.

C.4.2.4 Low-Income Energy-Efficiency Behavior & Education Program

C.4.2.4.1 Brief Overview of the Program and Its Success

The Low-Income Energy-Efficiency Behavior & Education Program informs customers about their home energy consumption and encourages them to adopt energy savings home improvements and behaviors. The program is nearly identical to the Residential Energy-Efficiency Behavior and Education program, except that it is targeting low-income residents.

No savings were reported for the Low-Income Energy-Efficiency Behavior and Education Program as it was launched late in PY6. The program evaluation will occur in PY7 when data are available and more complete.

C.4.2.5 Master Metered Low-Income Multifamily Housing Program

C.4.2.5.1 Brief Overview of the Program and Its Success

The Master Metered Low-Income Multifamily Housing Program targets energy efficiency improvements in master metered multifamily low-income housing buildings. 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 measures. These may include direct installation and prescriptive efficiency measures. This also qualifies customers for rebates through other PPL programs.

C.4.2.5.2 Summary of the Process Evaluation Findings

In PY6 the following process evaluation activities were conducted:

1) Program staff and implementer interviews (n=2)

2) Leave-behind tenant surveys (n=137; responses received from individual building tenants)

3) Decision-maker participant surveys (n=7; surveys representing 24 projects in 19 properties)

4) Database review (all Energy Efficiency Management Information System [EEMIS] database records, n=49 projects)

5) QA/QC review of records (n=EEMIS records reviewed for a sample of 24 verified projects)

The following findings emerged from the evaluation:

1) Overall, the program processes are working smoothly and customers are satisfied with the quality of the work performed by the ICSP and the equipment.

2) Low levels of satisfaction could lead tenants to remove the aerators and the showerheads.

3) Cadmus cannot conclude if dissatisfaction is tied to the showerheads or restriction valves (or both). A future survey in PY7 will investigate this issue.

C.4.2.5.3 Summary of the Process Evaluation Audit

The evaluation is consistent with the evaluation plan. Because the program did not meet planned savings and participation goals, the evaluator considered three possible reasons and investigated each one. The evaluator also explains why they cannot conclude if the showerheads or restriction valves have caused dissatisfaction and proposes a PY7 survey to investigate further.

The methodology section adequately explains the evaluation activities and analyses and includes the required sampling information and tables. For the data collection tasks requiring sampling, Cadmus achieved sample sizes that provided 85/15 confidence/precision per survey sample per program.

Program findings are clearly summarized, with recommendations following conclusions and ample evidence supporting the recommendations. The report also included a table of recommendations with a description of whether PPL was implementing or considering those recommendations.

C.4.3 Non-Residential Programs

Cadmus reported on process evaluations for four non-residential programs: Custom Incentive Program, School Benchmarking Program, Prescriptive Equipment Program, and Continuous Energy Improvement Program.

For the process evaluations of the above programs, Cadmus reviewed program documents and data; interviewed utility and implementation staff, retail partners, contractors, vendors, and other market actors; 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.

The conclusions were overall well supported by the findings; the evaluator presented findings in a clear manner.

For each program, a brief program description, summary of the process evaluation findings, and a review (audit) of the annual report follow below. The SWE Team notes one general comment about the methods discussions for the process evaluations of all programs: when mixed methods are used to achieve completions, it would have been helpful to have some context for why mixed methods were used.

C.4.3.1 Continuous Energy Improvement Program

C.4.3.1.1 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 ICSP assists each district in selecting one school or facility to participate and to develop a strategic energy management plan to implement.

Best practices are shared during monthly meetings, workshops, and conference calls led by the ICSP. Each district develops an energy reduction goal, a methodology for measuring energy savings, and a plan to continually improve its energy performance.

C.4.3.1.2 Summary of the Process Evaluation Findings

In PY6, Cadmus conducted two interviews with program staff and the implementer and eight participant surveys. Cadmus also completed database and QA/QC review of records. Overall, PPL's Continuous Energy Improvement Program operated well in PY6. Findings included:

1) The program was highly influential in participants' decision-making.

2) Energy managers at each school district, the ICSP, and PPL program management staff reported high satisfaction with the program.

3) The ICSP had been very successful in engaging energy managers from each participating school district by creating a dynamic and motivating environment in which energy managers learn from each other and improve operations in their own school districts.

4) Survey participants reported that some improvements could be made to engage the school communities within each school district.

5) In some cases, the school community (teachers and staff) had little influence on the decision to participate in the program, which was made at the superintendent level.

6) Some school districts had difficulties involving students due to schedule conflicts, part-time students, teacher involvement, and challenges with communicating to elementary school students about energy efficiency.

7) School districts would have participated in the program without the incentive. Two of the respondents (25%) said they would be very likely and four (50%) said they would be somewhat likely to participate in the program even without an incentive because they found the technical assistance provided by the program to be valuable.

C.4.3.1.3 Summary of the Process Evaluation Audit

The evaluation is consistent with the evaluation plan. The program targeted 10 participating districts, but two did not commit to participating in the program, resulting in 8 participating districts. The evaluator notes these two potential participants were not replaced because the program is designed as a two-year program and it was too late to start the recruiting process with two new districts. Nonparticipant

interviews with the two districts that were interested but did not join the program would be a useful addition and might help inform future program offerings and incentive levels.

The methodology section adequately explains the evaluation activities and analyses and includes the required sampling information and tables. Table 11-3 in the annual report would be clearer if the target sample size was described as a census, which is what the evaluation plan indicates, rather than eight of eight completed interviews.

Program findings are clearly summarized, with recommendations following conclusions. One conclusion (that school districts would have participated without the incentive) does not appear to be fully supported by the data presented and may not be applicable to future participants. Only two respondents out of eight indicated that they were "very likely" to participate in the program without an incentive. The rest said they were "somewhat likely" (two respondents) or "not at all likely" (one respondent). Given that "somewhat likely" was the middle option, it could as easily signify unlikely as likely. Considering that only two of 10 schools clearly indicated they were likely to participate without an incentive (two schools did not provide feedback, and no assumptions can be made about them), it seems premature to suggest that all schools would participate without incentives. The report also included a table of recommendations with a description of whether PPL was implementing or considering those recommendations.

C.4.3.2 Custom Incentive Program

C.4.3.2.1 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, installing equipment measures or systems that are not covered by the Prescriptive Equipment Program or the Pennsylvania TRM, and making operational and process improvements that result in cost-effective energy savings. 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. The program did not reach its planned MWh/yr and MW savings for PY6.

C.4.3.2.2 Summary of the Process Evaluation Findings

In PY6 the process evaluation activities were:

1) Participant surveys (n=15 unique participants representing 17 properties)

2) Partial participant surveys (n=5)

3) Interviews with program and ICSP staff (n=2)

4) Consulting firm interviews (n=3)

5) Database and QA/QC review of records

Three findings emerged from the process evaluation:

1) One of the key performance indicators is customer satisfaction. In PY6, 75% of participants reported they were satisfied. Generally, respondents were satisfied with the program but there were some challenges regarding responsiveness and program timelines.

2) Customers have difficulty determining if a project will qualify for the program during the application process. This may be limiting participation.

3) Final energy and cost calculations can be challenging for customers. The need to hire a third party to provide data for calculations added costs and created more delay on finalizing the project and receiving the rebate for some customers.

C.4.3.2.3 Summary of the Process Evaluation Audit

The evaluation is consistent with the evaluation plan with the exception that Cadmus used an online tool to complete quarterly satisfaction surveys, rather than a telephone survey, as specified in the plan. The differences between the PY5 and PY6 survey methodology were clearly documented. Additionally, Cadmus did not conduct a benchmarking review in PY6 because the topics of research were covered previously in the PY5 benchmarking study. This is also documented. The partial participant surveys helped inform program findings about participation challenges and added value to the analysis.

The methodology section adequately explains the evaluation activities and analyses and includes the required sampling information and tables. For the data collection tasks requiring sampling, Cadmus achieved sample sizes that provided 85/15 confidence/precision per survey sample per program by combining online and telephone responses to reach the 15 unique participants. The sampling table note describes how many were online completions and how many were telephone completions. It would have been helpful to have some context for why both methods were used.

Program findings are clearly summarized, with recommendations following conclusions and ample evidence supporting the recommendations. The report also included a table of recommendations with a description of whether PPL was implementing or considering those recommendations.

C.4.3.3 School Benchmarking Program

C.4.3.3.1 Brief Overview of the Program and Its Success

PPL's School Benchmarking Program works with school administrators to evaluate total building energy use using the Portfolio Manager tool from the U.S. EPA. The program provides school administrators the information they need to evaluate short- and long-term goals and paybacks for energy efficiency investment opportunities. The ICSP manages the program, which is offered to up to 25 schools each program year. Schools also receive assistance in developing action plans to reduce energy consumption. This program does not generate energy savings and thus has no savings goals.

C.4.3.3.2 Summary of the Process Evaluation Findings

Cadmus conducted a process evaluation at the beginning of PY6 that covered PY5. Cadmus completed these process evaluation activities:

1) Program staff and implementer interviews (n=3)

2) Participant surveys (n=3)

3) Program literature review and benchmarking

4) Process map development

Two findings emerged from the process evaluation:

1) Cadmus determined that the program is working as planned, based on evaluation activities.

2) No further evaluation activities are planned because the program does not contribute energy savings.

C.4.3.3.3 Summary of the Process Evaluation Audit

The evaluation is consistent with the evaluation plan. The objective of the evaluation was to gather insights into program design and delivery and assess customer satisfaction. The program does not claim energy savings.

The methodology section adequately explains the evaluation activities and analyses and includes the required sampling information and tables. Cadmus found that some schools were represented by the same contact—ultimately, eight contacts represented the 28 schools. Because of the small count of participants, the final sample was of eight contacts (unique decision makers) in order to ensure no one was contacted more than once for the same survey. Cadmus conducted a census of these eight contacts.

Program findings are clearly summarized; however the report does not include a table of recommendations with a description of whether PPL was implementing or considering those recommendations. As the program does not claim energy savings and will not be evaluated in the future, the lack of recommendations was not surprising. Including an explanation would have been helpful to the SWE Team.

C.4.3.4 Prescriptive Equipment Program

C.4.3.4.1 Brief Overview of the Program and Its Success

The Prescriptive Equipment Program offers incentives for lighting, non-lighting, and agriculture equipment. The program promotes the purchase and installation of high-efficiency equipment and lighting. Customers receive financial incentives to offset the higher purchase costs of the equipment. The program targets are small C/I customers, large C/I customers, the GNI sector, institutional and educational customers, and agricultural customers.

C.4.3.4.2 Summary of the Process Evaluation Findings

Cadmus completed these process evaluation activities in PY6, which also covered PY5:

1) Program staff and implementer interviews (n=2)

2) Participant surveys (n=75)

3) Lighting participants (n=60)

4) Direct discount delivery channel participants (n=12)

5) Equipment participants (n=3)

6) Contractor interviews (n=41)

7) Lighting contractors (n=15)

8) HVAC contractors (n=15)

9) HVAC distributors (n=4)

10) Refrigeration contractors (n=7)

11) HVAC contractor focus groups (2 groups, n=18)

12) Database and QA/QC review of records

The evaluation found that:

1) Overall, the program is operating well and is on track to meet its planned energy savings for Phase II.

2) The preapproval process has had some positive and negative impacts on the program.

3) Satisfaction with some aspects of the rebate application process is lower than in previous program years. The percentage of respondents who were very satisfied with the amount of time it took to receive the rebate after submitting the application fell to 44% from 72% in PY5. This change in satisfaction is likely due to the introduction of the pre-application process in PY6.

4) According to contractor feedback, there is evidence that changes in consumer attitudes, increased focus on energy efficiency as part of contractor promotional strategies, and the boost in sales of energy efficient technologies can be attributed to the Prescriptive Equipment Program.

5) Participation rates for equipment, including HVAC equipment, have been lower than expected.

6) Responses from HVAC contractors indicated that PPL's commercial HVAC rebate program is not sufficiently engaging contractors. Although some respondents were familiar with the residential HVAC offerings, most were unaware of the commercial utility incentives and had not worked with customers through the Prescriptive Equipment Program.

7) Widespread contractor interest in a direct discount program for equipment is not likely. Although some respondents were open to this type of design, others were skeptical because of the burden of additional risk.

C.4.3.4.3 Summary of the Process Evaluation Audit

The evaluation is consistent with the evaluation plan. This was a very comprehensive evaluation, with many activities informing the recommendations.

The methodology section adequately explains the evaluation activities and analyses and includes the required sampling information and tables. For the data collection tasks requiring sampling, Cadmus achieved sample sizes that provided 85/15 confidence/precision per survey sample per program.

Program findings are clearly summarized, with recommendations following conclusions and ample evidence supporting the recommendations. The report also included a table of recommendations with a description of whether PPL was implementing or considering those recommendations.

APPENDIX D | PY5 PROCESS EVALUATION RECOMMENDATIONS AND ACTIONS – UPDATES FROM THE EDCS

This appendix provides updates on the actions taken by the EDCs to respond to evaluation consultants' PY5 recommendations that EDCs were still considering as of the time of the PY5 SWE Annual Report. The recommendation statuses are provided by EDC and program type. The recommendation statuses are provided by EDC and program type. Only those recommendations which were categorized as "Being considered" in the PY5 SWE Annual Report are discussed below.

D.1 DUQUESNE

Sections D.1.1 through D.1.6 provide the process evaluation recommendations for Duquesne programs which were still being considered by Duquesne at the time the PY5 SWE Annual Report was finalized. The updated status of Duquesne's responses are provided in each table.

D.1.1 Residential Energy Efficiency Program

Recommendations	EDC Status of Recommendation (Implemented, Being Considered, Rejected AND Explanation of Action Taken by EDC)
Recommendation 1: Duquesne should deepen relationships with the market outreach partners that have special interest in the utility's energy efficiency programs, to leverage for deeper marketing and promotional support.	In the lead-up to full-scale Phase III REEP implementation, Duquesne plans to work more directly and intensively with REEP partner organizations who (1) share the utility's goals regarding helping customers to save energy, (2) understand the context in which Duquesne is offering its Act 129 programs, and (3) seek are more extensive involvement with the utility to further these goals. To the extent possible, the utility plans to leverage the efforts of these organizations to enhance program promotion.
Recommendation 2: Duquesne should tailor communications for the specific partner organization to convey the benefits associated with promoting REEP to their constituencies, including finding ways to quantify these benefits.	Duquesne will be working with REEP partner organizations leading up to the Phase III program and during that program to determine whether providing additional information to them could result in the organizations becoming more effective in promoting REEP to their constituents. Duquesne will assess what information is needed and the cost effectiveness of providing this information as part of the program's market outreach effort.
Recommendation 3: Duquesne should consider visiting participating stores more regularly, holding workshops for the retailers' sales associates, providing program promotional materials and rebate forms to the store manager to distribute to sales associates and throughout the store, and forming more direct relationships with corporate decision makers for the stores.	Duquesne plans to intensify its market outreach and training efforts with selected retailers in Phase III. For the remainder of Phase II, resources are being allocated to programs needing the most support to achieve savings goals. REEP is not one of those programs.
Recommendation 4: Duquesne should reassess whether it should be offering rebates for ENERGY STAR dehumidifiers, which appear to be the standard dehumidifier product offered to customers (notwithstanding the participant survey results to the contrary).	Energy Star's updated requirements for dehumidifiers are slated to become effective as of October 2016. Duquesne plans to incentivize only those dehumidifiers that will meet these requirements in Phase III. Energy Star's new requirements are only now being finalized. It was deemed impractical to update the utility's

Recommendations	EDC Status of Recommendation (Implemented, Being Considered, Rejected AND Explanation of Action Taken by EDC)
	requirements in the absence of an Energy Star update, both with respect to confusion in the marketplace (given an imminent major change from Energy Star and the Energy Star brand damage that might occur if the rebates were suddenly removed and then reinstated) and with respect to the level of research that would have been needed to establish new dehumidifier requirements. As a result, Duquesne will maintain its current rebate requirements for dehumidifiers until the beginning of Phase III.

D.1.2 Residential Appliance Recycling Program

Recommendations	EDC Status of Recommendation (Implemented, Being Considered, Rejected AND Explanation of Action Taken by EDC)
Recommendation 1: Duquesne should document the proper budget estimates for this program, so that future program assessments can use more realistic benchmarks against which to compare actual program performance. The utility may want to adjust its EE&C Plan filing to more accurately reflect these proper budget estimates. Should further review of the projected budgets indicate that these costs are valid, the utility will need to determine the source of the disconnect between planning estimates and actual performance.	Duquesne will provide a corrected budget for the program that can be used in the PY7 evaluation effort.
Recommendation 2: Duquesne should consider ramping up Watt Choices marketing efforts through RARP, assuming the aforementioned budget issues can be understood/addressed and the program can support such efforts.	Marketing other Watt Choices programs (e.g., REEP) through RARP may or may not result in increased participation in those programs. In any case REEP has had no problem in achieving its goals and Duquesne has not seen the need to do such marketing. However, using RARP as a marketing channel for REEP and possibly other programs is being considered for Phase III.
Recommendation 3: Duquesne should consider requesting a modification to the SWE-required approach for estimating free-ridership for this program, in which follow-up questions about the practicality or likelihood of respondents actually following through on their stated intentions are figured into the free-ridership results.	Duquesne is following SWE guidance on this issue. The SWE was not receptive to such modifications to its methodology. Therefore, Duquesne took no further action regarding this recommendation.
Recommendation 4: Duquesne should work with the PEG and SWE to ensure that the replacement appliance deemed savings value is adjusted to account for the fact that the majority of appliance replacements are not induced, and that these units would have been purchased regardless of the Duquesne/utility program.	The utility and its evaluator have participated in discussions to ensure that replacement appliances are treated appropriately. The TRM now addresses replacements correctly.

D.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 should consider re-engaging with schools that have participated in SEP in previous years, focusing on the earliest participating schools first, perhaps first as a pilot effort.	Duquesne has modified its schools program for implementation in Phase III. This recommendation is no longer valid.
Recommendation 2: Continue to promote the energy efficiency aspects of the program, providing specific suggestions for how incentive funds could be used to further increase EE. Continue to leverage the fact that schools use the program as a fundraiser.	Duquesne has modified its schools program for implementation in Phase III. This recommendation is no longer valid.
Recommendation 3: Duquesne should consider incorporating goals and prizes into the program design, or promote the idea that participating schools do so.	Duquesne has modified its schools program for implementation in Phase III. This recommendation is no longer valid.
Recommendation 4: Duquesne should determine the extent to which teachers are using (or are able to use) the lesson materials provided and possibly modify the program accordingly.	Duquesne has modified its schools program for implementation in Phase III. This recommendation is no longer valid.

D.1.4 Low-Income Energy Efficiency Program

Recommendations	EDC Status of Recommendation (Implemented, Being Considered, Rejected AND Explanation of Action Taken by EDC)
See recommendations for each of the other residential programs from which LIEEP participation was derived.	No response required

D.1.5 Commercial

Recommendations	EDC Status of Recommendation (Implemented, Being Considered, Rejected AND Explanation of Action Taken by EDC)
Recommendation 1: Duquesne should continue to closely track its industrial program project pipeline, to ensure that Phase II goals can be reached.	Duquesne's industrial project pipeline is always/has always been carefully tracked. Note that these projects can have very long lead times. In any case, as of the end of PY6, Duquesne is on track to achieve its savings goal for the Industrial program.
Recommendation 2: The utility should find a way to identify the projects for which rebate payments are being made and include that information along with the incentive payment when it is made, to facilitate customers' internal accounting and improve participant satisfaction.	Because rebate checks are not created by Duquesne but by a vendor, Duquesne is limited in what it can do regarding this issue. However, Duquesne has included a unique project identification number on each check to facilitate identifying specific projects related to the each check.
Recommendation 3: Duquesne should consider marketing its programs directly to trade allies, and train interested TAs to navigate the application process. A piece of this effort might include leave-behind brochures or flyers that clearly explain the many steps involved in program participation, to better align customer expectations with what will occur.	Such marketing has not been needed in Phase II. However, in Phase III, Duquesne and/or its CSP for the program will more fully engage trade allies in marketing activities.
Recommendation 4: Duquesne should continue its efforts to work with CSPs, to ensure that CSPs are transparent about the various assumptions and data used in estimating savings, particularly for custom projects. Screenshots of	Duquesne and its evaluation contractor conducted discussions with the Commercial Program CSPs. As a result, documentation of assumptions and savings calculations has improved. DLC will continue to

Recommendations	EDC Status of Recommendation (Implemented, Being Considered, Rejected AND Explanation of Action Taken by EDC)
calculators are often included in the project files, but not the actual calculator. For the sake of transparency, it would be helpful if the calculators were also included.	promote maintaining/improving project documentation for the remainder of Phase II and in Phase III.
Recommendation 5: Duquesne should take steps to automate the application form and the application review process. This will prevent errors in data transfer and will allow program staff to give feedback to program participants in a timely manner.	Duquesne's application forms are now available online and can be filled out online.
Recommendation 6: Duquesne should continue its efforts to ensure that its CSPs have taken steps to ensure that the correct TRM is being used in estimating project savings, especially for motors and VFDs.	Implemented. The evaluation team did not notice any instances of use of the wrong TRM for VFDs and motors in PY6.

D.1.6 Industrial

Recommendations	EDC Status of Recommendation (Implemented, Being Considered, Rejected AND Explanation of Action Taken by EDC)
Recommendation 1: Duquesne should continue to closely track its industrial program project pipeline, to ensure that Phase II goals can be reached.	Duquesne's industrial project pipeline is always/has always been carefully tracked. Note that these projects can have very long lead times. In any case, as of the end of PY6, Duquesne is on track to achieve its savings goal for the Industrial program.
Recommendation 2: The utility should find a way to identify the projects for which rebate payments are being made and include that information along with the incentive payment when it is made, to facilitate customers' internal accounting and improve participant satisfaction.	Because rebate checks are not created by Duquesne but by a vendor, Duquesne is limited in what it can do regarding this issue. However, Duquesne has included a unique project identification number on each check to facilitate identifying specific projects related to the each check.
Recommendation 3: Duquesne should consider marketing its programs directly to trade allies, and train interested TAs to navigate the application process. A piece of this effort might include leave-behind brochures or flyers that clearly explain the many steps involved in program participation, to better align customer expectations with what will occur.	Such marketing has not been needed in Phase II. However, in Phase III, Duquesne and/or its CSP for the program will more fully engage trade allies in marketing activities.
Recommendation 4: Duquesne should continue its efforts to work with CSPs, to ensure that CSPs are transparent about the various assumptions and data used in estimating savings, particularly for custom projects. Screenshots of calculators are often included in the project files, but not the actual calculator. For the sake of transparency, it would be helpful if the calculators were also included.	Duquesne and its evaluation contractor conducted discussions with the Industrial Program CSPs. As a result, documentation of assumptions and savings calculations has improved. Duquesne will continue to promote maintaining/improving project documentation for the remainder of Phase II and in Phase III.
Recommendation 5: Duquesne should take steps to automate the application form and the application review process. This will prevent errors in data transfer and will allow program staff to give feedback to program participants in a timely manner.	Duquesne's application forms are now available online and can be filled out online.
Recommendation 6: Duquesne should continue its efforts to ensure that its CSPs have taken steps to ensure that the correct TRM is being used in estimating project savings, especially for motors and VFDs.	Implemented. The evaluation team did not notice any instances of use of the wrong TRM for VFDs and motors in PY6.

D.2 FIRSTENERGY EDCs (MET-ED, PENELEC, PENN POWER, WEST PENN)

FirstEnergy EDCs did not conduct any process evaluation activities during PY5. Refer to Section E.2 for the status of FirstEnergy EDC process evaluation recommendations and actions for PY6.

D.3 PECO

D.3.1 Smart Appliance Recycling

Recommendations	EDC Status of Recommendation (Implemented, Being Considered, Rejected AND Explanation of Action Taken by EDC)
Recommendation 1: Review tracking data periodically for completeness and have JACO record if unit is located in un/conditioned space.	Implemented. PECO performs a monthly review of the tracking data to ensure completeness.
Recommendation 2: Have JACO confirm at pick up the participant's replacement intentions as stated on the application.	Implemented. JACO has been confirming with the customer the participant's intentions to replace at the time of collection.
Recommendation 3: Further work with retailers to promote the program.	Implemented. PECO works directly with retailers (SEARS) to ensure that the sales staff is properly informed, trained and educated to promote the program. In addition, the SHR field staff has visits other retailers to gain their support and educate them as well on the program.

D.3.2 Smart Home Rebates

Recommendations	EDC Status of Recommendation (Implemented, Being Considered, Rejected AND Explanation of Action Taken by EDC)
Recommendation 2: In Phase III, the SWE Team recommends that these measures be included in the Smart Multi-Family Program since this program has apartments and condominiums as their target market.	Implemented. All measures have been included in the Multi Family program for Phase III.
Recommendation 10: PECO, Ecova, and Navigant should collaborate with willing retailers and manufacturers to collect data in order to document the lift effect among participating and non-participating retail stores.	Implemented. Data from manufacturers and retailers outside what is provided via program participation is proprietary. The program has focused its forecasting and success rates based on past participation, national promotions, generalized regional information, rather than info obtained directly from manufacturers and/or retailers.

D.3.3 Smart House Call

Recommendations	EDC Status of Recommendation (Implemented, Being Considered, Rejected AND Explanation of Action Taken by EDC)
Recommendation 2: CSG, with oversight from PECO, should track program spillover more precisely, which may yield higher program NTG. Specific actions to focus on include: – Tracking specific, verifiable energy-saving actions that fall outside the bounds of the formal program measures. For example, assessment participants who are motivated by the program to reach out to	PECO has made great progress in providing the participants with access to resources and education materials electronically, with videos and brochures and through social media on our website. The spillover itself has not been captured because PECO has been focused on driving program participation, which is essentially paramount before addressing the spillover issues.

Recommendations	EDC Status of Recommendation (Implemented, Being Considered, Rejected AND Explanation of Action Taken by EDC)

contractors and have major measure work done without a program rebate represent a spillover opportunity if they are documented. Similarly, audit participants who work with contractors to make additional energy efficiency investments beyond the formal program measures represent an additional opportunity to document program spillover.
– Equipping program participants to educate themselves and find the resources they need to maximize the energy efficiency of their home by:
  ○ Making the description of all program measures available electronically
  ○ Creating short videos on the energy impacts of measures such as air sealing and making these available on the Smart Ideas website.	

Recommendation 3: CSG, with oversight from PECO, should improve the flow of information for contractors. Specific elements to focus on include: – Developing a website in place of the typical binder that tracks technical requirements and program policies, is easily searchable, and is kept up-to-date. This resource should be designed to make it easier for program contractors to stay abreast of program policies, specifications, and customer status. – Creating a central, online information source where contractors can see if a given customer had an audit or assessment done, since in some cases a customer does not know whether they have received an assessment or an audit, which changes the incentives for which they are eligible. – Developing an online tool to help contractor's cross-check a program participant's rebate application with program requirements in order to facilitate smooth approval.	PECO has implemented the recommendation of improving the flow of information for contractors by sending out scheduled updates of the program and any changes. This and additional information is always available upon request if the contractor shall need further information. Creating a tracking mechanism where a contractor can verify if a customer had an audit or an assessment done prior to visiting the site. Providing energy advisors with notifications on which customers moved ahead with major work. Involving the energy advisors in follow up efforts with audit participants regarding major measures and providing a feedback loop to the energy advisors on their effectiveness. As well as incorporating personalized/individualized follow-up process for 30-/60-/90-day touch points to reinforce recommendations and remind customer of incentives and expiration. Additional incentives have been added to encourage ownership by the energy advisor to have individuals move forward with work. New software was implemented that determines best routing and logistics for appointments for field staff to avoid lateness and no shows.
Recommendation 4: PECO should look for ways to more effectively facilitate the role of contractors as a marketing arm for the program. Specific elements to focus on include: – Giving contractors the chance to see the full array of program marketing materials – Providing contractors with program marketing and informational brochures that they can hand out to their customers – Adding each contractor's logo to program brochures that they can leave with customers to meet their own marketing objectives and program marketing objectives at the same time	Implemented. PECO has provided materials (brochures, door hangers, digital tools) to contractors to help them promote the program, and reach out on a quarterly basis for updates, ideas, and inventory checks. PECO also created a referral structure whereby a contractor can get a $50 referral fee and energy advisor will direct them back to the contractor to ensure the "lead" stays with that contractor.

Recommendations	EDC Status of Recommendation (Implemented, Being Considered, Rejected AND Explanation of Action Taken by EDC)
– Exploring possibilities for how a participating contractor could offer a complete package to the client that takes advantage of savings from all relevant PECO programs – Cultivating synergy with the vendor community, such as a structure where vendors could offer to pay for the SHC audit as a way of increasing the attractiveness of their offer when making a sale on a heat pump or other technology related to the program.	
Recommendation 5: CSG, with input from PECO and Navigant, should make better use of SHC's unique position to improve cross-promotion of all Smart Ideas programs in the residential portfolio. Specific actions to consider include: – Providing better and more thorough education to energy advisors and contractors about the other Smart Ideas programs, including eligibility criteria, typical energy savings, and rebate amounts – Setting a formal expectation that energy advisors and contractors let homeowners know the specific incentives that are available through other Smart Ideas programs for relevant measures – Providing the full list of other Smart Ideas programs, with descriptions of incentives and eligibility criteria, and having the energy advisor either leave this with all customers or hand it out as needed – Tracking SHC customers' participation in other Smart Ideas programs over time via tracking data analysis by customer number and secondarily by any verbal references to the SHC Program in customer and trade ally interviews for other programs. This can serve as a means of gauging the SHC Program's effectiveness as a lever and the particular programs that SHC participants pursue.	Implemented and in progress. PECO has been focused on providing more thorough education to energy advisors and contractors about the other Smart Ideas programs, with specific information about eligibility criteria, savings and rebates. PECO has assembled program descriptions and measure-related materials for customers to review. Cross promotion is an element of the program design, however the main focus is to gain traction with participation in the SHC program.
Recommendation 6: CSG, with oversight from PECO, should keep increasing the use of hands-on, on-site, and video-based training in favor of PowerPoint-style training for both energy advisors and contractors and do so in a way that is well-timed relative to when the work will be performed. Specific elements to focus on include: – Using more videos that directly demonstrate what needs to be done on-site, in favor of PowerPoint slides – Pairing videos with more frequent optional on-site training opportunities – Extending an open, optional invitation for contractors to see an energy audit take place – Increasing the frequency of refresher training courses, with more advance notice for training events and timing these appropriately relative to when the work will be performed	All recommendations have been implemented, such as video-based training, open house audits, and development of self-guided training. Also set up process training for contractors on expectations and knowledge-based testing in a group and one-on-one environment. The training is timed specifically around the timing of the work performed. PECO has also set up mandatory meetings for technical training, as well as periodic tech tips go out to contractors.

Recommendations	EDC Status of Recommendation (Implemented, Being Considered, Rejected AND Explanation of Action Taken by EDC)
– Developing resources for self-training and for self-guided review of concepts on the part of energy advisors and contractors and potentially making these available through the internal CSG learning and development site.	
Recommendation 7: CSG, with oversight from PECO, should improve the flow of information for energy advisors to increase their effectiveness. Specific actions to focus on include: – Making information available to energy advisors earlier regarding details of a household, such as number of occupants, size of home, and primary concerns expressed by the homeowner – Providing energy advisors with well-organized, easily accessible, and potentially automated notifications to allow customers to move ahead with major work, so energy advisors can receive feedback on their own effectiveness and how they might adjust their approach. This is helpful even if there is no additional action expected on the part of the energy advisor. – Changing the program structure so energy advisors actively follow up with audit participants to see if they have pursued any of the contractor-installed major measures and to ask if there are any other questions they can answer. This may serve several purposes, including increasing customer participation in the major measures, fostering a sense that the energy advisors are invested in the homeowners whom they have helped, and providing a feedback loop to the energy advisors that will help them hone their communications.	A list of housing details is provided to the energy advisor the day before each appointment. They are encouraged to look at online housing databases showing additional details to supplement the information provided the day before. A tracking database was created to provide the energy advisors with the status of where each job stands. Energy advisors are encouraged to follow up with the customers. A 30/60/90 day approach has been implemented for touch points by the energy advisor. Along with the implemented incentives for energy advisors for completed measures to engage and encourage the energy advisor to follow up.

D.3.4 Smart Builder Rebates

Recommendations	EDC Status of Recommendation (Implemented, Being Considered, Rejected AND Explanation of Action Taken by EDC)
Recommendation 4: Consider providing some form of financial support to contractors for achieving credentials required for program participation	Not Implemented. PECO is mainly focused on talking to builders and raters about streamlining the process and focusing on the design phase of the project, when most decisions get made. Also investigating the L&I standards and incorporating that into program requirements to get more interest.

D.3.5 Low-Income Energy Efficiency

Recommendations	EDC Status of Recommendation (Implemented, Being Considered, Rejected AND Explanation of Action Taken by EDC)
Recommendation 3: PECO should examine billing data for indications of electric space heating in homes that are not on the electric space heat rate and also are listed as having natural gas or other fuels as their primary heating source. Additionally, PECO and the CSP (CMC) should revise their intake data to ask specifically about electric space heater usage. Customers whose use of electric space heaters can be demonstrated as a substantial or major contributor to their space heat needs could then be treated as electric heating customers and provided appropriate base load and/or major measures.	In process. PECO is working with CMC to revise the intake data script to include specific questions about the electric space heater usage. Customers who are identified as those using space heaters as their primary heating source will be treated as electric heat customers and provided the base load and major measures.
Recommendation 5: PECO should take into consideration the recommendations from the preliminary ride-along observations memo, including adding shell improvements and ductless mini-split heat pumps to the program.	Being considered for Phase III. Rejected for Phase II since measure was not in the original plan and the cost benefit analysis proved that PECO does not have appropriate funding to offer this measure. As recommended on the observation memo PECO worked with CMC to develop and implement an electronics brochure which is now included as part of customer education an outreach program.

D.3.6 Smart Energy Saver

Recommendations	EDC Status of Recommendation (Implemented, Being Considered, Rejected AND Explanation of Action Taken by EDC)
Recommendation 1: Conduct surveys of previous-year parent/guardian participants in PY7 to better understand ISR for the CFL measures after one to two years.	Implemented. Revised the survey to obtain additional CFL installation info from the students. Asking them specifically what they've installed before and what they have now. This will provide better insights for the evaluation team.
Recommendation 5: Closely track the installation survey response rate in PY6 and conduct teacher interviews during the PY6 evaluation if the return rate remains an issue.	Partially implemented. We've increased our communication with teachers and parents via email encouraging responses, but that hasn't worked very well. Considering other options for the next phase.
Recommendation 7: Enhance program materials to better emphasize the resources available online at the SES website.	Implemented. Improvements included: – SES URL printed on all program materials – Added language in teacher book to drive teachers to visit our website for additional online resources and activities. Not seeing much traction or change
Recommendation 8: Provide options for teachers to use a regular-length or shortened version of the lesson plan and activities.	Implemented. Changes included: – Teachers were notified of program availability in August which gave them an opportunity to fit the program into their schedule. – Implemented for PY6 (based on teacher focus group feedback). – Removed 10-day optional curriculum, so only the 5-day curriculum will be offered. – Simplified the book by moving definitions to the back of the student book.

Recommendations	EDC Status of Recommendation (Implemented, Being Considered, Rejected AND Explanation of Action Taken by EDC)
	– Reduced the number of extra activities.
Recommendation 9: Increase efforts to cross-promote PECO's other residential programs through the SES Program.	Implemented. PECO has been engaged in cross-promotional efforts since the inception of the program: – Cross-promotion info is included in each kit design and highlights PSI programs with QR codes linking to PSI website. – Quick Start Guide included a panel highlighting PSI programs. – PSI URL is printed on all program materials.

D.3.7 Smart Usage Profile

Recommendations	EDC Status of Recommendation (Implemented, Being Considered, Rejected AND Explanation of Action Taken by EDC)
Recommendation 1: Contingent on contractual obligations, Navigant recommends that PECO retain the ability to adjust the number of treatment customers in Wave 3, or the timing of their enrollment in order to manage program savings and costs to meet the plan goals depending on how forecasts are trending relative to PY7 program goals. An additional option would be to adjust the frequency of HERs for Wave 1 and Wave 2.	PECO is actively working this suggestion depending on the results of the current BIDA contract negotiations. Currently, the most likely scenario is that we add X new recipients in upcoming years and then increase the number as the savings requirements increase in subsequent years. Additionally, we are discussing reducing the number of reports Wave 1 & Wave 2 get in the coming years.

D.3.8 Smart A/C Saver – Residential

Recommendations	EDC Status of Recommendation (Implemented, Being Considered, Rejected AND Explanation of Action Taken by EDC)
Recommendation 1: PECO should utilize AMI data for the PY7 SACS Program impact evaluation.	Implemented. PECO has utilized AMI data to identify and implement actionable load reduction opportunities within DLC program participants in the summer of 2015.

D.3.9 Smart Equipment Incentives – C/I

Recommendations	EDC Status of Recommendation (Implemented, Being Considered, Rejected AND Explanation of Action Taken by EDC)
Recommendation 1: DNV GL should review the TRM and train staff on the use of the TRM. Staff should be more careful when selecting the reported HOU and CF, as roughly half of the sampled projects had adjustments to both HOU and CF. DNV GL should also be more careful when selecting the reported post-retrofit equipment specifications, as the evaluation contractor adjusted this for approximately half of the sites sampled. For example, for the three projects that underwent pre-installation site visits, the evaluation team and DNV GL solicited customer-reported hours but TRM-deemed HOU were used in the ex	Implemented. PECO and DNVGL has instituted pre inspection of all equipment as well as active monitoring of all projects over 500 MWh/yr to ensure minimal errors. Also PECO and DNVGL has been training and regularly meeting with staff to align expectations.

Recommendations	EDC Status of Recommendation (Implemented, Being Considered, Rejected AND Explanation of Action Taken by EDC)
ante savings calculations. Most differences between the ex ante and ex post savings most would likely be resolved with a quick review of the project to ensure that it followed the TRM. PECO will benefit from this recommendation because if DNV GL and Navigant follow the TRM, the program-level realization rate should be closer to one, thus improving PECO's ability to track the portfolio's progress.	
Recommendation 2: DNV GL should ensure all projects undergo some level of review and that the values entered into the tracking system match the ex ante savings calculations. DNV GL should review project files and ascertain that ex ante savings calculation and values agree with the tracking system. This review should focus quality control on the HOU and CF for lighting projects and the motor nominal efficiency for VFD projects. These three inputs required a great number of adjustments in the ex post analysis. Although the realization rates for the program are relatively close to 1.00, the standard deviation for realization rates is 0.33 for energy and 0.38 for peak demand savings. For example DNV GL could potentially appoint one individual to review all projects for consistency with the TRM or appoint technology specific teams that focus on particular projects types as to gain expertise in evaluating the project savings associated with that technology type.	PECO is actively engaged with DNVGL to ensure a continuous process improvement. Specifically two engineers were hired in charge of analytics and project data inspections to review and QC, as well as aggressive training offered to staff to streamline the existing process.
Recommendation 3: PECO should direct DNV GL to improve their QA/QC processes with regard to the tracking system. DNV GL should make sure that all relevant columns in the tracking system are filled in with the appropriate data, leaving no blank cells within those relevant columns. This will allow verification of all the parameters that go into calculating project savings. DNV GL should develop a data dictionary for the tracking system that provides the definition of each field in the system. This will provide clarity on the data types being recorded in the tracking system to make sure that all necessary data are entered and are correct. DNV GL should make sure that all staff entering data into the tracking system fully understand the data type to be entered into each field (as defined in the data dictionary recommended above) and conduct periodic QC to ensure that all data conform to those definitions. This will ensure that all necessary data are entered and are correct. Correct data entry into the tracking system will improve PECO's ability to track the portfolio progress.	Implemented. DNVGL has invested in additional resources to handle invoices to make sure there are minimal errors. For future years considering developing a KPI to track and measure data related deliverables.
Recommendation 4: PECO and DNV GL should automate the data transfer process between DNV GL's database and PECO's database (SIDS). Currently, DNV GL transfers data monthly using a batch process. The evaluation team found discrepancies in the data transfer process (e.g., formatting issues, missing fields). PECO and DNV GL should automate the data transfer process between DNV GL's database and	Not implemented. DNVGL was facing a challenge in providing PECO with an automated data transfer process therefore batching still exists. PECO is investigating alternatives for Phase 3.

Recommendations	EDC Status of Recommendation (Implemented, Being Considered, Rejected AND Explanation of Action Taken by EDC)
PECO's database (SIDS). Automating the data transfer process will add a QC step, identify issues in the data during the transfer process, and save time over a batch process.	
Recommendation 5: PECO should work on building relationships with contractors and the trade ally network. Based on feedback received during the focus groups with contractors, it appears that contractors feel that PECO is not truly a partner in the EE space despite the incentives it offers. Building relationships with a trade ally network for the SEI Program is key to the program's success. Sixty-one percent of C/I respondents and 40% of GNI respondents first learned about the program from a contractor, trade ally, consultant, vendor or supplier. In addition, 63% of projects with non-lighting technologies first heard about the program through these channels. DNV GL has outlined plans to strengthen and motivate the trade ally network in their Strategic Marketing and Outreach Plan. Navigant recommends implementing these plans in PY6.	Implemented. PECO has been actively building relationships with trade allies and contractors by offering an incentivized trade ally program with bonus structures. PECO has been working with DNV GL to implement the strategies outlined in the marketing plan and outreach tactics for trade allies and contractors and it has proved to be very successful.

D.3.10 Smart Equipment Incentives – GNI

Recommendations	EDC Status of Recommendation (Implemented, Being Considered, Rejected AND Explanation of Action Taken by EDC)
Recommendation 1: DNV GL should review the TRM and train staff on the use of the TRM. Staff should be more careful when selecting the reported HOU and CF as roughly half of the sampled projects had adjustments to both HOU and CF. DNV GL should also be more careful when selecting the reported post-retrofit equipment specifications, as the evaluator adjusted this for approximately half of the sites sampled. For example, for the three projects that underwent pre-installation site visits, the evaluation team and DNV GL solicited customer-reported hours but TRM-deemed HOU were used in the ex ante savings calculations. Most differences between the ex ante and ex post savings most likely would be resolved with a quick review of the project to ensure that it followed the TRM. PECO will benefit from this recommendation because if DNV GL and Navigant follow the TRM, the program-level realization rate should be closer to one, thus improving PECO's ability to track the portfolio's progress.	Implemented. PECO and DNVGL has instituted pre inspection of all equipment as well as active monitoring of all projects over 500 MWh/yr to ensure minimal errors. Also PECO and DNVGL has been training and regularly meeting with staff to align expectations.
Recommendation 2: DNV GL should ensure all projects undergo some level of review and that the values entered into the tracking system match the ex ante savings calculations. DNV GL should review project files and ascertain that ex ante savings calculations and values agree with the tracking system. This review should focus quality control on the HOU and CF for lighting projects and the motor nominal efficiency for VFD projects. These three inputs required a great number of adjustments in the ex post analysis. Although the realization rates for the	PECO is actively engaged with DNVGL to ensure a continuous process improvement. Specifically two engineers were hired in charge of analytics and project data inspections to review and QC, as well as aggressive training offered to staff to streamline the existing process.

Recommendations	EDC Status of Recommendation (Implemented, Being Considered, Rejected AND Explanation of Action Taken by EDC)
program are relatively close to 1.00, the standard deviation for realization rates is 0.33 for energy and 0.38 for peak demand savings. For example, DNV GL could appoint one individual to review all projects for consistency with the TRM or appoint technology-specific teams that focus on particular project types to gain expertise in evaluating the project savings associated with that technology type.	
Recommendation 3: PECO should direct DNV GL to improve their QA/QC processes with regard to the tracking system. DNV GL should make sure that all relevant columns in the tracking system are filled in with the appropriate data, leaving no blank cells within those relevant columns. This will allow verification of all the parameters that go into calculating project savings. DNV GL should develop a data dictionary for the tracking system that provides the definition of each field in the system. This will provide clarity on the data types being recorded in the tracking system to make sure that all necessary data are entered and correct. DNV GL should make sure that all staff entering data into the tracking system fully understand the data type to be entered into each field (as defined in the data dictionary recommended above) and conduct periodic QC to ensure that all data conform to those definitions. This will ensure that all necessary data are entered and correct. Correct data entry into the tracking system will improve PECO's ability to track the portfolio progress.	Implemented. DNVGL has invested in additional resources to handle invoices to make sure there are minimal errors. For future years considering developing a KPI to track and measure data related deliverables.
Recommendation 4: PECO and DNV GL should automate the data transfer process between DNV GL's database and PECO's database (SIDS). Currently, DNV GL transfers data monthly using a batch process. The evaluation team found discrepancies in the data transfer process (e.g., formatting issues, missing fields). PECO and DNV GL should automate the data transfer process between DNV GL's database and PECO's database (SIDS). Automating the data transfer process will add a QC step, identify issues in the data during the transfer process, and save time over a batch process.	Not implemented. DNVGL was facing a challenge in providing PECO with an automated data transfer process therefore batching still exists. PECO is investigating alternatives for Phase 3.
Recommendation 5: PECO should work on building relationships with contractors and the trade ally network. Based on feedback received during the focus groups with contractors, it appears that contractors feel that PECO is not truly a partner in the EE space despite the incentives it offers. Building relationships with a trade ally network for the SEI Program is key to the program's success. Sixty-one percent of C/I respondents and 40% of GNI respondents first learned about the program from a contractor, trade ally, consultant, vendor, or supplier. In addition, 63% of projects with non-lighting technologies first heard about the program through these channels. DNV GL has outlined plans to strengthen and motivate the trade ally network in their Strategic Marketing and Outreach Plan. Navigant recommends implementing these plans in PY6.	Implemented. PECO has been actively building relationships with trade allies and contractors by offering an incentivized trade ally program with bonus structures. PECO has been working with DNV GL to implement the strategies outlined in the marketing plan and outreach tactics for trade allies and contractors and it has proved to be very successful.

D.3.11 Smart Business Solutions

Recommendations	EDC Status of Recommendation (Implemented, Being Considered, Rejected AND Explanation of Action Taken by EDC)
Recommendation 1: Evaluate additional measures for incorporation in the program to help reduce dependence on T12 retrofits.	Implemented. Measure mix was adjusted to phase out T-12 and introduce T-8 into the market for PECO customers.
Recommendation 2: Calculate project subsidies to provide the participant a one-year payback.	Implemented. Sales auditors evaluated projects that have a simple one year payback and primarily incorporated these projects in their implementation strategy.
Recommendation 3: In future CSP contracts, consider an administrative fee structure that does not depend on magnitude of energy savings.	Not Implemented. Contractual obligations with the CSP precluded a change in the incentive structure. However, strategies and open communication with CSP to educate them about PECO's needs and objectives, as well as incentive structures for comprehensive investments with higher acquisition costs were heavily promoted in accordance with plan design.
Recommendation 4: SmartWatt should determine whether any changes can be implemented to speed up the process of collecting removed equipment.	Implemented. This is no longer an issue because the equipment collection volume has greatly subsided, therefore the process is running much more robustly.
Recommendation 5: SmartWatt should follow up with survey respondents who indicated they have unresolved problems with their installations. SmartWatt should review its dispute resolution procedures to identify any gaps that may have resulted in the lack of satisfactory resolution of project issues.	Implemented. Smart Watt partnered with PECO to ensure any and all issues are addressed in a timely manner. Customers are receiving call backs to address their concerns and both PECO and CSP are fully invested to maintain top level customer service.
Recommendation 7: SmartWatt sales representatives should document customer-reported schedules where they diverge from default TRM hours, so that a review of HOU can become part of SmartWatt's internal QC process.	Implemented. PECO has added a form to document the HOU if they happen to differ from the TRM. Proper internal QC is being done by SmartWatt to ensure compliance with EM&V processes.

D.3.12 Smart Multi-Family Solutions – Non-Residential

Recommendations	EDC Status of Recommendation (Implemented, Being Considered, Rejected AND Explanation of Action Taken by EDC)
Recommendation 1: Given the healthy backlog of direct-install projects, PECO should consider experimenting with making participation in the prescriptive channel mandatory for customers that want to participate in the direct-install program. As an example experiment, PECO should consider the following: if a single building of a multi-property building management firm participates in the direct-install channel and if the management firm is interested in participating in the program in the future, the program could get the customer's commitment for at least some level of participation in the prescriptive channel. This will help PECO adjust the program participation to align better with the program design, which focuses on moving away from savings resulting from lighting measure installations.	This is the primary focus of PECO's Phase III Plan for a multifamily targeted segment is to shift to a customer centric approach to the multifamily target market. At present, the focus is to continue with the program implementation strategy and maintain participation levels to deliver targeted results.
Recommendation 2: PECO should consider establishing specific prescriptive participation savings targets with Franklin Energy to enhance prescriptive channel participation and help PECO achieve deeper savings. This will ensure that the prescriptive channel gets added traction, and increase the CSP's incentive to promote the prescriptive channel offerings more aggressively.	This is the primary focus of PECO's Phase III Plan for a multifamily targeted segment is to shift to a customer centric approach to the multifamily target market. At present, the focus is to continue with the program implementation strategy and maintain participation levels to deliver targeted results.

D.3.13 Smart Construction Incentives

Recommendations	EDC Status of Recommendation (Implemented, Being Considered, Rejected AND Explanation of Action Taken by EDC)
Recommendation 2: PECO should direct the CSP to make sure that the incentives recorded in the "Capped Incentive" column reflect the incentive that applies to each individual measure. Correcting this redistribution would improve the accuracy of measure-level benefit/cost results.	No action taken. Capping is only applied at measure level for custom measures. For non-custom measures, capping is applied based on total project cost as per terms and conditions listed in the program applications.
Recommendation 5: PECO should direct the CSP to run the proposed and baseline models for each modeled project in order to obtain 8,760 hour outputs and conduct a peak period analysis to determine demand savings. This will enable the program to estimate demand savings for these projects with much greater accuracy. Navigant also made this recommendation in the PY3 and PY4 evaluations.	We currently run the proposed and baseline models for each project in order to obtain 8760 hours and conduct a peak period analysis to determine demand savings.

D.3.14 Smart On-Site

Recommendations	EDC Status of Recommendation (Implemented, Being Considered, Rejected AND Explanation of Action Taken by EDC)
Recommendation 1: Consider providing design support to customers.	Considered but not implemented due to expectations that the program would be fully subscribed. Will be considered for Phase III program.

Recommendations	EDC Status of Recommendation (Implemented, Being Considered, Rejected AND Explanation of Action Taken by EDC)
Recommendation 2: Leverage completed SOS (and SEI CHP) projects to promote the technology.	Considered and partially implemented due to expectations that the program would be fully subscribed. The PECO Smart Ideas outreach team reactively discusses the benefits of CHP utilizing completed Smart Ideas projects as examples. Will be considered for Phase III program.
Recommendation 3: Consider marketing to organizations that value CHP's environmental benefits.	Considered but not implemented due to expectations that the program would be fully subscribed. Will be considered for Phase III program.

D.3.15 Smart Air Conditioner Saver – Commercial

Recommendations	EDC Status of Recommendation (Implemented, Being Considered, Rejected AND Explanation of Action Taken by EDC)
Recommendation 1: PECO should utilize AMI data for the PY7 SACS program impact evaluation.	In process. PECO will be utilizing the AMI data for C/I in PY7.

D.4 PPL

D.4.1 Portfolio

Recommendations	EDC Status of Recommendation (Implemented, Being Considered, Rejected AND Explanation of Action Taken by EDC)
Recommendation 2: Ensure that non-lighting trade allies are knowledgeable and well-informed about all of PPL's offerings.	Being considered. PPL to implement this though its Phase 3 plan.
Recommendation 3: Building on existing resources, consider opportunities to inform customers about specific energy-savings behaviors that have low customer penetration, such as washing clothes in cold water. Consider promoting just two to three specific behaviors in education campaigns initially.	Implemented. Done in phases 1 & 2. PPL to continue this practice in phase 3.
Recommendation 4: Consider more ways to communicate the value proposition of lighting and non-lighting energy-efficient upgrades to small businesses, such as reaffirming the participant's smart financial decision to make energy-efficient upgrades and improving how financial benefits are communicated on the PPL website.	Implemented though Direct Discount Program.
Recommendation 5: Explore the creation of an energy management training initiative; work with EPower Solutions to gather more information from program participants about specific topics of interest and assess gaps in staff technical expertise that could inform the training focus.	Not Implemented. PPL proposed this initiative in a revision to its Phase II EE&C Plan, but it was rejected by the Commission.
Recommendation 6: Consider energy-education campaigns aimed at younger people, such as increased focus on social media platforms and strategic online advertising that offer low- and no-cost energy-savings solutions.	Implemented. Done in phase 2. PPL to continue this practice in phase 3.

D.4.2 Residential Retail Program

Recommendations	EDC Status of Recommendation (Implemented, Being Considered, Rejected AND Explanation of Action Taken by EDC)
Recommendation 1: Consider options for educating licensed contractors and plumbers about the HPWH rebate.	Being considered. CSP did a direct mail piece to contractors and plumbers to update them on HPWH rebates. We will continue to expand our trade ally network in phase 3 with educational materials.
Recommendation 3: Consider investigating the impact of the change in HPWH eligibility and rebates and their influence on buyers' decision-making in PY6.	Implemented. Offered tiered rebates to customers in PY6.
Recommendation 4: Consider expanding marketing messaging to include non-energy benefits of LEDs.	Implemented. Our current marketing campaigns have resulted in higher than expected sales. Our messaging includes info about color, temperature, outside usage, dimming and instant on.
Recommendation 5: Explore options for targeting marketing to customers who have never used LEDs or demographics found to be less likely to have purchased/used LEDs.	Being considered. Our current broad marketing campaigns have resulted in higher than expected sales. We don't feel targeted marketing is necessary at this time, but will consider this option in phase 3.
Recommendation 7: Explore options for distributing LEDs at no cost to the low-income community, through food banks, senior-assistance programs, etc.	Implemented. We did direct mail of 40K LED's to low income customers, as well as handouts at the Spirit of the Lehigh Valley. We also provide LEDs to low income customers in our E Powerwise kits.
Recommendation 8: Consider including LEDs in the "leave-behind" package provided by the Appliance Recycling Program Implementation CSP or at the time of appliance pick-up.	Implemented. This is being included in our phase 3 Appliance Recycling Program.
Recommendation 9: Encourage retailers (in stores that allow it) and/or manufacturers to increase prevalence of signage and clarify labeling indicating that bulbs are subsidized by PPL.	Implemented. We continue to attempt to increase signage. The strict policies at most retailers are preventing us from expanding signage.
Recommendation 10: Examine promotional materials to ensure they clearly indicate that PPL subsidizes bulbs.	Implemented. Our current materials all display the PPL starburst to help with brand recognition
Recommendation 11: Explore ways to increase customer awareness of CFL recycling bins.	Not Implemented. Not implemented

D.4.3 Prescriptive Equipment Program

Recommendations	EDC Status of Recommendation (Implemented, Being Considered, Rejected AND Explanation of Action Taken by EDC)
Recommendation 1: Review corrections to application and project submittals and consider conducting additional training for trade allies.	Not Implemented. Will be implemented in Phase 3 to ensure trade allies understand how to properly complete rebate applications.
Recommendation 2: Consider adding a requirement to the incentive program for the Standard Path (prescriptive rebate delivery mechanism) stating that a lighting retrofit must result in a total annual energy consumption reduction in order to qualify for incentives.	Not Implemented. Not Implemented in phase 2 as it would require a plan change. Phase 3 will incorporate recommendation as incentives will be $/kwh.
Recommendation 4: Review program information resources such as information posted to the PPL program website and availability of support staff to ensure customers pursuing rebates through the Standard Path	Implemented. PPL made slight modifications to rebate process and will offer a online application process in phase 3.

Recommendations	EDC Status of Recommendation (Implemented, Being Considered, Rejected AND Explanation of Action Taken by EDC)
have the resources, such as support from program staff (Implementation CSP), to complete their application packages.	

D.4.4 Appliance Recycling Program

Recommendations	EDC Status of Recommendation (Implemented, Being Considered, Rejected AND Explanation of Action Taken by EDC)
Recommendation 1: Consider ways to increase the number of customers that look to PPL as a resource providing information about EE, such as leaving behind materials during pick-up.	Implemented. Done in phase 2. PPL to continue this practice.
Recommendation 2: Consider leaving an energy-savings kit with information and some free/low-cost measures, such as CFLs or an LED.	Not Implemented. Savings were not needed for this program in Phase 2. See D.3.2 recommendation #8 for Phase 3 status.

D.4.5 Student and Parent Energy Efficiency Education Program

Recommendations	EDC Status of Recommendation (Implemented, Being Considered, Rejected AND Explanation of Action Taken by EDC)
Recommendation 1: Provide safety and energy savings information on LEDs compared to CFLs and incandescent bulbs in the kits. Educating teachers and parents about the benefits of using LEDs over CFLs, especially when safety is of concern, should increase the use of LEDs.	Implemented. Operational benefits and energy savings information are provided in the installation pamphlet included with the kit that is distributed to students. That information is also part of the presentation in the classroom.
Recommendation 2: Consider adding another "plugged-in" measure (CFLs, LED bulbs, smart power strips, and nightlights) more than the "inspection" or "reminder" measures (shower flow test bag, furnace whistle, and light switch stickers) to the Bright Kids kit or increasing the instructions and discussion.	Implemented. LEDs and night lights were included in the PY6 and PY7 kits for Bright Kids. There were no low flow showerheads or furnace whistles in the kits for PY6 and PY7. Teachers who participated in the program received smart strips.
Recommendation 3: Consider removing the furnace whistle from the Take Action kit or providing additional installation instructions.	Implemented. Installation instructions were improved for a clearer understanding of how to install the furnace whistle. We are considering removal in phase 3
Recommendation 4: As a way to provide additional installation instructions, consider working with NEF on developing training and demonstration videos presented by classroom teachers that would be posted on the Think!Energy website for students, parents, and teachers to view.	Implemented. Videos are provided during the classroom presentation to the teachers and the students.
Recommendation 5: Explore the feasibility of customizing the kits or offering a choice of kits.	Implemented. PPL to implement this though its phase 3 plan
Recommendation 6: In secondary schools, fill out home energy Scantron forms in the classrooms.	Not Implemented. For PY6 and PY7, students who participate in the Innovations Program completed the forms online.
Recommendation 7: Cross-promote other PPL programs.	Not Implemented. Cross promotion of other PPL programs was discontinued due to overachievement of savings concerns. PPL will implement in phase 3.

Recommendations	EDC Status of Recommendation (Implemented, Being Considered, Rejected AND Explanation of Action Taken by EDC)
Recommendation 8: Emphasize savings potential and quality of light from LEDs during classroom presentations.	Implemented. Savings and quality of LEDs was emphasized during the classroom presentations and in the installation pamphlet included in the student kit.
Recommendation 9: Consider including a flyer in the take-home kits that describes LED benefits in detail.	Implemented. Implemented
Recommendation 10: Emphasize savings potential of kitchen faucet aerators to Take Action students during the classroom presentations.	Implemented. A demonstration video has been incorporated into the classroom presentations.
Recommendation 11: Consider including two types of aerators in the Take Action kit to cover internally and externally threaded faucets.	Not Implemented. This recommendation would be too expensive as we would need to survey each student's home and have two types of kits. Storage issues would also increase these costs.

D.4.6 Custom Incentive Program

Recommendations	EDC Status of Recommendation (Implemented, Being Considered, Rejected AND Explanation of Action Taken by EDC)
Recommendation 1: Consider requiring the Implementation CSP to develop a transition-and-change management plan to enhance project recordkeeping and the continuation of established procedures when employees leave.	Implemented/in process. PPL will implement in phase 3.
Recommendation 2: Consider providing an example application showing the level of detail required for supporting documentation.	Implemented. Developed standard submission kit for custom projects.
Recommendation 3: Explore the creation of an energy management training initiative.	Not Implemented. PPL proposed this initiative in a revision to its Phase II EE&C Plan but it was rejected by the Commission.
Recommendation 4: Consider enlisting dedicated outreach personnel to promote program awareness and gather information about barriers to the program.	Not Implemented. Not implemented. The Custom Program is achieving its savings and cost objectives in Phase 2.

D.4.7 Low-Income Winter Relief Assistance Program

Recommendations	EDC Status of Recommendation (Implemented, Being Considered, Rejected AND Explanation of Action Taken by EDC)
Recommendation 4: Review program costs to assess feasibility of cost reductions and whether improved cost efficiencies are possible.	Implemented. PPL will implement in phase 3.
Recommendation 5: Consider tracking measure quantities in the database to improve understanding of program services and impacts on cost-effectiveness.	Implemented. Implemented for transactions after 3/1/2015.

D.4.8 Residential Home Comfort Program – Audit and Weatherization

Recommendations	EDC Status of Recommendation (Implemented, Being Considered, Rejected AND Explanation of Action Taken by EDC)
Recommendation 6: If PPL wants to encourage customers to opt for the comprehensive audit, the company may want to consider a different program design for the audit component, such as one where customers pay a low fixed fee (such as $50 - $99) and PPL pays an additional amount negotiated with the contractors.	Partially Implemented. Partially implemented. We implemented an audit bonus incentive if customers followed through on insulation. This in essence, covers the cost of the audit.

D.4.9 Residential Home Comfort Program – Equipment

Recommendations	EDC Status of Recommendation (Implemented, Being Considered, Rejected AND Explanation of Action Taken by EDC)
Recommendation 2: Consider putting a link to the qualifying pumps page on the main pool pump web page so the information is closer to the top of the page and easier to find.	Implemented
Recommendation 3: Update the web page to make it clearer that two-speed pumps installed after May 31, 2014, are not eligible for a rebate.	Implemented
Recommendation 4: Continue working with trade allies to enhance how contractors, installers, builders, remodelers, and retailers can convey knowledge about all program offerings.	Implemented. A monthly newsletter to contractors/ trade allies was implemented and a liaison was hired by CLEAResult as a direct contact to contractors/trade allies.
Recommendation 5: Recommend that trade allies assist customers in completing the rebate forms, add a notice at the top of the form specifying that the trade ally should help customers complete the rebate form, and provide an example on the website that shows a completed rebate application with instructions on how to fill it out.	Implemented

D.4.10 Residential Home Comfort Program – New Construction

Recommendations	EDC Status of Recommendation (Implemented, Being Considered, Rejected AND Explanation of Action Taken by EDC)
Recommendation 1: PPL may want to consider lowering the manufactured homes rebate amounts for PY7 if these amounts appear higher than necessary. If interest in the program is low, PPL may want to consider splitting the $1,200 manufactured homes incentive between the customer and the retailers to motivate retailers to upsell.	Not implemented. Did not change rebate.. May be considered for phase 3.

D.4.11 E-Power Wise Program

Recommendations	EDC Status of Recommendation (Implemented, Being Considered, Rejected AND Explanation of Action Taken by EDC)
Recommendation 1: Add details to the agency training slides to highlight the benefits of installing the kit measures. This can include installation demonstrations, to highlight the interactive effects between the hot water temperature reduction and the water measure installation, and the money a family can save when they install the measures and change their behavior.	Implemented.
Recommendation 3: Explore the feasibility of offering different kits with a variety of items to increase installation rates.	Not Implemented. This was explored. Was not compatible with agencies.
Recommendation 4: Consider removing certain kit items, such as furnace whistles, and adding another item that piques the client's interest.	Implemented. Will be implemented for phase 3
Recommendation 5: Encourage agencies to offer community outreach, such as flyers on community bulletin boards, in addition to the posters and flyers distributed in agency waiting rooms.	Being considered. Agencies that have the capability currently do this type of outreach. Most agencies have limited budget or personnel.

D.4.12 Master-Metered Low-Income Multi-Family Housing Program

Recommendations	EDC Status of Recommendation (Implemented, Being Considered, Rejected AND Explanation of Action Taken by EDC)
Recommendation 2: Review energy audit and installation procedures to confirm they include measurement and documentation of area temperatures. Documented temperature readings will lead to more refined space-cooling estimates included in TRM Appendix C calculations.	Partially Implemented. Discussed changes with CSP, program scope was limited to mostly lighting applications. Will be implemented for phase 3
Recommendation 3: Consider customer feedback about lighting brightness in tenant units when transitioning to LEDs, and install bulbs with equivalent-lumen output.	Implemented. Implemented. We also have dealt with customer complaints that new LEDS were not offering enough omni-directional lighting which we addressed.
Recommendation 10: Review the EEMIS tracking systems used to store MMMF Program data and determine the feasibility of flagging customers that are completing larger facility improvements as a series of individual projects (that is, in more than one phase).	Being considered. Will be considered for Phase 3
Recommendation 11: Explore the cost-effectiveness of expanding program training to target multi-family property owners and operators, and include training seminars and demonstration projects.	Partially Implemented. We have done some of this by training building managers about showerheads, vending misers, sensor controlled lighting, etc.

D.4.13 Residential Energy Efficiency Behavior and Education Program

Recommendations	EDC Status of Recommendation (Implemented, Being Considered, Rejected AND Explanation of Action Taken by EDC)
Recommendation 1: Consider a persistence study that investigates how savings from legacy participants have changed from Phase I to Phase II.	Not Implemented
Recommendation 2: Consider tracking and evaluating the emailed reports through click rates and participant surveys.	Implemented

D.4.14 Low-Income Energy Efficiency Behavior and Education Program

Recommendations	EDC Status of Recommendation (Implemented, Being Considered, Rejected AND Explanation of Action Taken by EDC)
Recommendation 1: Consider discussing the fit of the email delivery channel with the Implementation CSP by consulting other low-income programs that have implemented an email delivery channel.	Being considered. Will be implemented in Phase III if there is a low Income behavior program.
Recommendation 3: Consider studying the prevalence of non-English speakers to determine the need to offer multi-lingual home energy reports or newsletters.	Being considered. Will be implemented in Phase III if there is a low Income behavior program.
Recommendation 4: Consider including an introduction in prevalent languages in the program welcome letter. Provide contact information in the introduction for customers to request reports in language other than English.	Being considered. Will be implemented in Phase III if there is a low Income behavior program.
Recommendation 5: Consider developing targeted outreach activities; including offering materials on EE in various languages and hosting free Wi-Fi events in the community. For example, review existing data to determine a customer's language preference. If needed, collect primary data regarding customers' language preferences, possibly through bill inserts or PPL's website.	Being considered. Will be implemented in Phase III if there is a low Income behavior program.

APPENDIX E | PY6 PROCESS EVALUATION RECOMMENDATIONS AND ACTIONS

This appendix provides further detail on the evaluator's process evaluation recommendations for PY6 and actions taken by the EDCs to respond to the recommendations. The recommendation statuses are provided by EDC and by program or program type.

E.1 DUQUESNE

Table E-1 through Table E-6 provide the process evaluation recommendations for Duquesne programs for PY6. The status of Duquesne's responses are provided in each table.

E.1.1 Residential Energy Efficiency Program

Table E-1 lists the evaluator's recommendations for the Duquesne REEP. The evaluation consultant made five total recommendations. Duquesne has indicated that all five of these recommendations are being considered.

Table E-1: Duquesne REEP – List of Evaluation Consultant Recommendations and Status of EDC Responses

Recommendations	EDC Status of Recommendation (Implemented, Being considered, Rejected) and Explanation of any Action Taken by EDC
Recommendation 1: Monitor ENERGY STAR for criteria changes and estimates on market penetration rates. Consider additional criteria or tiered incentives for increased savings and reduced free-ridership.	Being considered
Recommendation 2: Monitor call center activities, rebate rejection rates, and time duration between application submission and incentive payment to quantify program performance in PY7, to ensure that the possible decrease in satisfaction in the second half of PY6 does not reflect an ongoing problem.	Being considered
Recommendation 3: Consider emphasizing on the application form the critical importance of participants filling out the applications properly, to set expectations regarding completion of applications by participants.	Being considered
Recommendation 4: Consider leveraging the REEP, LIEEP, and SEP kits to introduce LEDs to participants, perhaps including an LED to the kits. However, the cost effectiveness of such an addition should be reviewed first.	Being considered
Recommendation 5: Consider using program collateral to place more emphasis on non-energy benefits of kit items, in addition to continuing to promote the energy benefits. For example, efficient lamps such CFLs or LEDs have longer lifetimes and require less frequent replacements due to burnouts.	Being considered

E.1.2 Residential Appliance Recycling Program

Table E-2 lists the evaluator's recommendations for the Duquesne Residential Appliance Recycling Program. The evaluation consultant made two total recommendations. Duquesne has indicated that both of these recommendations are being considered.

Table E-2: Duquesne Residential Appliance Recycling Program – List of Evaluation Consultant Recommendations and Status of EDC Responses

Recommendations	EDC Status of Recommendation (Implemented, Being considered, Rejected) and Explanation of any Action Taken by EDC
Recommendation 1: Duquesne should adjust its cost accounting for REEP and RARP to support proper tracking of program costs.	Being considered
Recommendation 2: Monitor the influence of the incentive on the decision to participate in RARP. The program may be capable of maintaining participation levels with reduced incentives. Further, the offer to remove the appliance might be sufficient to gain participation, even without a rebate.	Being considered

E.1.3 School Energy Pledge Program

Table E-3 lists the evaluator's recommendations for the Duquesne SEP. The evaluation consultant made two total recommendations. Duquesne has indicated that both of these recommendations are being considered.

Table E-3: Duquesne SEP – List of Evaluation Consultant Recommendations and Status of EDC Responses

Recommendations	EDC Status of Recommendation (Implemented, Being considered, Rejected) and Explanation of any Action Taken by EDC
Recommendation 1: Navigant understands that SEP has been implemented at a significant number of schools throughout Duquesne Light's territory and that repeating implementations at the same schools can risk low realization rates and high free-ridership. This is one reason for the low program achievements. Duquesne Light should consider revisiting certain schools where participant students of SEP have "graduated out" of the targeted grades, such as schools that participated when the program first began.	Being considered
Recommendation 2: Similar to the recommendation made for REEP, Duquesne Light should consider leveraging the various kits to introduce LEDs to participants. However, the cost effectiveness of such an addition should be reviewed first.	Being considered

E.1.4 Low-Income Energy Efficiency Program

Table E-4 lists the evaluator's recommendations for the Duquesne Low-Income Energy Efficiency Program. The evaluation consultant made three total recommendations. Duquesne has indicated that all three of these recommendations are being considered.

Table E-4: Duquesne Low-Income Energy Efficiency Program – List of Evaluation Consultant Recommendations and Status of EDC Responses

Recommendations	EDC Status of Recommendation (Implemented, Being considered, Rejected) and Explanation of any Action Taken by EDC
Recommendation 1: Duquesne Light should determine whether modifications to the Refrigerator Replacement program process or marketing are warranted. This would include ensuring that details regarding the size of the refrigerator unit are communicated clearly.	Being considered
Recommendation 2: Duquesne Light should also determine whether additional quality control checks should be incorporated into the refrigerator installation process. This would include documenting the status of equipment and noting damage, if any exists, before installations occur so that damaged equipment is not installed.	Being considered
Recommendation 3: Duquesne Light should clarify the process with participants for seeking assistance when refrigerator issues arise.	Being considered

E.1.5 Commercial

Table E-5 lists the evaluator's recommendations for the Duquesne commercial sector programs. The evaluation consultant made three total recommendations. Duquesne has indicated that all three of these recommendations are being considered.

Table E-5: Duquesne Commercial Sector Programs – List of Evaluation Consultant Recommendations and Status of EDC Responses

Recommendations	EDC Status of Recommendation (Implemented, Being considered, Rejected) and Explanation of any Action Taken by EDC
Recommendation 1: Duquesne Light should consider enhancing the PMRS tracking system with a more robust and functional system before the start of Phase III. The manual data transfer and database queries impose an unnecessary burden on the CSPs based on their feedback.	Being considered
Recommendation 2: Since most of the customer base for certain sectors has been identified and the most cost-effective energy opportunities exploited in Phase II, Duquesne Light should be very careful about the setting of Phase III savings goals for sectors that have drawn significant participation in Phase II and expect to need to pursue deeper retrofit possibilities at customer sites.	Being considered
Recommendation 3: Duquesne Light should reiterate to CSPs the evaluation approach Navigant will take regarding projects having <20 kW of savings, to maximize the chances of project realization rates being 100%.	Being considered

E.1.6 Industrial

Table E-6 lists the evaluator's recommendations for the Duquesne industrial sector programs. The evaluation consultant made three total recommendations. Duquesne has indicated that all three of these recommendations are being considered.

Table E-6: Duquesne Industrial Sector Programs – List of Evaluation Consultant Recommendations and Status of EDC Responses

Recommendations	EDC Status of Recommendation (Implemented, Being considered, Rejected) and Explanation of any Action Taken by EDC
Recommendation 1: Duquesne Light should consider enhancing the PMRS tracking system with a more robust and functional system before the start of Phase III. The manual data transfer and database queries impose an unnecessary burden on the program.	Being considered
Recommendation 2: Since most of the customer base for certain sectors has been identified and the most cost-effective energy opportunities exploited in Phase II, Duquesne Light should be very careful about the setting of Phase III savings goals for sectors that have drawn significant participation in Phase II and expect to need to pursue deeper retrofit possibilities at customer sites.	Being considered
Recommendation 3: Duquesne Light should reiterate to CSPs the evaluation approach Navigant will take regarding projects having <20 kW of savings, to maximize the chances of project realization rates being 100%.	Being considered

E.2 FIRSTENERGY EDCS (MET-ED, PENELEC, PENN POWER, WEST PENN)

Tables E-7 through E-15 provide the process evaluation recommendations for FirstEnergy EDC programs for PY6. The status of the FirstEnergy EDCs' responses are provided in each table. FirstEnergy administers identical programs across the Med-Ed, Penelec, Penn Power and West Penn service territories, so this section of the appendix addresses all of FirstEnergy's process evaluation recommendations for PY6.

E.2.1 Residential Appliance Turn-In Program

Table E-7 lists the evaluator's recommendations for the FirstEnergy EDC Residential Appliance Turn-In programs. The evaluation consultant made three total recommendations. FirstEnergy has indicated that one will be implemented, one is being considered and one of these recommendations was rejected.

Table E-7: FirstEnergy EDC Residential Appliance Turn-In Program – List of Evaluation Consultant Recommendations and Status of EDC Responses

Recommendations	EDC Status of Recommendation (Implemented, Being considered, Rejected) and Explanation of any Action Taken by EDC
Recommendation 1: Reduce reported savings for RACs to 150 kWh per unit.	Accept
Recommendation 2: Consider using bill inserts to address recycling concerns outside of the program.	Rejected
Recommendation 3: Consider adding a message to the rebate check that provides information about other FirstEnergy EDC programs.	Under Consideration

E.2.2 Energy Efficient Products Program

Table E-8 lists the evaluator's recommendations for the FirstEnergy EDC Energy Efficient Products Program. The evaluation consultant made seven total recommendations. FirstEnergy has indicated that one of these recommendations will be implemented and six of these recommendations are being considered.

Table E-8: FirstEnergy EDC Energy Efficient Products Program – List of Evaluation Consultant Recommendations and Status of EDC Responses

Recommendations	EDC Status of Recommendation (Implemented, Being considered, Rejected) and Explanation of any Action Taken by EDC
Recommendation 1: Review rebate paperwork processes to identify opportunities to streamline documentation requirements and notify contractors and/or customers more quickly if project documentation is incomplete.	Being Considered
Recommendation 2: Increase one-on-one communication and improve response time between participating program contractors and their ICSP representative.	Being Considered
Recommendation 3: Use one-on-one communication to increase contractor awareness of program communication tools – such as the newsletter and/or portal – that already exist.	Being Considered
Recommendation 4: 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.	Being Considered
Recommendation 5: Continue to use individual Appliance and HVAC subprogram NTG ratios during planning, rather than the overall program NTG ratio.	Implemented
Recommendation 6: For upstream lighting, report lamp source type, lamp type, wattage, lumens in the T&R system.	Being Considered
Recommendation 7: Remove the EDC name from equipment descriptions	Being Considered

E.2.3 Home Performance Program

Table E-9 lists the evaluator's recommendations for the FirstEnergy Home Performance Program. The evaluation consultant made six total recommendations. FirstEnergy has indicated that one of these will be implemented and five of these recommendations are being considered.

Table E-9: FirstEnergy EDC Home Performance Program – List of Evaluation Consultant Recommendations and Status of EDC Responses

Recommendations	EDC Status of Recommendation (Implemented, Being considered, Rejected) and Explanation of any Action Taken by EDC
Recommendation 1: For the New Homes component, flag homes with greater than 20,000 kWh for a REMRate baseline heating loads vs. heating energy usage review.	In Progress
Recommendation 2: For the conservation kits, consider including fewer 9W globes. Customers are slower to install those than any other lamps included in the kits.	Being Considered
Recommendation 3: 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 to energy efficiency program updates" on the FirstEnergy and ICSP websites.	Being Considered

Recommendations	EDC Status of Recommendation (Implemented, Being considered, Rejected) and Explanation of any Action Taken by EDC
Recommendation 4: Consider revising the rebate structure for the audit recommended improvements to adjust the focus of the program more towards encouraging implementation of efficiency upgrades.	Being Considered
Recommendation 5: 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 be beneficial for auditors.	Being Considered
Recommendation 6: 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 customer may drive more participation, according to auditors.	Being Considered

E.2.4 Residential Low Income Program

Table E-10 lists the evaluator's recommendations for the FirstEnergy EDC Residential Low Income Program. The evaluation consultant made two total recommendations. FirstEnergy has indicated that one of these will be implemented and one of these recommendations is being considered.

Table E-10: FirstEnergy EDC Residential Low Income Program – List of Evaluation Consultant Recommendations and Status of EDC Responses

Recommendations	EDC Status of Recommendation (Implemented, Being considered, Rejected) and Explanation of any Action Taken by EDC
Recommendation 1: Enhance quality assurance reviews and follow-up with those contractors for whom households report measures are more frequently "left behind" for future installation.	Implemented
Recommendation 2: For the conservation kits, consider including fewer 9W globes. Customers are slower to install those than any other lamps included in the kits.	Being Considered

E.2.5 Small Energy Efficient Equipment Program – C/I

Table E-11 lists the evaluator's recommendations for the FirstEnergy EDC Small Energy Efficient Equipment Program – C/I. The evaluation consultant made two total recommendations. FirstEnergy has indicated that one of these will be implemented and one of these recommendations is being considered.

Table E-11: FirstEnergy EDC Small Energy Efficient Equipment Program – C/I – List of Evaluation Consultant Recommendations and Status of EDC Responses

Recommendations	EDC Status of Recommendation (Implemented, Being considered, Rejected) and Explanation of any Action Taken by EDC
Recommendation 1: Ensure continued engagement with past participants as they are likely to participate in the future.	Implemented
Recommendation 2: If participation is lacking in the future, consider a referral/recruitment award program from past participants.	Being Considered

E.2.6 Small Energy Efficient Buildings Program – C/I

Table E-12 lists the evaluator's recommendations for the FirstEnergy EDC Small Energy Efficient Buildings Program – C/I. The evaluation consultant made just one recommendation. FirstEnergy has indicated that this recommendation is being considered.

Table E-12: FirstEnergy EDC Small Energy Efficient Buildings Program – C/I – List of Evaluation Consultant Recommendations and Status of EDC Responses

Recommendations	EDC Status of Recommendation (Implemented, Being considered, Rejected) and Explanation of any Action Taken by EDC
Recommendation 1: In Phase III, consider subsuming this program into the C/I Small Energy Efficient Equipment Program to reduce administrative costs and to ensure adequate budget is available in case participation levels increase significantly.	Under consideration

E.2.7 Large Energy Efficient Equipment Program – C/I

Table E-13 lists the evaluator's recommendations for the FirstEnergy EDC Large Energy Efficient Equipment Program – C/I. The evaluation consultant made three total recommendations. FirstEnergy has indicated that two of these are being implemented and one recommendation is being considered.

Table E-13: FirstEnergy EDC Large Energy Efficient Equipment Program – C/I – List of Evaluation Consultant Recommendations and Status of EDC Responses

Recommendations	EDC Status of Recommendation (Implemented, Being considered, Rejected) and Explanation of any Action Taken by EDC
Recommendation 1: 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
Recommendation 2: 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
Recommendation 3: Continue working closely with contractors and business owners to establish time periods during which project installations occur.	Implemented

E.2.8 Large Energy Efficient Buildings Program – C/I

Table E-14 lists the evaluator's recommendations for the FirstEnergy EDC Large Energy Efficient Buildings Program – C/I. The evaluation consultant made one recommendation. FirstEnergy has indicated that this recommendation is being considered.

Table E-14: FirstEnergy EDC Large Energy Efficient Buildings Program – C/I – List of Evaluation Consultant Recommendations and Status of EDC Responses

Recommendations	EDC Status of Recommendation (Implemented, Being considered, Rejected) and Explanation of any Action Taken by EDC
Recommendation 1: In Phase III, consider subsuming this program into the C/I Small Energy Efficient Equipment Program to reduce administrative costs and to ensure adequate budget is available in case participation levels increase significantly.	Under Consideration

E.2.9 Government and Institutional Program

Table E-15 lists the evaluator's recommendations for the FirstEnergy EDCs' Government and Institutional Program. The evaluation consultant made four total recommendations. FirstEnergy has indicated that two of these will be implemented and two of these recommendations are being considered.

Table E-15: FirstEnergy EDC Government and Institutional Program – List of Evaluation Consultant Recommendations and Status of EDC Responses

Recommendations	EDC Status of Recommendation (Implemented, Being considered, Rejected) and Explanation of any Action Taken by EDC
Recommendation 1: 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
Recommendation 2: 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
Recommendation 3: Continue working closely with contractors and business owners to establish time periods during which project installations occur.	Implemented
Recommendation 4: Consider stipulating an annual indoor lighting hours of use of 1,000 hours for all program participants	Being Considered

E.3 PECO

Tables E-16 through E-29 provide the process evaluation recommendations for PECO programs for PY6. The status of PECO's responses are provided in each table.

E.3.1 Smart Appliance Recycling

Table E-16 lists the evaluator's recommendations for the PECO Smart Appliance Recycling program. The evaluation consultant made two total recommendations. PECO has indicated that both of these recommendations are being implemented.

Table E-16: PECO Smart Appliance Recycling Program – List of Evaluation Consultant Recommendations and Status of EDC Responses

Recommendations	EDC Status of Recommendation (Implemented, Being considered, Rejected) and Explanation of any Action Taken by EDC
Recommendation 1: Navigant recommends that at the point of pickup JACO attempts to confirm the participant's replacement intentions indicated at the point of application. Alternatively, the evaluation team recommends that the PUC adopt a utility-specific deemed replacement rate in the TRM that is based on phone survey results from the most recently completed evaluation.	Implemented - At the time of pick up the CSP confirms the participant's replacement intentions which were initially indicated during the appointment.
Recommendation 2: Navigant recommends that the incentive level remain at the $50 level throughout PY7 to maintain the current participation levels. Navigant also recommends that PECO continue to send bill inserts and direct mailings at the more frequent rate adopted in PY6.	Implemented - The incentive level will remain at $50 throughout PY7 with bill inserts continuing to be the primary method of promotion.

E.3.2 Smart Home Rebates

Table E-17 lists the evaluator's recommendations for the PECO Smart Home Rebates program. The evaluation consultant made seven total recommendations. PECO has indicated that three of these recommendations are being implemented and four of these recommendations are being considered.

Table E-17: PECO Smart Home Rebates Program – List of Evaluation Consultant Recommendations and Status of EDC Responses

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

Recommendations	EDC Status of Recommendation (Implemented, Being considered, Rejected) and Explanation of any Action Taken by EDC
	marketing experts to design a plan to reach under-served markets.

E.3.3 Smart House Call

Table E-18 lists the evaluator's recommendations for the PECO Smart House Call program. The evaluation consultant made six general recommendations, with two that had two parts each, for a total of eight recommendations. PECO has indicated that two of these recommendations are being implemented, two of these recommendations are being considered, and two were rejected.

Table E-18: PECO Smart House Call Program – List of Evaluation Consultant Recommendations and Status of EDC Responses

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

Recommendations	EDC Status of Recommendation (Implemented, Being considered, Rejected) and Explanation of any Action Taken by EDC
	to the customer, there is no plan to add measures into the program.

E.3.4 Smart Builder Rebates

Table E-19 lists the evaluator's recommendations for the PECO Smart Builder Rebates Program. The evaluation consultant made four total recommendations. PECO has indicated that two of these recommendations are being implemented and two are being considered.

Table E-19: PECO Smart Builder Rebates Program – List of Evaluation Consultant Recommendations and Status of EDC Responses

Recommendations	EDC Status of Recommendation (Implemented, Being considered, Rejected) and Explanation of any Action Taken by EDC
Recommendation 1: Use the PA TRM algorithm for DHW savings calculations in PY7.	This recommendation has been implemented.
Recommendation 2: Use the PA TRM algorithm for modeled demand savings until an errata correction can be made to TRM protocols.	In progress - PECO is following this recommendation.
Recommendation 3: PECO should increase the base incentive amount from $400/home to at least $750/home, while retaining the additional $0.10/kWh.	PECO recommends increasing the base incentive amount from $400/home to at least $750/for single homes, while retaining the additional kWh of$0.10 with the flexibility to increase to $0.20 per Kwh savings as the budget allows.
Recommendation 4: PECO should offer a variable incentive structure based on building type with lower base incentives for multifamily units, and higher base incentives for multi-single and single-family homes.	PECO agrees we should offer additional tiered incentives. PECO will investigate this recommendation of a less stringent pathway to allow builders to participate who are not yet willing or able to build to ENERGY STAR standards.

E.3.5 Low-Income Energy Efficiency

Table E-20 lists the evaluator's recommendations for the PECO Low-Income Energy Efficiency program. The evaluation consultant made four general recommendations, one of which has two parts, for a total of five recommendations. PECO has indicated that one of these is being implemented and four of these recommendations are being considered.

Table E-20: PECO Low-Income Energy Efficiency Program – List of Evaluation Consultant Recommendations and Status of EDC Responses

Recommendations	EDC Status of Recommendation (Implemented, Being considered, Rejected) and Explanation of any Action Taken by EDC
Recommendation 1a: Encourage auditors to spend more time during the audits discussing usage and explaining the difference between turning off and unplugging appliances.	In process - Working with outreach and ESO to ensure we are involved in every project in the earliest stage possible.

Recommendation 1b: Consider leaving additional spare energy-efficient lighting for participants so that they can replace on burnout.	Being Considered - This may pose budget and evaluation issues.
Recommendation 2: For Phase III, expand the measures offered to include floor insulation.	Being Considered. Budget and evaluation impacts are being evaluated.
Recommendation 3: For Phase III, expand the measures offered to include window replacement.	Being Considered - Budget and evaluation impacts are being evaluated.
Recommendation 4: For Phase III, include LEDs in the program in addition to CFLs. Including LEDs in the program plan will give the program staff the ability to adapt the program to the rapidly changing lighting market.	Being Considered - Budget and evaluation impacts are being evaluated.

E.3.6 Smart Energy Saver

Table E-21 lists the evaluator's recommendations for the PECO Smart Energy Saver program. The evaluation consultant made five general recommendations, one of which has two parts, for a total of six recommendations. PECO has indicated that three of these are being implemented and three of these recommendations are being considered.

Table E-21: PECO Smart Energy Saver Program – List of Evaluation Consultant Recommendations and Status of EDC Responses

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

E.3.7 Smart Usage Profile

Table E-22 lists the evaluator's recommendations for the PECO Smart Usage Profile program. The evaluation consultant made four total recommendations. PECO has indicated that one of these is being implemented and all three of these recommendations are being considered.

Table E-22: PECO Smart Usage Profile Program – List of Evaluation Consultant Recommendations and Status of EDC Responses

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

E.3.8 Smart Equipment Incentives – C/I

Table E-23 lists the evaluator's recommendations for the PECO Smart Equipment Incentives C/I program. The evaluation consultant made four general recommendations, one with two parts for a total of five recommendations. PECO has indicated that three of these are being implemented and two of these recommendations are being considered.

Table E-23: PECO Smart Equipment Incentives C/I Program – List of Evaluation Consultant Recommendations and Status of EDC Responses

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

E.3.9 Smart Equipment Incentives – GNI

Table E-24 lists the evaluator's recommendations for the PECO Smart Equipment Incentives – GNI program. The evaluation consultant made five total recommendations. PECO has indicated that three of these are implemented and two of these recommendations are being considered.

Table E-24: PECO Smart Equipment Incentives – GNI Program – List of Evaluation Consultant Recommendations and Status of EDC Responses

Recommendations	EDC Status of Recommendation (Implemented, Being considered, Rejected) and Explanation of any Action Taken by EDC
Recommendation 1: PECO should direct DNV GL to provide a final set of project documents.	Being considered - Currently setting expectations with CSP to have a certain number of documents on all paid finished projects.
Recommendation 2: DNV GL should ensure customers receive an accurate incentive. If incentive amount is difficult to determine, seek further assistance.	In process - Working with outreach and an internal point of contact helping manage large accounts to ensure we are involved in every project in the earliest stage possible.
Recommendation 3: PECO should simplify savings calculations requirements and increase incentive levels for non-lighting and custom measures.	Being considered - Working with DNV engineering to identify measures that use a standard, industry-based baseline for usage.
Recommendation 4: PECO should get involved during the project planning cycle in order to have a greater influence on the type and amount of measures implemented.	In process - Working with outreach and an internal point of contact helping manage large accounts to ensure we are involved in every project in the earliest stage possible.
Recommendation 5: PECO should instruct DNV GL to increase outreach, develop new and interesting promotional materials, and create metrics to measure the impact of all marketing activities.	In process - Currently working with promotions team to develop new pathways and materials to customers and trade allies.

E.3.10 Smart Business Solutions

Table E-25 lists the evaluator's recommendations for the PECO Smart Business Solutions program. The evaluation consultant made five general recommendations, one with two parts, for a total of six recommendations. PECO has indicated that four of these are being implemented and two of these recommendations are being considered.

Table E-25: PECO Smart Business Solutions Program – List of Evaluation Consultant Recommendations and Status of EDC Responses

Recommendations	EDC Status of Recommendation (Implemented, Being considered, Rejected) and Explanation of any Action Taken by EDC
Recommendation 1: The SW sales auditor should gather and document lighting schedules accurately and use this information in the savings estimates presented to customers and in the calculation of ex ante savings.	In process - CSP will add an additional form to document the actual hours of operation vs. stated. An example would be a restaurant which requires prep time before HOU and break down time after hours of operation.

Recommendations	EDC Status of Recommendation (Implemented, Being considered, Rejected) and Explanation of any Action Taken by EDC
Recommendation 2: Where it uses non-default HOU, SW should calculate a non-default coincidence factor in compliance with the TRM and prior SWE guidance.	Implemented - This is in process for the instances of non-default HOU.
Recommendation 3: PECO should ensure that its CSP contracts are tightly aligned with approved program plans and that contract language allows PECO to either modify budgets and savings goals based on PUC-approved plan changes, or to terminate the contract if the CSP refuses to accommodate such modifications.	Implemented - This has been addressed with all parties. A process for careful attention to new contracts and amendments are in place.
Recommendation 4: Navigant recommends that in any future contract CSP remuneration be divorced from project-level energy savings estimates, as this could create a perverse incentive for the CSP to inflate savings.	This contract change will be considered for Phase III.
Recommendation 5a: SW should consider providing installers with a stock of common bulbs and ballasts, as this would likely improve customer service and could reduce program implementation costs.	Being Considered - This will be discussed with CSP. Although their method of buying materials and inventory control play a part in their ability to be efficient.
Recommendation 5b: If PECO decides to implement the SBS program in Phase III, Navigant should evaluate the advisability of including parking lot lighting and LED exit signs with remote heads in the program design.	In process - This has been addressed in Phase III program design.

E.3.11 Smart Multi-Family Solutions

Table E-26 lists the evaluator's recommendations for the PECO Smart Multi-Family Solutions program. The evaluation consultant made seven total recommendations. PECO has indicated that two of these are being implemented, four of these are being considered, and one recommendation was rejected.

Table E-26: PECO Smart Multi-Family Solutions Program – List of Evaluation Consultant Recommendations and Status of EDC Responses

Recommendations	EDC Status of Recommendation (Implemented, Being considered, Rejected) and Explanation of any Action Taken by EDC
Recommendation 1: Track the DI equipment make and model in SIDS or place stickers or identifying marks on DI equipment by the program implementer.	Rejected - PECO's implements a comprehensive marketing strategy at the point of sale but does not maintain a relationship with product manufacturers.
Recommendation 2: Collect, maintain, and provide non-residential participant tenant contact information by the program implementer.	Being Considered - Looking into management of participant tenant contract information by the implementer.
Recommendation 3: PECO should review current protocols with the program implementer, who should work with landlords to ensure that the proper communication protocol is followed in every case to notify tenants before installation.	Implemented - PECO has reviewed protocols to support communication with implementer, landlords, and tenants.
Recommendation 4: Offer DI LEDs.	Being Considered - Budget and evaluation impacts are being reviewed.
Recommendation 5: Provide installed equipment make and model to landlords in closeout report.	Being Considered - Process is being reviewed.

Recommendations	EDC Status of Recommendation (Implemented, Being considered, Rejected) and Explanation of any Action Taken by EDC
Recommendation 6: Follow up more frequently with landlords after the DI measure installation project completion to encourage prescriptive participation.	Implemented - Follow up frequency has increased.
Recommendation 7: Establish a predetermined minimum prescriptive participation level for repeat landlords in order to qualify for future DI projects.	Being Considered - Process and qualifying levels are being reviewed.

E.3.12 Smart Construction Incentives

Table E-27 lists the evaluator's recommendations for the PECO Smart Construction Incentives program. The evaluation consultant made five total recommendations. PECO has indicated that two of these are being implemented and three of these recommendations are being considered.

Table E-27: PECO Smart Construction Incentives Program – List of Evaluation Consultant Recommendations and Status of EDC Responses

Recommendations	EDC Status of Recommendation (Implemented, Being considered, Rejected) and Explanation of any Action Taken by EDC
Recommendation 1: PECO should instruct the program CSP, DNV GL, to establish a quality control process to ensure that project information entered into the tracking system is correct and complete.	Being considered/in process - Working with CSP to develop better methods and have established a peer review process.
Recommendation 2: PECO should instruct the program CSP, DNV GL, to gather project-specific data through customer interviews for projects that surpass the expected kWh savings thresholds set in Table 13-2 of the 2014 PA TRM.	Being considered/in process - Working with CSP to develop better methods and have established a peer review process.
Recommendation 3: PECO should offer an incentive for building modeling expenses.	Being considered - These incentives are being considered for Phase III.
Recommendation 4: PECO should gain better understanding of the new construction market and the project cycle by getting involved earlier in new construction projects.	In process - PECO agrees and is gaining a better understanding of the cycle.
Recommendation 5: PECO should instruct the program CSP, DNV GL, to begin outreach earlier in the project cycle and to implement metrics to track promotion activities.	Implemented - Program CSP has been instructed to begin project outreach earlier and track promotional activities.

E.3.13 Smart On-Site

Table E-28 lists the evaluator's recommendations for the PECO Smart On-Site program. The evaluation consultant made three general recommendations, one of which had four parts, for a total of six recommendations. PECO has indicated that all six of these recommendations are being considered.

Table E-28: PECO Smart On-Site Program – List of Evaluation Consultant Recommendations and Status of EDC Responses

Recommendations	EDC Status of Recommendation (Implemented, Being considered, Rejected) and Explanation of any Action Taken by EDC
Recommendation 1a: Cease accepting project applications at least 2 years in advance of the end of the phase.	A 2 year cut off is being considered for Phase III.
Recommendation 1b: Consider an incentive structure that reduces incentives steeply as the end of a phase approaches.	Incentive structure changes are being considered for Phase III.
Recommendation 1c: Consider offering customers a CHP system design incentive.	CHP system design incentives are being considered for Phase III.
Recommendation 1d: Consider developing a pool of pre-qualified CHP project developers with whom participants must work to receive program incentives.	Making incentives contingent on using a qualified developer is being considered for Phase III.
Recommendation 2: Identify opportunities to streamline the interconnection process; develop a schedule identifying all steps in the process.	Streamlining opportunities and process information collection are being considered.
Recommendation 3: Develop and deploy an educational and marketing campaign targeting specific market segments.	A campaign targeting specific market segments is being considered for Phase III.

E.3.14 Smart Air Conditioner Saver – Commercial

Table E-29 lists the evaluator's recommendations for the PECO Smart Air Conditioner Saver – Commercial program. The evaluation consultant made two total recommendations. PECO has indicated that both of these recommendations are being considered.

Table E-29: PECO Smart Air Conditioner Saver – Commercial Program – List of Evaluation Consultant Recommendations and Status of EDC Responses

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

E.4 PPL

Tables E-30 through E-41 provide the process evaluation recommendations for PPL programs for PY6. The status of PPL's responses are provided in each table.

E.4.1 Portfolio

Table E-30 lists the evaluator's general recommendation for the PPL portfolio of programs. The evaluation consultant made just one such general recommendation. PPL has not provided a status update for this recommendation.

Table E-30: PPL General Portfolio – Evaluation Consultant Recommendation and Status of EDC Response

Recommendations	EDC Status of Recommendation (Implemented, Being considered, Rejected) and Explanation of any Action Taken by EDC
Recommendation 1: Cadmus recommends PPL Electric Utilities request PUC approval to discontinue the fuel switching survey (fossil fuel to electricity) in Phase III. This survey was conducted in Phase I and Phase II to demonstrate the degree to which customers switch from fossil fuels to electricity to receive a rebate. Survey findings consistently show the rebates have had a marginal to no impact on the customer's decision to switch from fossil fuels to electric equipment.	Status Unknown

E.4.2 Residential Retail Program

Table E-31 lists the evaluator's recommendations for the PPL Residential Retail Program. The evaluation consultant made seven total recommendations. PPL has indicated that six of these will be implemented and one of these recommendations is being considered.

Table E-31: PPL Residential Retail Program – List of Evaluation Consultant Recommendations and Status of EDC Responses

Recommendations	EDC Status of Recommendation (Implemented, Being considered, Rejected) and Explanation of any Action Taken by EDC
Recommendation 1: Consider replacing refrigerators with another product that is more likely to have impact on savings, can benefit from rebates, and increase customer satisfaction.	Being considered for Phase III.
Recommendation 2: Work with the ICSP and Cadmus to explore ideas for marketing campaigns to reach and educate water heater installers to stock and promote heat pump water heaters.	Will be implemented in Phase III with an enhanced trade ally network.
Recommendation 3: Continue to research changes in residential customer purchasing behavior with regard to LEDs, in preparation for optimal program impact in Phase III.	Implemented
Recommendation 4: For Phase III, consider developing marketing for the general residential population (bill inserts, etc.) that highlights the promotional price of discounted LEDs.	Implemented
Recommendation 5: Work with retailers to utilize LED product placement as a lower cost mechanism for generating sales lift (rather than more aggressive incentives throughout the year) and to reduce free-ridership.	Will be implemented in Phase III.
Recommendation 6: Consider ways to organize the program to decrease LED free-ridership by focusing on products or channels with lower free-ridership.	Will be implemented in Phase III.
Recommendation 7: Use customer surveys to explore ways to encourage CFL recycling.	Will be implemented in Phase III.

E.4.3 Prescriptive Equipment Program

Table E-32 lists the evaluator's recommendations for the PPL Prescriptive Equipment program. The evaluation consultant made 11 total recommendations. PPL has indicated that six of these will be implemented and five of these recommendations are being considered.

Table E-32: PPL Prescriptive Equipment Program – List of Evaluation Consultant Recommendations and Status of EDC Responses

Recommendations	EDC Status of Recommendation (Implemented, Being considered, Rejected) and Explanation of any Action Taken by EDC
Recommendation 1: Review corrections to application and project submittals and consider conducting additional training for trade allies.	Being considered - The ICSP continues to offer webinars to new contractors to review eligibility requirements and the rebate application process.
Recommendation 2: Consider adding a requirement to the incentive program for the standard path (prescriptive rebate delivery mechanism) stating that a lighting retrofit must result in a total annual energy consumption reduction to qualify for incentives.	Being considered - Was not implemented during PY6; however, there was only one lighting project that resulted in an increase in energy consumption.
Recommendation 3: Consider reviewing the number of commercial appliance and equipment incentives in PY4 and program progress compared to the portfolio plans to decide if a change in the amount of the incentive or marketing strategy is necessary.	Implemented - Increased incentive amount for LEDs and HVAC equipment in Q4 of PY6.
Recommendation 4: Review program information resources such as information posted to the PPL Electric Utilities program website and availability of support staff to ensure customers pursuing rebates through the standard path have the resources, such as support from program staff (ICSP), to complete their application packages.	Being considered - PPL Electric Utilities generally agrees.
Recommendation 5: Ensure that equipment trade allies are knowledgeable and well-informed about all of PPL Electric's offerings.	Being considered - PPL Electric Utilities generally agrees.
Recommendation 6: Continue with the preapproval process; however, contractors and customers may need more support in completing applications as the process evaluation found that customer satisfaction with the rebate process declined in PY6 as compared to PY5.	Will be implemented in Phase III. PPL will significantly improve the application, QA/QC, and rebate processes in Phase III.
Recommendation 7: Provide more support in filling out the applications by giving examples of completed applications on the website and naming a point of contact for questions about the applications.	Will be implemented in Phase III. PPL will significantly improve the application, QA/QC, and rebate processes in Phase III.
Recommendation 8: Continue to provide guidance to the ICSP and quality assurance checks on completed projects regarding TRM requirements; likewise, Cadmus will provide quality assurance spot checks of ICSP Appendix C and E spreadsheets to see if site-specific coincidence factors are used where required and inform the ICSP of any discrepancies that are uncovered.	Implemented
Recommendation 9: Consider requiring the ICSP to use the 2016 TRM LED fixture code generator for all LED fixtures in PY7.	Being considered - Will be implemented in Phase III.
Recommendation 10: Consider requiring the ICSP to use the 2016 TRM LED fixture code generator for all LED fixtures in PY7.	Implemented
Recommendation 11: Explore new incentives for LEDs as replacements for linear fluorescent lamps.	Implemented

E.4.4 Appliance Recycling Program

Table E-33 lists the evaluator's recommendations for the PPL Appliance Recycling Program. The evaluation consultant made three total recommendations. PPL has indicated that one of these will be implemented and two of these recommendations are being considered.

Table E-33: PPL Appliance Recycling Program – List of Evaluation Consultant Recommendations and Status of EDC Responses

Recommendations	EDC Status of Recommendation (Implemented, Being considered, Rejected) and Explanation of any Action Taken by EDC
Recommendation 1: Increase program marketing and focus on the low season months such as summer and fall if PPL Electric would like to levelize monthly participation to reduce the seasonal swing, in addition to spring.	Under consideration
Recommendation 2: Consider a leave-behind flyer or post card that includes information on all PPL Electric program offerings, including Act 129 programs, to ensure participants are aware of all program resources available.	Will be implemented in Phase III.
Recommendation 3: Consider investigating customer segments to identify which segments have yet to participate; identifying segments and characterizing them can yield marketing and outreach ideas.	Will be implemented in Phase III.

E.4.5 Student Parent Energy Efficiency Education Program

Table E-34 lists the evaluator's recommendations for the PPL Student Parent Energy Efficiency Education Program. The evaluation consultant made eight total recommendations. PPL has indicated that two of these will be implemented and six of these recommendations are being considered.

Table E-34: PPL Student Parent Energy Efficiency Education Program – List of Evaluation Consultant Recommendations and Status of EDC Responses

Recommendations	EDC Status of Recommendation (Implemented, Being considered, Rejected) and Explanation of any Action Taken by EDC
Recommendation 1: Continue to recruit new schools and educators.	Will be implemented in Phase III.
Recommendation 2: Consider increasing the grade-appropriate classroom instructions and discussion about the furnace whistle, showerhead, and faucet aerator items.	Will be implemented in Phase III.
Recommendation 3: Explore new program implementation ideas such as rotating kits, product trade-ins, and donating unused products.	Being considered for Phase III.
Recommendation 4: Consider revising the workshop curriculum by including more topics that align with STEM or modify existing curriculum topics to align with STEM.	Being considered for Phase III.
Recommendation 5: Offer grade-appropriate breakout sessions or grade-specific workshop dates.	Being considered for Phase III.
Recommendation 6: Test the idea of using an online HEW completion process proposed by the ICSP with the Innovation student cohort.	Being considered for Phase III.
Recommendation 7: Consider a streamlined online HEW data collection process where after students enter the data online, teachers can review and submit data online, thus reducing the paperwork.	Being considered for Phase III.
Recommendation 8: Consider cross-program marketing through the kits.	Being considered for Phase III.

E.4.6 Custom Incentive Program

Table E-35 lists the evaluator's recommendations for the PPL Custom Incentive Program. The evaluation consultant made four total recommendations. PPL has indicated that all four of these recommendations will be implemented.

Table E-35: PPL Custom Incentive Program – List of Evaluation Consultant Recommendations and Status of EDC Responses

Recommendations	EDC Status of Recommendation (Implemented, Being considered, Rejected) and Explanation of any Action Taken by EDC
Recommendation 1: Continue to work to reduce the program free-ridership; Cadmus and PPL Electric could explore options for the Custom program to offer dedicated, ongoing support to large business customers.	Will be implemented in Phase III.
Recommendation 2: Consider ways to improve responsiveness to customers questions such as tracking the questions and answers to determine if the response is timely.	Will be implemented in Phase III.
Recommendation 3: Add more detail to online tools regarding the amount of time each step in the participation process may take.	Will be implemented in Phase III.
Recommendation 4: Revise program materials to mention that a third-party may be needed to assist or supply pre and post verification data.	Will be implemented in Phase III.

E.4.7 Low-Income Winter Relief Assistance Program

Table E-36 lists the evaluator's recommendations for the PPL Low-Income Winter Relief Assistance Program. The evaluation consultant made two total recommendations. PPL has indicated that both of these recommendations will be implemented.

Table E-36: PPL Low-Income Winter Relief Assistance Program – List of Evaluation Consultant Recommendations and Status of EDC Responses

Recommendations	EDC Status of Recommendation (Implemented, Being considered, Rejected) and Explanation of any Action Taken by EDC
Recommendation 1: Identify additional KPIs, such as participant satisfaction, and upgrade LEAP to collect and report them. To assess program satisfaction on an on-going basis, consider administering an online survey or leave-behind postcard survey to all participants.	Will be implemented in Phase III.
Recommendation 2: Consider steps to control or reduce program delivery costs, such as setting a standard labor cost across the program and reviewing the measures and measure costs to prioritize measures offered in Act 129 and those offered in USP LIURP.	Will be implemented in Phase III. The Phase III EE&C Plan projects an approximately 50% decrease in the program acquisition cost for Act 129 WRAP.

E.4.8 Residential Home Comfort Program – Equipment

Table E-37 lists the evaluator's recommendations for the PPL Residential Home Comfort Program – Equipment. The evaluation consultant made nine total recommendations. PPL has indicated that all nine of these recommendations are being considered.

Table E-37: PPL Residential Home Comfort Program – Equipment – List of Evaluation Consultant Recommendations and Status of EDC Responses

Recommendations	EDC Status of Recommendation (Implemented, Being considered, Rejected) and Explanation of any Action Taken by EDC
Recommendation 1: Continue to offer and market bonus rebates to reduce financial participation barriers to participating in audits.	Under consideration for Phase III.
Recommendation 2: Consider dropping the rebate for SEER 15 ductless heat pump systems and raising the minimum efficiencies for each rebate tier by at least one SEER; consider starting the minimum efficiency eligibility at SEER 18 and reserve the highest rebate for customers installing systems with a minimum efficiency rating of SEER 22.	Under consideration for Phase III.
Recommendation 3: Consider eliminating the SEER 15 rebate raising the minimum SEER requirement for the air source heat pump rebate to SEER 16 or above to push installation of equipment that is significantly above the baseline of SEER 14, and increase savings.	Under consideration for Phase III.
Recommendation 4: The $1,200 limited time offer for SEER 16 ASHP rebates was very successful in moving the market. Consider re-offering the $1,200 ASHP rebates for SEER 16 and above in Phase III if savings are needed and the budget can accommodate this (over $1/annual kWh saved acquisition cost).	Under consideration for Phase III but the budget likely cannot accommodate this level of rebate (program acquisition cost is more than $1/annual kWh saved).
Recommendation 5: Consider extending marketing to manufactured homes retailers through personal contact and/or personal e-mail messages; messaging could describe the benefits of the program and rebate.	Under consideration for Phase III.
Recommendation 6: Consider further study to assess the potential market for electrically heated manufactured homes.	Under consideration for Phase III.
Recommendation 7: Continue to market to new home builders by emphasizing their selling power.	Under consideration for Phase III.
Recommendation 8: Consider expanding the list of products rebated through the prescriptive path or offer the same prescriptive product rebate, but with a reduced rebate if appliances are not installed.	Under consideration for Phase III.
Recommendation 9: When marketing the HERS approach option, refer to the MLS entries.	Under consideration for Phase III.

E.4.9 E-Power Wise Program

Table E-38 lists the evaluator's recommendations for the PPL E-Power Wise Program. The evaluation consultant made five total recommendations. PPL has indicated that all five of these recommendations are being considered.

Table E-38: PPL E-Power Wise Program – List of Evaluation Consultant Recommendations and Status of EDC Responses

Recommendations	EDC Status of Recommendation (Implemented, Being considered, Rejected) and Explanation of any Action Taken by EDC
Recommendation 1: To encourage installation of the water-saving devices, consider adding additional details to the agency training slides to highlight the various benefits to installing the water products. Consider installation demonstrations using sink and showerhead props and real-life examples that are applicable to low-income families so	Under consideration for Phase III.

Recommendations	EDC Status of Recommendation (Implemented, Being considered, Rejected) and Explanation of any Action Taken by EDC
they will feel empowered to install the water-saving devices. Also emphasize the interactive effects of reducing the hot water temperature and the money a family can save when it installs the products and turn down the temperature.	
Recommendation 2: Continue to explore the feasibility of offering different energy-savings kits with varied products in Phase III as a way to increase installation rates of the water-saving devices. PPL Electric Utilities could provide a general kit that includes LED bulbs and a power strip for all participants as well as the option to include the water-saving devices based on the recipient's hot water fuel source.	Under consideration for Phase III.
Recommendation 3: Consider communicating information regarding the MMMF program to the E-Power Wise agencies.	Under consideration for Phase III.
Recommendation 4: Explore the potential for distributing LED bulbs to Phase I participants. Agencies or RAP could distribute LEDs with an installation survey similar to the current survey in the energy-savings kit and, once returned, these customers could be included in the monthly gift card raffle.	Under consideration for Phase III.
Recommendation 5: Consider alternatives for the furnace whistle: increase energy education around the furnace whistle; or remove the furnace whistle from the energy-savings kit; and/or consider a rebate for a new furnace filter.	Under consideration for Phase III.

E.4.10 Master-Metered Low-Income Multi-Family Housing Program

Table E-39 lists the evaluator's recommendations for the PPL Master-Metered Low-Income Multi-Family Housing Program. The evaluation consultant made five total recommendations. PPL has indicated that three of these are being considered and one of these recommendations was rejected.

Table E-39: PPL Master-Metered Low-Income Multi-Family Housing Program – List of Evaluation Consultant Recommendations and Status of EDC Responses

Recommendations	EDC Status of Recommendation (Implemented, Being considered, Rejected) and Explanation of any Action Taken by EDC
Recommendation 1: Review the program saving potential in common areas of individually metered multifamily buildings and if necessary, in other building types that may be eligible for program participation.	Under consideration for Phase III.
Recommendation 2: For Phase III, establish program saving targets based on an updated estimate of the remaining saving potentials in the eligible master metered multifamily sector.	Rejected - There will not be a separate multifamily program in Phase III. Multifamily buildings will be served by other programs (residential, low-income, non-residential).
Recommendation 3: For Phase III, extend program eligibility requirements beyond GNE and low-income.	Will be implemented in Phase III.
Recommendation 4: Consider providing additional educational materials about faucet aerators, low-flow showerheads, and thermostatic shower restriction valves.	Under consideration for Phase III.
Recommendation 5: Consider a review of measure persistence for low-flow aerators and thermostatic shower restriction valves.	Under consideration for Phase III.

E.4.11 Residential Energy Efficiency Behavior and Education Program

Table E-40 lists the evaluator's recommendations for the PPL Residential Energy Efficiency Behavior and Education Program. The evaluation consultant made three total recommendations. PPL has indicated that all three of these recommendations will be implemented.

Table E-40: PPL Residential Energy Efficiency Behavior and Education Program – List of Evaluation Consultant Recommendations and Status of EDC Responses

Recommendations	EDC Status of Recommendation (Implemented, Being considered, Rejected) and Explanation of any Action Taken by EDC
Recommendation 1: Continue delivering the paper and e-mail home energy reports as planned.	Implemented
Recommendation 2: Continue to promote PPL Electric Utilities energy efficiency programs through the home energy reports to inform customers about energy-saving opportunities.	Will be implemented in Phase III.
Recommendation 3: Focus on ways to deliver a better customer experience with the home energy reports by having early discussions with the Phase III ICSP on personalization, gamification, and online services.	Will be implemented in Phase III.

E.4.12 Continuous Energy Efficiency Improvement Program

Table E-41 lists the evaluator's recommendations for the PPL Continuous Energy Efficiency Improvement Program. The evaluation consultant made five total recommendations. PPL has indicated that all five of these recommendations are being considered.

Table E-41: PPL Continuous Energy Efficiency Improvement Program – List of Evaluation Consultant Recommendations and Status of EDC Responses

Recommendations	EDC Status of Recommendation (Implemented, Being considered, Rejected) and Explanation of any Action Taken by EDC
Recommendation 1: The ICSP should continue using its current regression methods and could consider a few improvements.	Being considered
Recommendation 2: The ICSP should revisit the coincidence factor and consider increasing it to be more in line with a coincidence factor calculated by dividing the verified demand reduction by the verified energy savings.	Being considered
Recommendation 3: The energy managers of the participating school districts praised the dynamic, motivating, and competitive environment that the ICSP created in PY6. PPL Electric Utilities could consider ways to create the same engaging and competitive environment within each school district to better motivate teachers, school staff, and students of individual schools.	Under consideration for Phase III.
Recommendation 4: Consider investigating opportunities for creating self-sustaining organizations such as student clubs with a focus on energy efficiency to minimize the required amount of teacher engagement and maintain the continuity of the behavioral energy efficiency efforts.	Under consideration for Phase III.

Recommendations	EDC Status of Recommendation (Implemented, Being considered, Rejected) and Explanation of any Action Taken by EDC
Recommendation 5: Consider reducing the incentive amount, eliminating the incentive in the second year, or eliminating the incentive altogether.	Under consideration for Phase III.

APPENDIX F| BEST PRACTICES REVIEW – EVALUATION AND IMPLEMENTATION

F.1 EVALUATION, MEASUREMENT, AND VERIFICATION BEST PRACTICES

The SWE Team has 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 during Phase II and that are now in place in either the SWE Evaluation Framework or the 2016 Pennsylvania TRM.

F.1.1. Department of Energy Uniform Method Project Protocols

The U.S. Department of Energy's (DOE's) UMP[66] develops M&V protocols for evaluating program energy savings. The UMP includes all the major commercial and residential energy efficiency programs in the United Sates. 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 calculating energy savings will increase the overall accuracy of reported savings. The SWE Project Manager also 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 as guidance 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 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 CF results from these studies are now incorporated into the 2016 PA 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 evaluators, the TUS, and members of the SWE Team. All protocols are opened to public comment before incorporation into the TRM.

F.1.2. Net-to-Gross Protocols

The SWE Team worked with the Pennsylvania NTG TWG to identify and develop best practices for developing NTG ratios for different types of energy efficiency programs. The SWE Team emphasized that the lack of a common approach would lead to different NTG ratios, 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 are now using this NTG protocol in new 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.

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

F.1.3. Residential Site Inspection Protocols

The SWE has 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 evaluators' visits (to the displeasure of the customer). Now the SWE has more transparent data on the number and percentage of EDC inspections where equipment is reported as being installed or not installed, along with other discrepancies. Therefore, the SWE is focusing its resources on reviewing the results gleaned from the extensive site visits already being performed by the EDCs and their evaluators.

F.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 evaluators. The modifications help to address the dual baseline issue encountered during some lighting retrofits and how to account for the savings in a concise manner.

F.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 off of PJM Manual 19, which governs load forecasting and analysis. For C/I programs, the SWE built the protocol off of PJM Manual 11.

F.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 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 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. This workshop is discussed in the SWE PY5 annual report, and is readdressed here as the workshop was not held until early in PY6.

F.2 EMERGING IDEAS IN RESIDENTIAL PROGRAM DESIGN AND IMPLEMENTATION

In order to fulfil the SWE's contractual obligation to provide recommendations for program improvements the SWE Team reviewed recent industry literature, focusing on identifying emerging trends in residential 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 residential program design and implementation.

The majority of these papers can be divided into four broad 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.

F.2.1. 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 those customers 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.

F.2.1.1. 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 characteristics of the home. 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 to those who began, but did not complete, the participation process. The program dropouts had similar characteristics to complete participants in many ways, but expressed a lower sense of self-efficacy in controlling their energy savings.

F.2.1.2. 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 (WECC), 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" (Lightbourn 2014).

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, and in others, 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 range 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 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.

F.2.2. 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.

F.2.2.1. 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 NTG ratio. 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 a NTG ratio of 100%.[67]

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 in that the retailer 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.

F.2.2.2. Retail Products Portfolio

The Retail Products Portfolio (RPP) Program offered by PG&E targets a range of consumer electronics and appliance products.[68] RPP offers participating retailers an incentive for each unit sold within the participating PAs' service territories that meets a program-defined efficiency specification.[69] 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 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, while 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 efforts, although the pilots' small scale limited their results. The PG&E pilot increased sales of efficient products by, on average, approximately 5% across all the product categories it targeted.

[67] 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.

[68] In 2016, PG&E plans 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.

[69] 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%).

F.2.2.3. 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 RPP's predecessor business and consumer electronics programs. However, they may be reluctant to provide data to smaller-scale program efforts and may be reluctant to provide the level of data PAs and their evaluators 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 demonstrate the challenges 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 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. Evaluators are working to develop ways to identify the effects of these national decisions, but no approach has gained widespread acceptance to date.

F.2.3. 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, PA experience, including that of many ARRA grantees who heavily focused on these types of upgrades, has suggested there may be a benefit to adopting an approach that 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.

F.2.3.1. 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.

F.2.3.2. 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.

F.2.3.3. Financing

PAs have long looked to financing as a tool to increase uptake of comprehensive home energy upgrades by eliminating the upfront 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 program administrators 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% to 20% that program administrators 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.[70] 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. Further, 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 non-payment 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 non-payment. 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 the proportion of loans that transfer relative to those that are paid off before a property is sold is unclear.[71]

F.2.4. Behavioral Interventions

Recent industry literature reflects a growing focus among energy efficiency program administrators 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 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.

F.2.4.1. Behavioral Strategies

As noted above, programs seeking to bring about behavior change do so by leveraging specific interventions based in social science theory. Catalogs of behavioral interventions have identified 33

[70] Expanded underwriting criteria use traditional financial metrics to judge a borrower's credit worthiness, 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 credit worthiness.

[71] 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.

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.

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" (Mazur-Stommen and Farley 2013)[72]. Interventions seeking to leverage social norms as a behavioral strategy compare participants to other members of their community and make community members' energy saving actions visible in order to build norms around the targeted energy saving 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 to 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 ($0.01/kWh) cost of saved energy.

Feedback

Feedback programs provide participants with information about their energy use, which they can use to inform decisions on energy saving actions and potentially see the results of those actions. Asynchronous feedback programs provide participants with information about their energy use over a defined period in the past. HERs are the most common form of asynchronous feedback PAs are currently using.[73] 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 a 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) 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.[74] 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.

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

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

[73] As noted above, home energy reports can also leverage social norms if they are framed as a comparison to other members of one's community. Many behavioral programs seek to combine multiple strategies.

[74] Source: SCE website. Accessed 12/15/2015 at https://www.sce.com/wps/portal/home/customer-service/my-account/smart-meters/opt-out/.

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.[75] 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.[76] Respondents are rewarded with a $5 gift card to Walmart, Barnes and Noble, or a variety of other retailers and restaurants.[77]

F.2.4.2. 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.

Pre- and post-treatment comparisons evaluate an intervention by comparing the energy use of participants prior to the intervention to the same participants' energy use following the intervention. This approach can be effective for programs in which participants opt in (rather than being randomly selected). Individuals that 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/post 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.

[75] Cognitive dissonance occurs when a person's actions do not align with that person's beliefs or attitudes.
[76] Source: Entergy Solutions Rewards website. Accessed 12/15/2015 at https://www.entergysolutionsrewards.com.
[77] Source: Entergy Solutions Rewards website. Accessed 12/15/2015 at https://www.entergysolutionsrewards.com/faqs.

APPENDIX G | 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 that 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 investment or practice when compared with the costs of energy produced and delivered in the absence of such an investment. In the energy efficiency field, the terms refers to the present value of the estimated benefits produced by an energy efficiency 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 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 or points 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 induces 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 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 EE, 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 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 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 measures and their installation for qualified customers. Typical measures distributed by these programs include low-flow showerheads and compact fluorescent bulbs.

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.

Effective Useful Life: The assumed life expectancy, in years, of an energy efficiency measure.

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: Publically-owned electric service providers

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 in that DSM programs are utility-sponsored and -financed, while 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. Energy efficiency ratio 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 Contractor: Contractor retained by an EDC to evaluate a specific EE&C program and generate ex post savings values for efficiency measures.

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/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 will be 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.")

-F-

Free-Driver: A non-participant that adopts a particular efficiency measure or practice as a result of a utility program. See SPILLOVER for aggregate impacts.

Free-Rider: A program participant that would have implemented a program measure or practice in the absence of the program within the same timeframe.

-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 Technical Reference Manual.

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 non-participant 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.

Non-Participant: 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 non-participant 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 that would have implemented, to some degree, a program measure or practice in the absence of the program. Examples include participants that 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 Three (PY3): The period between June 1, 2011 and May 31, 2012.

Program Year Four (PY4): The period between June 1, 2012 and May 31, 2013.

Program Year Five (PY6): The period between June 1, 2 013 and May 31, 2014.

Program Year Six (PY6): The period between June 1, 2014 and May 31, 2015.

Program Year Seven (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 non-participant spillover.

Stakeholder: An organization with interest 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: 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 Technical Reference Manual (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 H | REFERENCES

Colvin, Julie, Todd Malinick, and Richard Ridge. 2015. "Pacific Gas and Electric Company Retail Plug-Load Portfolio (RPP) Trial: Evaluation Report." Evaluation Report. San Francisco, CA: Pacific Gas and Electric Company.

Conzemius, Sara. 2015. "RPP & EM&V." Presented at the ENERGY STAR Products Partner Meeting, Portland, OR, October 13. https://www.energystar.gov/sites/default/files/asset/document/4_Sara%20Conzemius_ENERGY%20STAR%20Retail%20Products%20Platform_FINAL.pdf.

Deason, Jeff. 2015. "The Impact of On-Bill Programs on Loan Performance: Evidence from the Green Jobs, Green New York Program." In *Proceedings of the International Energy Program Evaluation Conference*. Long Beach, CA: International Energy Program Evaluation Conference.

Dunn, Stephen, and Rebecca Ciraulo. 2014. "Residential Energy Efficiency Financing: Insight and Lessons Learned from the Better Buildings Neighborhood Program." In *Proceedings of the ACEEE Summer Study on Energy Efficiency in Buildings*. Pacific Grove, CA: American Council for an Energy-Efficient Economy.

Ehrhardt-Martinez, Karen, Kat Donnelly, and John A. "Skip" Laitner. 2010. "Advanced Metering Initiatives and Residential Feedback Programs: A Meta-Review for Household Electricity-Saving Opportunities." Washington, D.C.: American Council for an Energy-Efficient Economy.

Fuller, Merrian, Cathy Kunkel, Mark Zimring, Ian Hoffman, Lindgren Soroye, and Charles Goldman. 2010. "Driving Demand for Home Energy Improvements: Motivating Residential Customers to Invest in Comprehensive Upgrades That Eliminate Energy Waste, Avoid High Bills, and Spur the Economy." LBNL-3960E. Berkeley, CA: Environmental Energy Technologies Division, Lawrence Berkeley National Laboratory.

Hastings, Riley, Michael Goldman, and Kara Rodgers. 2015. "Driving Miss Participation." In *Proceedings of the AESP National Conference*. Orlando, FL: Association of Energy Services Professionals.

Howard, A. J., Todd Malinick, Teddy Kisch, Michael Lukaziewicz, and Brian Smith. 2014. "What's Your UEC? Baselining Sales-Weighted Unit Energy Consumption for Plug Load Products at the Retailer Level." In *Proceedings of the ACEEE Summer Study on Energy Efficiency in Buildings*. Pacific Grove, CA: American Council for an Energy-Efficient Economy.

Ignelzi, Patrice, Jane Peters, Katherine Randazzo, Linda Dethman, and Loren Lutzenhiser. 2013. "Paving the Way for a Richer Mix of Residential Behavior Programs." San Francisco: California Investor-Owned Utilities.

ILLUME Advising. 2015. "Literature Review, Benchmarking Analysis, and Evaluation Guidelines." COMM-20140512-86775. St. Paul, MN: Minnesota Department of Commerce: Division of Energy Resources.

Jacobsohn, Ely, Subid Wagley, Eric Werling, and Stephen Bickel. 2014. "Is It Time To Move Beyond the Whole House Approach?" In *Proceedings of the ACEEE Summer Study on Energy Efficiency in Buildings*. Pacific Grove, CA: American Council for an Energy-Efficient Economy.

Johnson, Katherine, Phil Degens, Lucia Nixon, Antje Flanders, and Philippe Dunsky. 2013. "Coast-to-Coast: An Update on On-Bill Financing Program Strategies." In *Proceedings of the International Energy Program Evaluation Conference*, 11. Chicago: International Energy Program Evaluation Conference.

KEMA, Inc. 2014. "Final Report: Baseline Characterization Market Effects Study of Investor-Owned Utility Whole House Retrofit Programs in California." City of publication: California Public Utilities Commission.

Kwatra, Sameer, Jennifer Amann, and Harvey Sachs. 2013. "Miscellaneous Energy Loads in Buildings." A133. City of publication: American Council for an Energy-Efficient Economy.

Lightbourn, Steve. 2014. "Community Marketing: What Worked? What Didn't? What We Would Do Again." Phoenix, AZ: Association of Energy Services Professionals.

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

McKenzie-Mohr, Doug. 2011. *Fostering Sustainable Behavior: An Introduction to Community-Based Social Marketing*. Gabriola Island, BC, Canada: New Society Publishers.

McRae, Marjorie, and Jordan Folks. 2015. "What Have We Learned about Success and Its Drivers in Comprehensive Residential Upgrade Programs?" In *Proceedings of the International Energy Program Evaluation Conference*, 12. Long Beach, CA: International Energy Program Evaluation Conference.

Michel, Tim. 2015. "Creating a More Energy Efficient Future for Residential Customers." Presented at the ENERGY STAR Products Partner Meeting, Portland, OR, October 13. https://www.energystar.gov/sites/default/files/asset/document/2_Tim%20Michel_ENERGY%20STAR%20Retail%20Products%20Platform_FINAL.pdf.

Mitchell-Jackson, Jennifer, Andy Fessel, Kessie Avseikova, and Katherine Randazzo. 2014. "What a Difference A House Makes! Targeting Through Data Mining." In *Proceedings of the AESP National Conference*, 12. City of publication: Association of Energy Services Professionals.

Moran, Dulane, Alexandra Dunn, and Cynthia Kan. 2014. "Mining for Community-Based Gold: Striking It Rich in California." In *Proceedings of the ACEEE Summer Study on Energy Efficiency in Buildings*, 13. Pacific Grove, CA: American Council for an Energy-Efficient Economy.

Peters, Jane, Dulane Moran, and Marti Frank. 2010. "Lighting Program Assessment: Residential Direct Distribution." Final Report. City of publication: Bonneville Power Administration.

Research Into Action, Inc. 2015a. "RPP Pilot Evaluation Draft Report." Portland, OR: Northwest Energy Efficiency Alliance.

———. 2015b. "Process Evaluation of the Better Buildings Neighborhood Program Final Evaluation Volume 4." City of publication: U.S. Department of Energy Office of Energy Efficiency and Renewable Energy.

———. 2015c. "Spotlight on Key Program Strategies from the Better Buildings Neighborhood Program, Final Evaluation Volume 6." City of publication: U.S. Department of Energy Office of Energy Efficiency and Renewable Energy. http://www1.eere.energy.gov/analysis/pdfs/bbnp_volume_6_spotlight_072215.pdf.

Russell, Chris, Mike Strom, Scott Dimetrosky, and Noah Leib. 2015. "What's the Point (of Sale)? Program Activity Impacts Efficient Bulb Sales - Proof Across 44 States and Five Years." In *Proceedings of the*

International Energy Program Evaluation Conference. Long Beach, CA: International Energy Program Evaluation Conference.

Scott, Kate, Erika Kociolek, Matt Braman, Matt Nelson, Lara Bonn, Sarah Moore, Elizabeth Titus, Chris Cloutier, Chris Javier-Barry, and Toby Swope. 2014. "Team Lift: A Three-State Approach to Testing a New Program Design." In *Proceedings of the ACEEE Summer Study on Energy Efficiency in Buildings*, 13. Pacific Grove, CA: American Council for an Energy-Efficient Economy.

Scott, Kate, Erika Kociolek, and Sarah Castor. 2014. "Customer Engagement Experiment: Which Follow-Up Strategies Turn Home Energy Audits Into Home Energy Savings." In *Proceedings of the ACEEE Summer Study on Energy Efficiency in Buildings*. Pacific Grove, CA: American Council for an Energy-Efficient Economy.

State and Local Energy Efficiency Action Network Residential Retrofit Working Group. 2011. "Roadmap for the Home Energy Upgrade Market." City of publication: U.S. Department of Energy.

Strom, Michael, and Matthew Nelson. 2015. "Market Lift: The Enigma of Incentive Program Redesign." Long Beach, CA: IEPEC International Energy Program Evaluation Conference.

Van Clock, Joe, Marjorie McRae, Jane S. Peters, and Edward Vine. 2015. "I'll Gladly Pay You Tomorrow for an Energy Upgrade Today: Integrating Financing into Residential Upgrade Programs." In *Proceedings of the International Energy Program Evaluation Conference*, 11. Long Beach, CA: International Energy Program Evaluation Conference.

Wobus, Nicole, Jan Harris, Steve Hastie, and June Shelp. 2015. "Charting New Territory: Using Evaluation to Inform Residential Lighting Program Response to Changing Market Conditions." In *Proceedings of the AESP National Conference*. Orlando, FL: Association of Energy Services Professionals.

Zimring, Mark, Greg Leventis, Charles Goldman, Merriam Borgeson, Peter Thompson, and Ian Hoffman. 2014. "On-Bill Finance: From Policy to Promise to Practice." In *Proceedings of the ACEEE Summer Study on Energy Efficiency in Buildings*, 14. Pacific Grove, CA: American Council for an Energy-Efficient Economy.