Act 129 Statewide Evaluator

Annual Report

Program Year 3: June 1, 2011 – May 31, 2012

Presented to

PENNSYLVANIA PUC
PUBLIC UTILITY COMMISSION

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Prepared by the Statewide Evaluation Team of

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ENGINEERS AND CONSULTANTS

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Acknowledgements

The Statewide Evaluator (SWE) Team thanks the Energy Association of Pennsylvania, Pennsylvania's Electric Distribution Companies (EDCs), their Act 129 program staff and evaluation contractors, for their feedback and comments on site reports and audit findings incorporated into this SWE Annual Report, and for their review of the draft of this Annual Report. The SWE also thanks them for their timely provision of data and information, and for their many suggestions for improvements to the SWE Team's Act 129 auditing and reporting activities. The SWE Team anticipates that improvements will continue to be made and appreciates the ongoing support and responsiveness of the EDCs' staff and their evaluation contractors in that regard. The SWE Team recognizes the many hours that the EDCs' staff and contractors have devoted to the design and launch of the EDCs' Act 129 energy efficiency and demand reduction programs and to the monitoring of programs progress.

The SWE Team thanks the Staff of the Pennsylvania Public Utility Commission's Bureau of Technical Utility Services for their assistance and support in all aspects of the SWE Team's work since inception, including but not limited to updating the SWE Audit Plan and developing efficient processes for the review and approval of interim measure protocols for the Technical Reference Manual. The SWE Team appreciates the PUC Staff's provision of many constructive comments and recommendations on the draft of this Annual Report to improve its clarity and readability.

This SWE Program Year 3 Annual Report presents the findings, conclusions, and recommendations of the SWE only and, as such, are 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 at a later date in appropriate proceedings, such as the annual Technical Reference Manual update, Total Resource Cost Test Order update, and individual EDC Energy Efficiency and Conservation Plan revision proceedings.

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List of Acronyms

B/C Ratio: Benefit-Cost Ratio

C&I: Commercial and Industrial

CFL: Compact Fluorescent Light

CMP: Custom Measure Protocol

CPITD: Cumulative Program Inception To-Date

Cv: Coefficient of Variance

CSP: Conservation Service Provider

Commission: Pennsylvania Public Utility Commission

DEER: Database for Energy Efficient Resources

DLC: Direct Load Control

DR: Demand Response

DSM: Demand Side Management

EDC: Electric Distribution Company

EE: Energy Efficiency

EE&C: Energy Efficiency and Conservation

EER: Energy Efficient Ratio

EER: Energy Efficiency Resource

EFLH: Equivalent Full Load Hours

EISA: Energy Independence and Security Act

EM&V: Evaluation, Measurement and Verification

EMS: Energy Management System

EUL: End of Useful Life

GHSP: Ground Source Heat Pump

GNP: Government/Educational/Non-Profit

HOU: Hours of Use

IQ: Incremental Quarterly

kW: Kilowatt

kWh: Kilowatt-Hour

M&V: Measurement and Verification

MW: Megawatt

MWh: Megawatt-Hour

NP: Non-Profit

NPV: Net Present Value

NTG: Net-to-Gross

NTGR: Net-to-Gross Ratio

PA PUC, or PUC: Pennsylvania Public Utility Commission

PEG: Program Evaluation Group

PMRS: Program Management and Reporting System

PY: Program Year

PYTD: Program Year to Date

RR: Realization Rate

SAA: Symmetric Additive Adjustment

SEER: Seasonal Energy Efficiency Ratio

SEM: Simple Engineering Model

SSMVP: Site Specific M&V Plan

SWE: Statewide Evaluator

SWE Team: Statewide Evaluator Team

TOU: Time of Use

TRC: Total Resource Cost Test

HSPF: Heating Seasonal Performance Factor

HVAC: Heating, Ventilation, and Air Conditioning

IMP: Interim Measure Protocol

IPMVP: International Performance Measurement and Verification Protocol

TRM: Technical Reference Manual

TUS: Bureau of Technical Utility Services

VFD: Variable Frequency Drive

Please see Appendix I 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) with establishing an energy efficiency and conservation (EE&C) program. The seven Electric Distribution Companies (EDCs) subject to Act 129 include[1]: West Penn Power Company (West Penn or West Penn Power);[2] Duquesne Light Company (Duquesne); the FirstEnergy companies – Metropolitan Edison Company (Met-Ed), Pennsylvania Electric Company (Penelec), and Pennsylvania Power Company (Penn Power); PECO Energy Company (PECO), and PPL Electric Utilities (PPL). Stated below is the section of Act 129 that discusses the kWh and kW savings targets to be achieved by May 31, 2011 and by May 31, 2013:

> 66 Pa. C.S. §§ 2806.1 and 2806.2 – The EE&C program requires each Electric Distribution Company (EDC) with at least 100,000 customers to adopt a plan to reduce energy demand and consumption within its service territory. Each EDC, through its approved plan, is to reduce electric consumption by May 31, 2011, by at least 1% of its expected consumption for June 1, 2009 through May 31, 2010. By May 31, 2013, the total annual consumption is to be reduced by a minimum of 3% of its consumption for June 1, 2009 through May 31, 2010. Also, by May 31, 2013, each covered EDC's peak demand is to be reduced by a minimum of 4.5% of the EDC's annual system peak demand in the 100 hours of highest demand, measured against the EDC's peak demand during the period of June 1, 2007 through September 30, 2007.

In order to fulfill this obligation, on January 16, 2009, 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 or SWE Team) to evaluate the EDCs' EE&C programs. GDS Associates, partnered with Nexant and Mondre Energy, was retained as the PA SWE to fulfill requirements of the Implementation Order of Act 129. The SWE Team is contracted to monitor and verify EDC data collection, quality assurance processes and performance measures, by customer class. The SWE Team has other contractual obligations, including reviewing the Technical Reference Manual (TRM) information and savings values and developing recommendations for possible revisions and additions.

This report is the third annual report from the SWE to the PA PUC. This report provides detailed information on the findings of the SWE's Program Year Three (PY3) audit activities of the Act 129 EE&C programs implemented by seven EDCs in Pennsylvania. PY3 started June 1, 2011 and ended May 31, 2012. The PY3 evaluation includes:

- An analysis of plan and program impacts (demand and energy savings) and cost-effectiveness;
- A report of results, and recommendations for program and plan improvements;
- Recommendations for improvements to the TRM; and

[1] EDCs within the Commonwealth of Pennsylvania with over 100,000 customer are subject to the energy efficiency targets outlined in Act 129.
[2] While West Penn Power has since merged with the FirstEnergy companies, it will be referred to as a separate company for purposes of this Annual Report.

- Recommendations relating to changes proposed by some of the EDCs to their EE&C plans.

Contents of this report address:

- The status of programs;
- Discussion of the SWE'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;
- Quantitative findings and recommendations by program and EDC, including recommendations for the upgrade of the TRM,;
- A summary of findings and recommendations; and
- A List of Acronyms and a Glossary of Terms.

The following are findings and recommendations of program enhancements that should be considered by the EDCs[3]:

1. It is the SWE Team's recommendation in this Final Annual Report that the PY3 kWh and kW savings numbers provided in the EDC PY3 annual reports should be accepted by the Commission.
2. The SWE finds that the seven Pennsylvania EDC's (that are subject to the electricity savings requirements of Act 129) are making steady progress towards meeting the Phase 1 savings targets listed in Act 129.
3. The SWE finds that the overall Total Resource Cost Test benefit/cost ratio for the period covering the first three program years is 2.97 to 1. The net present value savings to Pennsylvania ratepayers is approximately $1.3 billion.
4. New focus and emphasis should be placed upon marketing of specialty CFL bulbs. Additionally, where not already underway, EDCs should develop materials to inform and educate customers about pending lighting changes resulting from the Energy Independence and Security Act regulations.
5. For EDCs that have waiting lists for non-residential programs, methods should be researched to improve non-residential waiting-list issues. EDC process evaluations have identified that these issues have caused customer confusion and dissatisfaction with non-residential energy efficiency programs.[4]

[3] These recommendations are based upon the SWE's review of EDC program evaluators' process evaluations as well as SWE observations gleaned from SWE audit activities. It is important to note that a key contractual responsibility of the SWE is to identify opportunities for program improvements.

[4] A waiting list for an energy efficiency program means that the program is accepting applications for rebates but no incentive funds are reserved or guaranteed. Waiting lists can be imposed for a variety of reasons, but budget constraints are the most common cause. Typically, once the program is released from waiting list status, rebates are awarded in the order that they were reserved.

6. High free ridership, participation in a program that would have occurred in the absence of the program, is a problem for some EDCs' home energy audit and efficient equipment programs. When high free ridership exists, EDCs should examine program requirements and practices to determine if free ridership can be reduced. However, rigorous screening for free ridership can reduce program participation and increase an EDC's chances of missing a gross savings compliance target, so it is important for EDCs to balance efforts to reduce free ridership without jeopardizing compliance targets.
7. During Program Year 4, the SWE Team will be contacting all of the EDCs to determine the implementation status of all of the process evaluation recommendations made by each EDC's evaluation contractor.

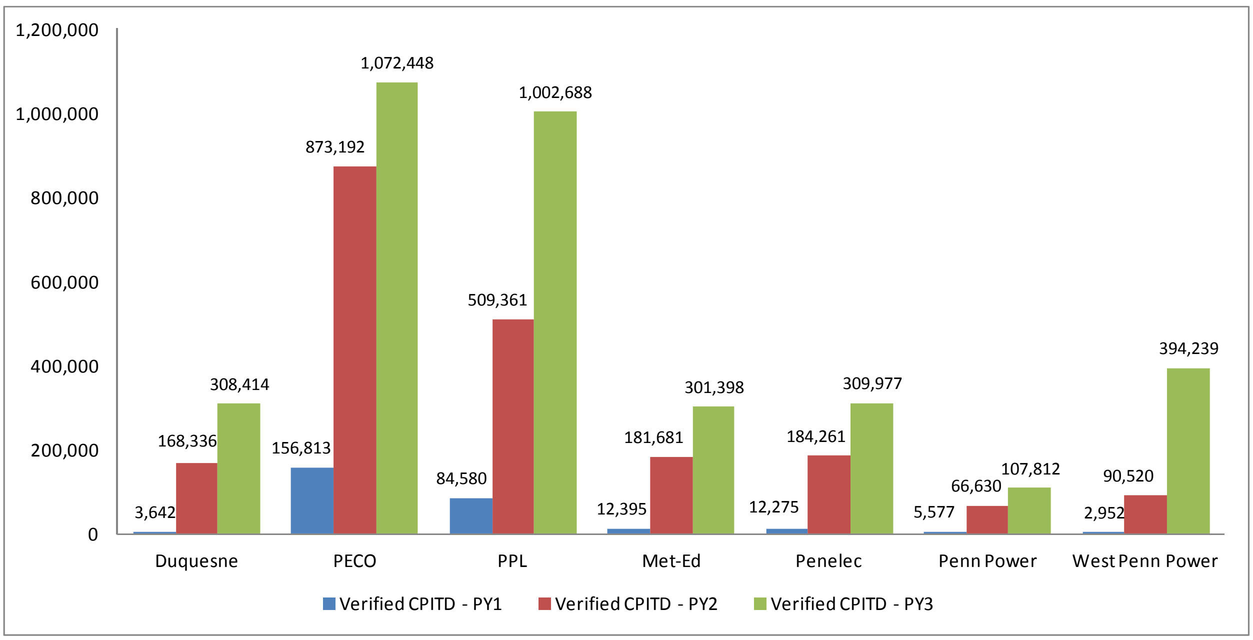
The SWE Team would like to thank all of the EDCs and the PA PUC Staff for providing their feedback and comments on draft versions of site-reports and audit findings, which have been incorporated into this SWE PY3 Annual Report. Their edits and recommendations have helped to clarify and improve this report. The SWE Team, the PA PUC Staff, the EDCs and the EDC evaluation, measurement and verification (EM&V) contractors (referenced in this report as Program Evaluators) have worked hard to develop a solid foundation for the EM&V of the Act 129 energy efficiency and demand reduction programs. The SWE anticipates that improvements will continue to be made to the SWE audit processes, and the SWE appreciates the support and responsiveness of the EDCs and their EM&V contractors.

As of May 31, 2012 (end of PY3), the seven EDCs have collectively saved 3,617,997 MWh and 540 MW.[5] These savings are attributable to 74 EE&C programs implemented by the seven EDCs. The SWE and the EDCs expect that the cumulative annual savings will only 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 towards reaching its 2013 savings targets as of the end of PY3 on May 31, 2012. Figure 1-1 shows the progress by program year that the EDCs have made in increasing their respective Cumulative Program Inception to Date (CPITD) verified energy savings.

Table 1-1: EDC Compliance Goal Progress as of the End of PY3[6] - Summary

% of Target Achieved	Statewide[7]	Duquesne	PECO	PPL	Met-Ed	Penelec	Penn Power	West Penn Power
% of 2013 Energy Savings Target	**79.5%**	73.0%	90.8%	87.5%	67.6%	71.8%	75.3%	62.8%
% of 2013 Demand Reduction Target	**42.0%**	30.2%	52.4%	48.4%	32.8%	35.2%	29.5%	29.9%

Figure 1-1: CPITD Verified Energy Savings by Program Year and EDC



5 Savings represent gross energy and demand savings achieved.

6 Percentage of compliance target achieved calculated using verified Cumulative Program Inception to Date (CPITD) values divided by compliance target value.

7 Statewide values are for illustration purposes only. There are no statewide targets under Act 129. These percentages were computed by dividing the sum of EDC verified CPITD values by the sum of EDC compliance target values.

In PY3, the SWE conducted an audit of the following general program categories and evaluations performed by the EDCs' EM&V contractors:

- Residential Programs:
  - Residential Energy Efficient Product Rebate Programs
  - Residential Lighting
  - Residential Appliance Recycling
  - Low-Income Energy Efficiency
- Non-Residential Programs:
  - Commercial Sector Programs
  - Government, Educational, Non-Profit Programs

Based upon PY3 audit findings and a review of the up-to-date impact evaluations, the SWE recommends the following:[8]

1. Actions should be considered by all EDCs to reduce free ridership, such as implementing a 90-day rebate eligibility clause for purchase of energy efficient equipment. There are many other ways to reduce free ridership as well and the SWE recommends that the EDCs look into which methods suit their individual programs.
2. Where not already underway, EDCs should consider creating new marketing/education material to increase awareness of lighting changes initiated by EISA 2007 and increase marketing of specialty CFL bulbs. Placing increased attention on specialty CFLs was suggested by stakeholders at their 2012 meeting with the EDCs.
3. EDCs should consider implementing a direct install program in order to improve realization of energy savings.

This SWE PY3 Annual Report submitted to the PA PUC is structured to provide the following:

- An analysis and assessment of each EDC's plan and program expenditures;
- An analysis of each EDC's protocol for M&V of energy savings attributable to its plan, in accordance with the Commission adopted TRM and custom measure protocols (CMPs);
- 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 best practices for energy efficiency programs;
- A review of Pennsylvania TRM information and savings values with suggestions for possible revisions and additions;
- A review of the TRC Test calculation procedures included in the Commission's TRC Orders with suggestions for possible revisions and additions; and
- A review of any proposed revisions and updates to EDC EE&C plans.

[8] These recommendations are based on SWE findings that are summarized in greater detail throughout this Annual Report.

This report also explains where, on a going forward basis, EDC procedures for calculating energy (kWh/yr) and demand (kW) savings need to be revised based upon the SWE audit findings, and summarizes the revisions needed to the next edition of the TRM in order to provide more accurate and reliable calculations of kWh/yr and kW savings.

2 Final Annual Report Summary

The following sections present a summary of the EDC program impacts and SWE activities completed to date.

2.1 Summary of Aggregated EDC Portfolio Savings

Table 2-1 presents the seven EDCs' aggregated cumulative program inception to date savings (CPITD[9]) reported gross MWh and MW impacts, and CPITD verified[10] gross MWh and MW impacts. The following table also includes estimates in the reduction of CO_2 emissions through the end of the fourth quarter for PY3 (PY3Q4) based on CPITD verified MWh savings. PY3Q4 ended on May 31, 2012.

Table 2-1: Summary of EDC CPITD Impacts – Through the End of PY3

	CPITD Reported Gross Impact[f]	CPITD Verified Impact[h]
Total Energy Savings (MWh/yr)	3,617,997	3,496,976
Total Demand Reduction (MW)	533.3	501.5
TRC Benefits ($1,000) [a]	Not Applicable[g]	$1,955,017
TRC Costs ($1,000) [b]	Not Applicable[g]	$658,416
TRC Benefit-Cost Ratio[c]	Not Applicable[g]	2.97
CO_2 Emissions Reduction (Tons) [d][e]	2,930,578	2,852,551

NOTES:

[a] 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. 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 TRC Order.

[d] 8.1x10-4 metric tons of CO_2 per kWh (EPC's eGRID2007 Version 1.1, RFCE Region annual non-baseload CO_2 output emissions rate, year 2005 data). This is included in this report per the approved SWE work plan.

[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] Defined as the gross energy savings that were reported during the period since date of program implementation through the current reporting period (i.e., reporting period of this report). CPITD = Cumulative Program Inception To-Date.

[g] TRC Benefits and Costs are calculated only for verified savings, which reflect actual program results.

[h] Defined as the energy savings that have been verified by the EDC EM&V contractors and audited by the SWE, and since the date of program implementation through the end of PY3.

9 PY3 ended on May 31, 2012. CPITD Reported Gross = CPITD Reported Gross Savings through PY2 + PYTD Reported Gross Savings. All savings reported as CPITD are reported this way.

10 CPITD verified = Sum of verified savings from PY1 through PY3.

2.2 Summary of Energy and Demand Reductions by EDC[11]

Table 2-2 contains a summary of the energy and demand reductions impacts on a CPITD basis for each EDC.[12]

Table 2-2: Summary of EDC Energy and Demand Reductions

	Statewide[13]	Duquesne	PECO	PPL	Met-Ed	Penelec	Penn Power	West Penn Power
CPITD Reported Gross[14] Energy Savings (MWh/yr)	**3,617,997**	315,998	1,096,933	1,036,103	322,878	334,582	115,559	395,944
CPITD Verified Gross[15] Energy Savings (MWh/yr)	**3,496,976**	308,414	1,072,448	1,002,688	301,398	309,977	107,812	394,239
% of 2013 Energy Savings Target Achieved	**79.5%**	73%	90.8%	87.5%	67.6%	71.8%	75.3%	62.8%
CPITD Reported Gross Demand Reduction (MW)	**539.7**	34	188	151	47	49	15	56
CPITD Verified Gross Demand Reduction (MW)	**500.8**	34	186	144	39	38	13	47
% of 2013 Demand Reduction Target	**42.0%**	30.2%	52.4%	48.4%	32.8%	35.2%	29.5%	29.9%

Cumulative Portfolio Energy Impacts

- The CPITD reported gross energy savings is 3,617,997 MWh/yr.
- The CPITD verified gross energy savings is 3,496,976 MWh/yr.

Portfolio Demand Reduction[16]

- The CPITD reported gross demand reduction is 539.7 MW.
- The CPITD verified gross demand reduction is 500.8 MW.

11 Act 129 establishes goals for "consumption reduction" and "demand reduction." In this Report, "energy savings" and "energy reduction" are used synonymously with "energy consumption," and "demand savings" is used synonymously with "demand reduction."

12 Note: The "Savings Achieved as a % of 2011 Targets" are based on CPITD Verified Gross savings. Thus, this achievement is subject to change pending results of final impact evaluation activities.

13 Statewide values are for illustration purposes only. There are no statewide targets under Act 129. These percentages were computed by dividing the sum of EDC verified Cumulative Program/Portfolio Inception to Date values by the sum of EDC compliance target values.

14 Gross savings represent change in energy consumption and/or demand that results directly from program-related actions taken by participants in an efficiency program, regardless of why they participated.

15 CPITD verified = Sum of verified savings from PY1 through PY3. Verified gross impact is calculated by applying the realization rate to reported gross impacts. Realization rate is a term used in several contexts in the development of reported program savings. The primary applications include the ratio of project tracking system savings data (e.g. initial estimates of project savings) to savings (a) adjusted for data errors and (b) that incorporate evaluated or verified results of the tracked savings.

16 Demand reduction to include both the demand savings from the installation of energy efficiency measures and the demand reduction associated with demand response programs.

Low-Income Sector

- The number of measures offered to the low-income sector comprises approximately 23.5% of the total number of measures offered through all programs which exceeds the compliance requirement of 7.4%.[17]
- The CPITD verified gross energy savings for low-income sector programs is 139,754 MWh/yr.

Government/ Educational/Non-Profit (GNP) Sector

- The CPITD reported gross energy savings for GNP programs are 473,805 MWh/yr. This is 13.1% of total portfolio reported savings.
- The CPITD verified gross energy savings for GNP programs are 436,777 MWh/yr. This is 12.5% of total portfolio verified savings.

PY3 Program Year portfolio highlights:

- The PYTD verified gross energy savings are 1,433,397 MWh/yr.
- The PYTD verified gross demand reduction is 196.0 MW.
- The PYTD reported participation is 1,940,207 participants.[18]

2.3 Statewide Evaluator Summary

Below is a summary of the activities undertaken by the SWE during PY3.

The SWE has reviewed the EDCs' respective Final Annual Reports for PY3 for completeness against the requirements of the SWE Audit Plan. The SWE reviewed the available CPITD reported gross impacts, CPITD verified gross impacts, and PYTD gross impacts for each EDC. The SWE audit activities and findings related to the savings reported in the EDCs' Final Annual Reports can be found in Sections 4 through 10 of this Annual Report.

A summary of the SWE findings includes the following.

1. At the end of PY3, 74 programs had been implemented and are generating savings across the state.
2. Approximately 26 additional programs are expected to be implemented and generate savings in PY4.
3. Progress towards 2013 MWh/yr savings targets ranges from 62.8% - 90.8%
4. Progress towards 2013 MW reduction targets ranges from 29.5% - 52.4[19]

[17] Compliance target is the fraction of the electric consumption of the utility's low-income households divided by the total electricity consumption in the EDC's territory

[18] Statewide participants are based upon the participant numbers reported by each EDC. Most EDCs excluded the number of CFL bulbs distributed from these numbers; other EDCs estimated the number of bulbs per participant and included that estimate in their totals.

[19] Please note that the majority of peak demand savings is expected to occur from demand response programs during 2012 summer period (June - September) and those will be reported in Program Year 4.

5. Key SWE activities during the PY3Q4 included the following:
    - Residential program desk audits;
    - Low-Income program desk audits;
    - Non-residential program desk audits and on-site inspections;
    - Participation in Program Evaluation Group (PEG) meetings;
    - Baseline study analyses for residential, commercial and industrial sectors; and
    - Analysis of statewide energy efficiency potential.

2.4 Summary of Findings and Recommendations

The SWE, the PUC TUS Staff, the EDCs and the EDC program evaluators have worked hard to develop a solid foundation for the evaluation, measurement and verification (EM&V) of the Act 129 EE&C programs. The SWE notes that improvements continue to be made to the SWE audit processes and appreciates the support and responsiveness of the Pennsylvania Energy Association, the EDCs and their program evaluators.

Based on the findings from the SWE audit activities conducted in PY3, the SWE makes the following recommendations to the PA PUC relating to the Act 129 energy efficiency and demand response programs.

1. It was found for several EDCs that Effective Full Load Hour (EFLH) values for measures in the commercial sector in the supporting project documentation submitted to the SWE were different than EFLH values in the 2011 TRM. The SWE recommends that the EDCs incorporate TRM assumptions and algorithms earlier in the implementation process by requiring use of the TRM Appendix C (Lighting Inventory Tool) and TRM Appendix D (Motor and Variable Frequency Drive Inventory Tool) during the rebate application process.
2. It was discovered in the review process that non-residential programs for PECO and the FirstEnergy companies have waiting lists for customers wishing to implement energy efficient measures. It is recommended that work be initiated to reduce these waiting lists, and thus increase the number of non-residential energy efficiency measures installed. The Commission may want to consider granting EDCs additional flexibility to reallocate budget between sectors to prevent this type of lost opportunity.
3. It is recommended that net-to-gross (NTG) analysis be conducted or modified for several of the programs reviewed. Specifically, the Duquesne Upstream Lighting program, the PECO Smart Lighting Discounts and PPL’s Residential Lighting program should be updated in Phase II of Act 129 so that they meet the Enhanced level of rigor as defined in the SWE Net-to-Gross Study Methods paper.
4. It is recommended that the FirstEnergy companies explore the feasibility of more clearly presenting avoided cost calculations at the measure level so that measure-specific effective useful life and participant cost values can be applied.

2.5 Recommendations from EDC Program Evaluator Process Evaluation Reports

The main purpose of this section of the report is to summarize findings and recommendations included in process evaluation reports completed by the EDCs' program evaluator that are working for each of the EDCs subject to the evaluation, measurement and verification requirements of Act 129. It is very important for the SWE and the EDCs to seriously consider the recommendations made in process evaluation reports and then decide if each recommendation should be implemented or not.[20] Implementing applicable recommendations can help improve the efficiency and cost-effectiveness of the EDCs' EE&C programs. During the first quarter of 2013, the SWE plans to follow up with all of the EDCs to determine the final status of each of these process evaluation recommendations. The SWE recognizes that some of these recommendations may have already been implemented, some recommendations may not be applicable after consideration, and some recommendations may be awaiting further action by EDCs. The final disposition for a recommendation has been listed in this report where EDCs have provided information to the SWE on the status of a recommendation. The SWE plans to issue a report by April 1, 2013 that provides an update on the final status of all of the process evaluation recommendations made by each of the EDC program evaluators.

The SWE also conducted a thorough literature search to obtain up-to-date information on best practices for the design and delivery of energy-efficiency programs. Summaries of the studies reviewed are provided in Appendix D of this report.

Table 2-3 provides a sample of the recommendations of the EDC program evaluators on a program level basis. The SWE believes these recommendations deserve serious consideration and provide opportunities across all EDCs for continuous improvement of their EE&C programs. The disposition of each recommendation is also provided where such information was provided by the EDCs to the SWE.

[20] The revised SWE contract (executed in January 2012) with the PA PUC states on page 30 that "This contractor shall also evaluate each EDC plan results on an annual basis and the entire energy efficiency and conservation programs as a whole in 2013. This evaluation will include an analysis of plan and program impacts (demand and energy savings) and cost-effectiveness, report results and provide recommendations for plan and program achievements."

Table 2-3: Summary of EDC Evaluations

No.	Category	EDC	Recommendation
1	Appliance Turn-In	FE[21]	Reinstate the $35 incentive offering for refrigerators and freezers. When asked to identify the primary reason for their participation, nearly 60% of participants said that the reason they participated in the program was the incentive level. However, the differences between the influence of the different levels of rebates offered between calendar year 2010 and 2011 ($35 and $50, respectively) for refrigerators and freezers are negligible. This finding suggests that the change in incentive level has a minimal effect on a participant's decision to recycle an appliance through the program. Furthermore, when asked whether they would have participated in the program had the incentive level been lower, over three quarters of survey respondents confirmed they would have participated for a lower incentive. **Disposition**: FirstEnergy rejected this recommendation due to potential reductions in participation since up to one quarter of the respondent participants did not indicate they would participate for a lower incentive.
2	Appliance Turn-In	FE	Do not move ahead with a program referral incentive. Program staff indicated they were interested in exploring the possibility of offering cash incentives for referrals. Surveyed participants were receptive to this idea. Over 83% indicated they would be very likely to recommend the program to others for a cash incentive, providing a rating of eight or higher on a zero to ten point scale. However, participants were also asked to indicate whether they had recommended the program to others and whether they would consider doing so in the future. Of those surveyed, 72% of respondents indicated that they had already recommended the program to others and approximately 98% indicated that they would be willing to recommend the program in the future. **Disposition**: Given this information, it is unlikely that an incentivized referral mechanism would greatly benefit the program. FirstEnergy explored this during program development and accepted the recommendation to not move ahead with a program referral incentive concluding that a referral incentive would increase costs without substantial benefits.
3	Custom	PPL	PPL should consider requiring a customer to submit an application for a custom project before that project is installed. **Disposition**: PPL rejected this recommendation. PPL believes that retroactive eligibility is permitted in Act 129 to June 1, 2009 and was approved by the PUC in PPL's EE&C Plan. Regardless, a customer who completed a project before applying for the rebate is not necessarily a free-rider in PPL's view. The customer may have been aware of the EDC's rebate and that rebate influenced the customer's decision, regardless of when the customer completes or submits the application.

21 FirstEnergy companies.

No.	Category	EDC	Recommendation
4	Efficient Equipment	FE	Limit the eligibility period after installation to 90 days. Thirty-two percent of the appliance participants overall reported that they had already purchased the equipment before they were aware of the rebate, indicating a high level of free-riders. Currently, the program does not designate a time frame in which participants must submit applications after installation (the current application mentioned the potential for rebates for equipment purchased prior to 2012). Now that the program has been operating for two years, shortening that time frame will reduce the number of participants that install program-eligible equipment and then later find they are eligible for a rebate. As the rebate did not affect the decision to purchase energy efficient equipment for these participants, limiting their participation will increase the overall cost-effectiveness of the program. **Disposition**: : FirstEnergy rejected this recommendation given its conflict with compliance objectives, and reasons similar to those stated above for PPL (i.e., retroactive eligibility is permitted in Act 129, the participant is not necessarily a free-rider as participant may have been aware of the EDC's rebate, and that rebate influenced the participant's decision).
5	Efficient Equipment	PECO	PECO is strongly urged to decide what will happen to qualified projects on the wait list. The evaluation team recommends that program staff develop an action plan to manage the wait list. Once PECO has developed a wait list action plan, PECO should increase outreach efforts and reactivate the communication with both customers and contractors about the wait list and the process going forward. PECO needs to improve communication about the wait list, and the evaluation team recommends that PECO develop a portfolio of informational material that includes an explanation of how the wait list works, what is going to happen with the projects that are in the wait list and a timeline for program activity related to wait-listed projects. **Disposition**: PECO has accepted this recommendation
6	Home Audit	FE	Consider cost-effective strategies to offset a portion of the $50 co-pay to encourage participation in the program. One idea would be to eliminate or reduce the co-pay amount based upon installation of minimum number of upgrade opportunities. The program might also consider offering a mail-in rebate to offset the $50 co-pay based upon installation of a minimum number of upgrade opportunities. Another option might be to offer to install more measures to provide greater value to the participant. First Energy would need to evaluate the cost-effectiveness of any of these or other strategies. **Disposition:** FirstEnergy has worked with its program implementer to increase savings and participation levels in this program, including reduction of the$50 co-pay.
7	Home Audit	FE	Conduct additional research to assess the extent of free ridership and spillover. Additional quantitative research to quantitatively evaluate free ridership and spillover rates should be conducted to inform program design improvements and program planning. **Disposition**: FirstEnergy accepted this recommendation. This research was completed in PY3 and the results were delivered to the PUC's TUS staff and the SWE.

No.	Category	EDC	Recommendation
8	Home Audit	FE	Explore additional strategies to more fully leverage contractor relationships in customer recruitment efforts. Along with its own customer outreach efforts, the program should also explore ways to stimulate contractor promotion of the program to encourage broader participation. One idea would be to expand cooperative marketing efforts with participating contractors, such as encouraging more contractors to put links or information about the program on their company's website. Another possibility is offering a financial incentive program to participating contractors based on the number of projects they bring in and the performance of those projects. FirstEnergy might also consider offering incentives to other HVAC and insulation contractors not enrolled in the program for referring customers to the Whole-House Audit program or participating whole-house contractors. A similar strategy was implemented by Wisconsin's Focus on Energy for its Home Performance with ENERGY STAR® program, which is similar to the Whole-House Audit program in its design. **Disposition**: FirstEnergy rejected in part, and accepted in part this recommendation. FirstEnergy is working with its program implementer to assess cost-effective implementation of expanding participation, and it rejected referral incentives for contractors that have not enrolled in the program.
9	HVAC/Audit	FE	For the PY3 evaluation effort, incorporate a quantitative contractor survey (also known as an influential vendor survey) that assesses the level of influence the program has over contractors. The preliminary attribution estimate yielded an attribution rate of 28% overall. However, it is important to note that this attribution does not quantitatively assess the extent to which the program has influenced contractors. This self-report methodology considers only the participant's perspective and does not take into account the likelihood that the participant is unaware that his/her contractor is promoting these technologies because of the program. Implementing a quantitative contractor survey will make it possible to develop a more complete assessment of the program's influence and support more accurate attribution analyses. The contractor survey will also identify whether program offerings should be revisited and revised based on their standard practices. **Disposition**: The Company (FirstEnergy) and its Program Evaluator acted on this recommendation in PY3 and will do the same in PY4. The Program Evaluator completed a formal net-to-gross assessment using customer self-report data for PY3, which was delivered to the SWE in November 2012. The Program Evaluator planned to use the participant data, as well as qualitative trade ally results completed on PY3, to develop a quantitative net-to-gross survey guide targeted to contractors. The Program Evaluator plans to implement contractor interviews using PY4 data at the time when West Penn Power's net-to-gross studies are complete.
10	Lighting	PPL	As EISA is phased in, ramp up customer education about EISA and energy-efficient light bulb choices through the ePower Website, manufacturer and retailer partners, and CFL give-away events. **Disposition**: PPL agrees. In fact, PPL currently educates its customers about EISA, efficient light bulb

No.	Category	EDC	Recommendation
			choices, and the Lighting Facts labeling, and the company plans to continue this education. PPL developed a brochure "The Next Generation of Lighting" that was issued to customers and is posted on PPL's ePower (energy efficiency) web site. PPL's residential lighting CSP has field personnel on hand at community and retail events to educate customers about EISA, Lighting Facts labeling, and efficient light bulb products.
11	Lighting	PPL	Continue educating customers about and providing incentives for specialty CFLs. **Disposition**: PPL agrees. PPL's residential lighting program currently offers discounts for specialty CFLs and PPL will continue those discounts.
12	Lighting	PECO	Focus education and marketing efforts on the wide variety of specialty CFLs that are available: Both the process evaluation and the market assessment indicate that a next generation of program marketing is warranted, moving from basic awareness of CFLs to a focus on the availability of specialty CFLs and their applicability. PECO customers are very familiar with standard CFLs, as indicated by the findings from the general population survey. Since the PECO program has switched to a "Stay in Market" strategy and is now providing discounts on specialty CFLs, PECO should now develop a marketing campaign around the uses of these specialty CFLs. **Disposition**: PECO has accepted this recommendation.
13	Lighting	DQE	In its 2011 process evaluation of Duquesne's residential lighting program, Navigant determined that "ECOVA, Duquesne's Upstream Lighting program administrator (for the Duquesne residential lighting program), provides detailed documentation to Duquesne Light along with its invoices, which allows the utility to report savings into its tracking system (PMRS). However, at that time, information on the "measure" purchased was based on manufacturer product names and most manufacturers identify their CFL products in terms of their incandescent equivalents. This means that the Residential Coordinator could only estimate the actual wattage of the CFLs sold. Navigant recommended in its process evaluation that Duquesne should require that its program administrator provide the actual wattage of the CFLs sold in each product category (SKU), so that checks on the accuracy of reported savings can be made on an ongoing basis. **Disposition**: Duquesne agrees with the recommendation and is in the process of implementing it with ECOVA.
14	Low-Income	FE	Reinforce to auditors that measures should be directly installed and not simply left behind. Although, per the Pennsylvania TRM, savings can be claimed for measures received regardless of installation, it is within this program's design and directives that the measures be directly installed. The survey data indicates this is not happening consistently, although most notably with CFLs than water saving measures. Should this programmatic element continue to be a component of program design, we recommend communication with auditors to reinforce the requirement that measures be directly installed. **Disposition**: FE agrees with this recommendation and has stressed the importance of direct installation on various occasions with contractors. FE is continuing to monitor this issue thru its third party contractor.

No.	Category	EDC	Recommendation
15	Rates	FE	Provide customers with near-immediate feedback on energy savings after an event. Benchmarking data and information indicates that programs that provide immediate, or regular, feedback on performance throughout the program reap higher savings. Providing real-time feedback can lead to greater savings - several pilots found 2-4% more savings from real-time feedback compared to other interventions such as energy-savings advice and more frequent, enhanced bills. Additionally, a lack of feedback can lead to passive un-enrollment, or customers remaining enrolled in the program but who take no action to reduce usage when called upon to do so. **Disposition**: FirstEnergy rejected this recommendation for Phase I, as the program ended operations on September 30, 2012 and has no plans in place for future operations. The Company did provide regular feedback to program participants both through a web portal and on their electric bill. This recommendation is significant in scope and costs, but may be considered in any future programs.

3 Statewide Evaluator Audit Activities

In its audit activities, the SWE reviews with each EDC its current program implementation and evaluation activities. The SWE holds bi-weekly teleconferences with each EDC to discuss current and planned M&V activities, to schedule upcoming site-visits and audit activities, and to address any questions or unresolved issues that may arise throughout the evaluation process. During PY3, SWE members traveled to each EDC and to specific project sites to conduct on-site audits of the various programs implemented in PY3. Additionally, the SWE is in the process of conducting desktop audits for various programs. This section summarizes PY3 and current SWE audit activities.

3.1 Audit Activities

This section summarizes SWE audit activities by program type. The findings from the SWE audit of each EDC's respective lighting program are presented in Sections 4 through 10.

3.1.1 Residential Programs

3.1.1.1 Residential Lighting Programs

Residential lighting programs generally involve:

- the buy-down cost of CFLs;
- CFLs distributed via a give-away program; or
- the offer of rebates for the purchase of CFLs.

All of the eligible measures for these programs have deemed savings values. The SWE reviewed the program databases to verify the accuracy of a sample of measures rebated against invoices, verified total measure counts as reported in the EDCs' respective annual reports, and verified measures savings assumptions per TRM deemed savings values. No on-site inspections were conducted, as the lighting programs are primarily upstream programs. Thus actual customer accounts cannot be associated with the bulbs purchased. Additionally, the savings algorithm inputs used to estimate CFL savings, including installation rates, are stipulated in the TRM.

3.1.1.2 Appliance Recycling Programs

The appliance recycling programs include those programs for which JACO, the CSP for all EDCs' appliance recycling programs, removes older, inefficient appliances from the home. JACO 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 reviews the program databases to verify the accuracy of a sample of measures rebated against JACO contractor invoices, verified total measure counts as reported in the annual report, and verified measures savings assumptions per TRM deemed savings values. The SWE did not conduct site-visit verification of the measures recycled under this program.

3.1.1.3 Energy Efficient Products Programs

Energy efficiency products programs include programs which offer rebates for ENERGY STAR® or high efficiency appliances. All of the eligible measures for these programs have deemed savings values. The

SWE reviewed the program databases to verify the accuracy of a sample of measures rebated against rebate applications, verified total measure counts as reported in the annual report, and verified measure savings assumptions per TRM deemed savings values. The SWE did not conduct site-visit verification of the measures purchased under this program, as this type of program is a straightforward rebate program.

3.1.1.4 New Construction Programs

Only Met-Ed, Penelec, and Penn Power had active residential new construction programs in PY3. These programs contributed 1.04%, 0.56%, and 2.20% to total PY3 portfolio verified gross savings, respectively. The SWE performs a desktop audit on these programs on an annual basis rather than quarterly basis, as total portfolio impacts are relatively small.

The SWE selected a representative sample of homes from each EDC evaluator's sample to conduct its desktop audit. The SWE selected homes representing a variety of the builders that received incentives through new construction programs. The SWE desktop audit process involved multiple steps: REM/Rate™[22] verification; demand savings verification; appliance and lighting savings verification; and construction verification. In general, the SWE checked for consistency with TRM standards in the baseline model, checked for proper calculation and accuracy of REM/Rate™ results, checked for proper usage of TRM algorithms, and checked for proof of completed construction through builder certificates and on-site photographs taken by the EDCs' program evaluators.

The REM/Rate™ verification step required the review of all modeling inputs and results for the selected SWE sample of homes. Per the TRM, REM/Rate™ is used to estimate energy savings results for weather-sensitive measures (e.g., HVAC equipment upgrades, insulation upgrades).

Demand savings verification involved checking that the algorithm provided in the TRM for estimating demand savings was being used and applied correctly.

Appliance and lighting savings verification involved checking that the methodology used by the EDC evaluator to estimate the appliance and lighting savings conformed to the TRM algorithms for high efficiency lighting and appliances.

Construction verification involved review of builder certificates, unique premise ID numbers, and program evaluator's on-site photographs to confirm completed construction of the homes.

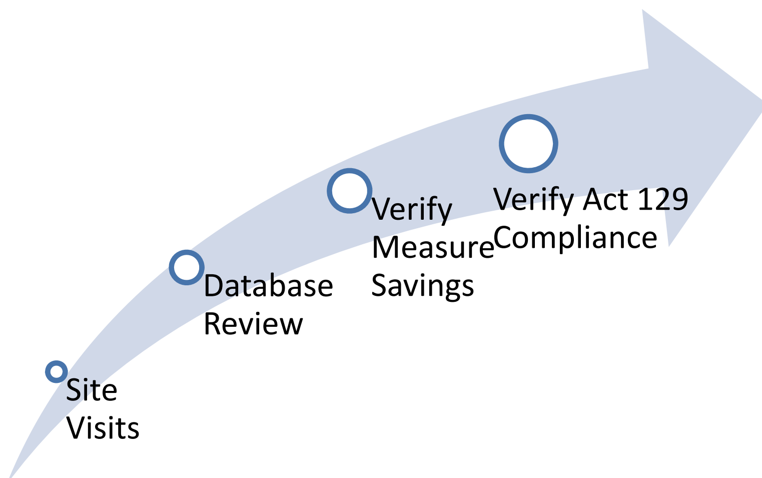
[22] REM/Rate™ is a software product that can compare a newly constructed or retrofit home to a baseline home and estimate savings from installed energy efficiency measures. REM/Rate™ was used by the program implementer for Met-Ed, Penelec, and Penn Power to determine if homes qualified for incentives under the residential new construction programs.

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."[23] During PY3, the SWE conducted various audit activities to ensure that reported low-income energy efficiency measures were being installed, savings impacts were being calculated and reported appropriately, and that EDCs were in compliance with the Act 129 low-income proportion of measures requirement.

The SWE's low-income programs audit process is organized into four steps, as is shown in Figure 3-1 SWE Low-Income Programs Audit Process

Figure 3-1 SWE Low-Income Programs Audit Process



In the first audit step, the SWE either conducts site inspections of low-income installations or reviews the site inspection reports of the EDCs' program evaluators. The purposes of the site inspections are to confirm that measures are installed, third-party inspection contractors are correctly collecting information on space heating and domestic hot water fuel type (when necessary), measures are being invoiced correctly, and whether inspectors are looking for missed opportunities.

During prior program years, the SWE aimed to conduct ten site inspections of low-income installations per quarter per EDC. However, toward the end of PY2, the SWE became aware that a number of the EDCs already conduct a large number of low-income site inspections. Sample site inspection reports were requested from those EDCs to determine whether the reports provided installation information sufficient for the SWE's auditing requirements. The SWE subsequently issued a guidance memo stating that EDCs could submit a SWE-selected sample of ten site inspection reports per quarter for a desktop review in lieu of the SWE conducting additional site inspections. The goal was to obtain valuable site inspection information while making the most efficient use of resources. The guidance memo also extended the opportunity to EDCs that did not already conduct a sufficient number of site inspections of low-income installations to do so going forward, provided a third-party inspector conducted the

[23] 66 Pa.C.S. §2806.1(b)(i)(G).

inspections. In addition to efficiency gains, this change in site inspection practices alleviated EDCs' concerns associated with recruiting and scheduling participants for site inspections over the course of a couple of days. For any EDC not exercising the option to conduct the site inspections, the SWE continued to complete ten site inspections per quarter.

Based on its site inspections, the SWE provided feedback to the EDCs if there were consistent issues of missing measures, poor quality of work, or inappropriate use of measures, such as water heating measures being distributed to non-electric hot water heating customers.

The second step in the SWE audit process is to compare the site inspection findings with the corresponding database records. EDC program database extracts were reviewed to confirm that invoice records and site inspection findings were consistent with the database records in order to ensure that installed measures are being reported properly. In addition, some of the EDCs have Act 129 weatherization programs that are extensions of their existing LIURP programs. The measurement and verification of energy and demand savings of those programs involves a statistical billing analysis. The billing analysis is conducted at the job type level. In reviewing the site inspection reports, the SWE confirmed that the reports classified participants in accordance with the EDCs' job type classifications used in the billing analysis, and that the database records contained accurate job type assignments.

The third step in the SWE audit process involves the verification of low-income measures' energy and demand savings. This step involves a review of calculations of savings at the measures level for all installed measures subject to site inspections, and a sample of installed measures per the database records but not subject to site inspections. Correct use of, and results from, the 2011 TRM algorithms were checked for where deemed measure savings were involved. If any discrepancies were found, the SWE discussed with the EDC for resolution. At the conclusion of the program year, the SWE verified that any adjustments to the reported data for deemed measures were in accordance with the 2011 TRM.

The final step in the SWE audit was to determine whether each EDC achieved its specific Act 129 requirements for the number of low-income measures offered. The SWE verified the reported proportion of low-income measures in PY3 by requesting measure lists from the EDCs. In its review, the SWE also verified that the per-participant and per-measure savings and counts were consistent with the program energy and demand savings reported in the EDC annual reports.

Table 3-1 shows each EDC's minimum percentage of measures target and the percentage of measures offered in PY3. Every EDC is in compliance with the Act 129 low-income requirements.

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

	Percentage of Low-Income Measures Requirement	Percentage of Low-Income Measures Offered in PY3
Duquesne	7.88%	38.57%
PECO	8.05%	13.71%
PPL	8.64%	36.99%
Met Ed	7.84%	17.07%
Penelec	9.51%	17.07%
Penn Power	8.16%	17.07%
West Penn Power	8.50%	23.81%

In 2010, the Act 129 Low-Income Working Group ("the Working Group") directed that "on a quarterly basis, EDCs must report actual energy reductions from each customer sector, including the low-income sector, and each sector's proportion of the total energy reductions."[24] Therefore, EDCs must estimate low-income participation in their other Act 129 programs in order to help gauge how the Act 129 programs in aggregate are reaching the low-income sector. Subsequently, it was found that some of the EDCs were not providing conforming reports. Therefore, the SWE issued a guidance memo in September 2012 reaffirming that all EDCs should estimate and report low-income savings from their other Act 129 programs in their annual reports. Also, to avoid confusion as to cost assignment and allocation, the SWE directed the EDCs to estimate and report the costs associated with low-income participation in non-low-income programs. Per the guidance memo, the EDCs are to report energy and demand savings and corresponding costs in their PY4 annual reports.

3.1.3 Non-Residential Programs

The SWE performed a number of audit activities in PY3 to confirm the accuracy of the gross reported (*ex ante*) and gross verified (*ex post*) savings values reported by the EDCs.

- The SWE conducted desk reviews of project files to verify that 2011 TRM algorithms and values were used in the reported savings calculations. The savings impacts in the supporting documentation were also compared to the program tracking data to confirm that project impacts were being stored correctly in the system of record.
- The SWE compared program tracking data to quarterly and annual reports to verify accurate reporting of *ex ante* impacts.
- The SWE reviewed and approved sample designs submitted by the EDCs' Program Evaluators.
- The SWE audited the M&V approaches used by the EDCs' Program Evaluators to determine verified savings estimates for sampled projects.

[24] Report of the Act 129 Working Group. March 19, 2010. Docket No. 2009-2146801.

- The SWE performed ride-along and independent site inspections.
- The SWE verified the realization rates, coefficient of variation/error ratio and relative precision values presented in EDC annual reports.

3.1.3.1 Site Inspections

The SWE conducted a total of 40 site inspections of non-residential project installations in PY3. The SWE performed both "ride-along inspections" and "independent inspections," in a 5:1 ratio targeted for PY3, and as summarized in Table 3-2.

Table 3-2: Summary of Commercial and Industrial Site Inspections

EDC	Ride-Along Inspections	Independent Inspections	Total Inspections
Duquesne	7	2	9
PECO	7	1	8
PPL	11	3	14
FirstEnergy	8	1	9
Total	33	7	40

In the ride-along inspections, the SWE accompanies the EDC Program Evaluators to assess performance of the evaluation activities. The SWE selects a subset of the EDC Program Evaluators' selected projects for site inspections for the ride-along inspections; the SWE selection is based on measure diversity or high impact projects. Ride-along inspections are valuable because the interaction between the SWE auditor and the EDC Program Evaluators has proven to be constructive. SWE suggestions and corrective actions can be immediately incorporated by the EDC Program Evaluators into their audit practices for all of their inspected project audits going forward. Similarly, any questions that the SWE auditor would have for the EDC Program Evaluators can be answered quickly and efficiently.

Following the ride-along site inspections, the SWE issued site inspection reports (SIRs) to the EDCs and the EDC Program Evaluators. The reports included site visit findings, a review of the EDC Program Evaluator's analysis, and, if necessary, recommendations for the EDC Program Evaluator, EDC and/or SWE action items. The EDC Program Evaluator reviews the SIRs and provides feedback to the SWE. When necessary, the EDC Program Evaluators revise their savings calculations and the SWE subsequently revises the SIRs to reflect the changes. In many cases, SWE SIRs result in both quantitative and qualitative modifications to evaluation procedures, ensuring that impacts reported by EDCs are in compliance with statewide standards.

In the independent site inspections, the SWE audits projects without EDC Program Evaluator present. The SWE selects high impact projects to audit. The independent inspections provide a check against potential audit bias, which might occur if the SWE's presence on the ride-along inspections influences the findings of the EDC Program Evaluators. The SWE then submits its independent SIR to the EDC containing observations on the project's performance, energy and/or demand savings estimates for comparison to the EDC's claimed or reported savings. The report also could include recommended changes to evaluation practices.

The projects inspected included a variety of deemed and custom measures. In PY3, the SWE identified 44 findings from the 40 site inspections, which are summarized in Appendix G of this Annual Report. The findings summarized are categorized as follows:

- **Evaluation** findings are associated with ride-along site inspections, and may reflect site activities or evaluator savings calculations and/or reports.
- **Process** findings are associated with project applications, documents, or implementation activities.
- **TRM** findings are associated with TRM protocols or TRM stipulated values, often stemming from differences in interpreting TRM protocols. This category may also include findings that lead to recommendations for updates to existing TRM protocols.

The SWE believes that the site inspection process continues to be instrumental in resolving evaluation issues and establishing standard evaluation protocols among the EDCs. Where issues were identified in PY3 through site inspections, EDC Program Evaluators were receptive to feedback and willing to update their evaluation procedures and findings accordingly. In several cases, savings calculations were adjusted to account for SWE feedback through interactive discussions between the SWE and the EDC Program Evaluators.

The site inspection process continues to result in annual progress toward realization rate consistency between the SWE and the EDC Program Evaluators. SWE independent site inspections have resulted in realization rates similar to reported realization rates by the EDC Program Evaluators. This correspondence leads the SWE to believe that EDCs are adequately performing verification activities for those sites where the SWE does not have the direct ability to review annual energy savings and demand reduction calculations.

Resolution of the findings regarding Non-Residential Programs typically involves action taken by the SWE and/or the EDC Program Evaluators to improve the accuracy of the project savings calculations or to adjust evaluation practices going forward. For the TRM-related findings, the resolutions involve identifying potential TRM improvements or indicating that relevant revisions have been made in the 2012 or 2013 TRMs.

The most common evaluation findings included:

- Improper representation of baseline (7[25]);
- Analysis inconsistent with customer reported information and/or site visit findings (6);

[25] Numbers for each finding indicates number of occurrences. Specific findings and resolutions are discussed in Appendix G.

- Did not provide sufficient evidence to deviate from TRM protocols (2); and
- Insufficient M&V for large lighting project (1)

The process findings included:

- Implementer project documentation and/or calculation error (13);
- Insufficient project documentation (2); and
- Inappropriate building type selected to determine lighting EFLH (2)

The TRM findings included:

- TRM Tables 3-2 and 3-5, which provide lighting operating hours for various usage groups and building types, lacked suitable choices, clarity with regard to how usage groups can be applied, or the hours-of-use (HOU) listed were significantly different than those established during site inspections (6);
- TRM Table 3-15, which provides operating hours for motors in various building types, lacked suitable choices (1).

3.2 Program Evaluation Group Meetings

The Program Evaluation Group (PEG) meetings are attended by representatives from the following:

- Technical Utility Services (TUS) Staff;
- SWE;
- EDCs;
- EDC Program Evaluators; and
- Pennsylvania Energy Association.

The SWE held the following PEG meetings during PY3:

- August 9, 2011
- September 1, 2011
- October 11, 2011
- November 16, 2011
- December 13, 2011
- January 18, 2012
- February 15, 2012
- March 20, 2012
- April 19, 2012
- May 23, 2012

The focus of each PEG meeting varied depending on the interests and needs of the parties in attendance. The following topics were discussed at one or more PEG meetings:

- Updates to the Technical Reference Manual
  - Updating deemed savings values for Appliance Recycling measures,
  - Fuel switching measures
  - NTG issues

  - Lighting and Appendix C (Lighting Inventory Tool)
  - Motors, VFDs and Appendix D (Motor and Variable Frequency Drive Inventory Tool)
  - ENERGY STAR® Appliances
  - Residential measures in commercial applications, and
  - Ground Source Heat Pumps;
- Highlights from the July 28, 2011 TRC Order;
- Discussion of the SWE's quarterly data request to the EDCs;
- Demand Response Study
  - Discussion of demand response audit activities for the summer of 2011
  - Discussion of how to determine savings for demand response programs;
- Residential, Commercial and Industrial Baseline Studies
- Methodology for the Statewide Energy Efficiency Potential Study, including methodology for program potential scenarios;
- Net-to-Gross (NTG) issues and NTG white paper;
- Audit activity findings and updates;
- Quarterly and annual reporting template;
- Act 129 Phase II planning issues;
- Act 129 Tentative Implementation Order;
- 2012 TRC Order;
- EDC EE&C Plan filings; and
- One-tailed versus two tailed test.

3.3 EDC Meetings

The SWE held bi-weekly teleconferences with each of the EDCs during PY3 to discuss ongoing and/or emerging issues. Some of the topics discussed during these bi-weekly teleconferences included:

- Baseline study updates, including baseline issues relating to residential and commercial lighting and other energy efficiency measures;
- Market potential study updates;
- Evaluation activities updates;
- C&I site-visit scheduling issues
- Program data questions;
- Refrigerator/Freezer Recycling savings protocols;
- CFL average daily hours of use (HOU);
- Reporting issues;
- PEG agendas;
- Interim measures and deemed savings value;
- Sample sizes for statistically significant evaluations by program type and projected impact;
- TRC Test calculations and assumptions;
- Demand response programs and audit activities;
- NTG studies and results;
- Process evaluation findings;
- Methodology to be used for the statewide energy efficiency potential study;
- Development of random samples for the SWE residential and commercial baseline studies;
- Analysis and results from statewide baseline study; and
- Analysis and results from statewide energy efficiency potential study.

3.4 Status of TRM Update

In accordance with previous Commission Orders, the TRM was updated for PY1 of Phase II, effective June 1, 2013 to May 31, 2014 (2013 TRM). The focus for this TRM update was on a list of high priority measures that was developed through the PEG. The 2013 TRM Final Order (with manual and appendices) was approved at the Public Meeting held on December 20, 2012.

General updates found in the 2013 TRM include, but are not limited to:

- Clarification of Coincident Peak Window used to determine the annual electric energy and electric coincident peak demand savings;
- Clarification of the applicability of Residential and C&I Protocols for Multifamily Housing;
- Correction of Measure Lives in TRM Appendix A; and
- Clarification of definition of Custom Measure Protocols in TRM Appendix B.

Updates in the 2013 TRM pertaining to residential measures include, but are not limited to:

- Updates to the heating, ventilation and air conditioning (HVAC) equivalent full load hours (EFLH) for various protocols based on REM/Rate™ modeling for all HVAC end use measures, addition of a proper sizing algorithm for cooling equipment;
- Clarification of lighting protocols regarding the hours of use (HOU) of compact fluorescent light bulbs (CFL), updates to the algorithms for ENERGY STAR® lighting, and clarification regarding the implementation of federal legislation and regulations;
- Clarifications to the ENERGY STAR® appliances protocols, including new protocols for each appliance, updates to the baseline assumptions for appliances, inclusion of new and future standards for relevant appliances;
- Updates to the deemed savings for refrigerator and freezer replacement and recycling using the Uniform Methods Project (UMP) regression equation to develop a unit energy consumption (UEC) for refrigerators and freezers;
- Updates to the daily hot water usage assumption for all hot water end use measures based on recent studies and evaluations results;
- Updates to low flow showerheads and low flow faucet aerators assumptions, addition of granularity to distinguish between single-family and multifamily savings estimates;
- Clarifications to the residential new construction savings protocols;
- Clarification of the sources used for furnace whistle savings estimation;
- Removal of evaluation protocols for heat pump water heaters;
- Clarification of the programmable thermostat protocols;
- Clarification of solar water heaters protocols peak demand savings estimates;
- Clarification of electric water heater pipe insulation savings estimates;
- Update of fuel switching: electric heat to gas heat baseline efficiency standards;
- Update of ENERGY STAR® televisions protocol;
- Modification of the LED nightlight algorithm to be consistent with other residential lighting protocols;

- Modification and discussion of Residential Occupancy Sensors protocol; and
- Clarification of Holiday Lights terms

Updates in the 2013 TRM pertaining to non-residential measures include, but are not limited to:

- Clarification of lighting protocols regarding the HOU and coincidence factors (CF), building types, control technologies and savings factors, implementation of federal legislation and regulations, new construction calculator, and temperature ranges for interactive factor values (accordingly, the TRM appendices have been updated);
- Clarification of HVAC protocols regarding EFLH;
- Clarification of motor and variable frequency drive (VFD) protocols regarding energy savings and demand savings factors, as well as operating hours;
- Clarification of office equipment network power management systems protocols regarding deemed savings values;
- Clarification of light-emitting diode (LED) channel signage protocol regarding savings algorithm, and assumptions table;
- Clarification of refrigeration protocols regarding EFLH;
- Clarification of low flow pre-rinse sprayers protocol regarding minimum code requirement for time of sale/retail program type;
- Clarification of refrigeration evaporator fan controllers protocol regarding savings algorithm, definitions, and assumptions table;
- Clarification of geothermal heat pumps protocol regarding language and definitions
- Improvements to the functionality and scope of the TRM Appendix C (Lighting Inventory Tool) and Appendix D (Motor and Variable Frequency Drive Inventory Tool);
- Clarification of use of terms seasonal energy efficiency ratio (SEER), energy efficiency ratio (EER), heating seasonal performance factor (HSPF) and coefficient of performance (COP) for ductless mini split heat pumps and C&I refrigerant charge correction measures to calculate the energy and peak demand savings for air conditioning and heat pump units less than 65,000 BtuH;
- Clarification of ENERGY STAR® clothes washers regarding new Federal standards and ENERGY STAR® requirements, assumptions, algorithms, deemed savings, and measure lives; and
- Correction of algorithms for electric resistance water heaters and heat pump water heaters protocols.

3.5 Interim Protocols

For measures not already in the Commission-adopted TRM that are suitable for deemed or partially deemed savings, EDCs may use interim measure protocols (IMPs) to determine savings prior to adoption via the formal TRM process. The SWE approves protocols for use after a collaborative and iterative review process with the PEG. The changes focus on improving assumptions for key parameters, algorithms, deemed savings values and accounting for new codes and standards for existing residential, and commercial and industrial EE&C measures only. The Commission did not receive any recommendations from the EDCs and their EDC Program Evaluators to include new protocols in the 2013 TRM via the interim measure protocol process.

3.6 Demand Response Protocols

Table 3-3 summarizes the EDCs' Demand Response (DR) programs and activities during PY3. The DR programs are designed to reduce peak demand temporarily through dispatched peak shaving resources. The Act 129 compliance period for peak demand reduction is June 1 – September 30, 2012, thus demand reduction impacts resulting from the 2012 DR programs will be reported in PY4.

Table 3-3: Summary of EDC Demand Response Programs

EDC	Program Name	Program Type	Sector	PY3 Activities	EM&V Plan Approved?
Duquesne					
	Direct Load Control	DLC, AC Water Heaters	Res	**Customer Recruiting, Equipment Installation and EM&V Plan Development**	Yes
	Direct Load Control	Direct Load Control, AC	Small C&I	**Customer Recruiting, Equipment Installation and EM&V Plan Development**	Yes
	Large CSP	Load Curtailment	Large C&I	**Customer Recruiting, Equipment Installation and EM&V Plan Development**	Yes
PECO					Yes
	Res Direct Load Control	Direct Load Control	Res	**Customer Recruiting, Equipment Installation and EM&V Plan Development**	Yes
	C&I Direct Load Control	Direct Load Control	C&I	**Customer Recruiting, Equipment Installation and EM&V Plan Development**	Yes
	DR Aggregation (PJM DR)	Load Curtailment	C&I	**Customer Recruiting, Equipment Installation and EM&V Plan Development**	Yes
	Distributed Resources	Distributed Generation	C&I	**Customer Recruiting, Equipment Installation, EM&V Plan Development and Test Event**	Yes
	CVR Energy/Demand	Custom, Voltage Reduction	Res and C&I	**No Incremental Program Activity**	Yes
PPL					
	Direct Load Control	Direct Load Control	Res, C&I	**Customer Recruiting, Equipment Installation and EM&V Plan Development**	Yes
	Load Curtailment	Load Curtailment	C&I	**Customer Recruiting, Equipment Installation and EM&V Plan Development**	Yes
FirstEnergy					
	Res Demand Reduction	DLC, CAC Two Way Com	Res	**Customer Recruiting, Equipment Installation and EM&V Plan Development**	Yes
	Mandatory Program,	Load Curtailment	C&I	**Customer Recruiting, Equipment Installation and EM&V Plan Development**	Yes
	Voluntary Program	Load Curtailment	C&I	**Customer Recruiting, Equipment Installation and EM&V Plan Development**	Yes
	FE as CSP	Load Curtailment	C&I	**Customer Recruiting, Equipment Installation and EM&V Plan Development**	Yes

West Penn Power					
	Critical Peak Rebate Rate	Peak Rebate	Res	**Customer Recruiting, Equipment Installation and EM&V Plan Development**	Yes
	TOU w/Critical Peak Rate	Peak Tariff Rate	Res	**Program Not Implemented**	NA
	Cust Resources DR	CSP Load Curtailment	Large C&I	**Customer Recruiting, Equipment Installation and EM&V Plan Development**	Yes
	Cust Load Response	WPP Load Curtailment	Large C&I	**Customer Recruiting, Equipment Installation and EM&V Plan Development**	Yes
	Distributed Generation	Distributed Generation	Large C&I	**Program Not Implemented**	NA
	CVR	Custom, Voltage Reduction	Res, C&I	**Program Planning**	Yes

3.7 Total Resource Cost Test Issues

The SWE examined the TRC Test calculations for each EDC and found that their respective TRC ratios for PY3 were calculated correctly. While calculations are being performed correctly by each EDC, the TRC Test depends on a number of common assumptions, which are being dealt with differently by each EDC. These assumptions include the line loss factor, discount rate, participant costs and avoided costs of energy and capacity costs.

3.7.1 Line Loss Factor

Line loss factors are presented for each EDC by sector in Table 3-4.

Table 3-4: Line Loss Factor by EDC and Sector

EDC	Residential	Commercial	GNP	Industrial
Duquesne	6.90%	6.90%	6.90%	6.90%
Met-Ed	11.00%	11.00%	11.00%	11.00%
Penelec	11.00%	11.00%	11.00%	11.00%
Penn Power	11.00%	11.00%	11.00%	11.00%
PECO[26]	7.10%	7.10%	7.10%	7.10%
PPL	8.33%	8.33%	8.33%	4.12%[27]
West Penn	11.00%	11.00%	11.00%	11.00%
Average	**9.48%**	**9.48%**	**9.48%**	**8.87%**

[26] PECO uses line loss factors for several programs for peak demand savings that are different from the factors used for energy savings shown in the table above. Average line loss factor is shown. PECO uses differing line loss factors for energy and demand savings, which are shown in Section 5.2 of this Annual Report.

[27] PPL applied a different line loss factor for Industrial sector compared to that of other sectors as show in the table above. Industrial customers are supplied at a higher voltage than commercial and residential customers, so there is less line loss from voltage step-downs.

PPL is the only EDC whose TRC line loss factor for energy varies by sector. Increasing the line loss factor will increase the benefits associated with a program, and therefore larger line loss factors will result in higher TRC ratios. Higher line loss factors will also increase peak demand reductions which are grossed-up by the line loss factors. EDCs were directed to use line loss factors as filed in their original EE&C plans. Moving forward, the SWE recommends that the use of line loss factors be reviewed through PEG processes to reflect the most accurate representation of benefits for energy and peak demand. Different line loss factors should apply to average and peak load conditions.

3.7.2 Discount Rate

The nominal discount rate is another underlying assumption that has a considerable effect on the final TRC ratio. In a TRC Test, the discount rate reflects the utility cost associated with borrowing capital. This rate is used to compare the Net Present Value (NPV) of program benefits that will occur throughout a measure's lifetime to the upfront costs of installation and implementation. The discount rates for each EDC, along with the average across the seven EDCs are shown in Table 3-5.

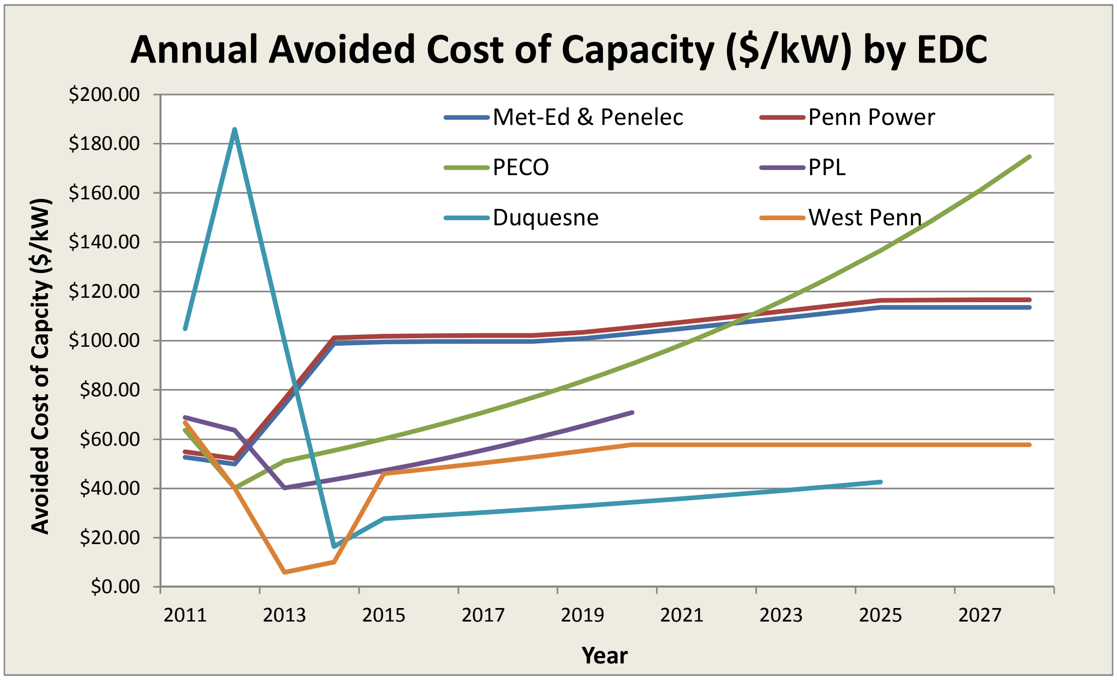
Table 3-5: Discount Rate by EDC

EDC	Discount Rate
Duquesne	6.90%
Met-Ed	7.92%
Penelec	7.92%
Penn Power	7.92%
PECO	7.60%
PPL	8.00%
West Penn	9.03%
Average	**7.90%**

3.7.3 Avoided Costs

Avoided cost of capacity benefits, or the TRC Test benefits associated with peak demand savings, is another area that contained significant variation between EDCs. Figure 3-2 shows the annual avoided cost of capacity for each of the EDCs.

Figure 3-2: Avoided Cost of Capacity Forecast by EDC



No value is assigned to the avoided cost of capacity for Duquesne because the avoided cost of energy filed by Duquesne in its EE&C plan included the cost of capacity, so a separate calculation is not needed to account for capacity benefits.[28] PPL's TRC model does not include estimates for the avoided cost of capacity beyond 2020 because the energy futures used to determine the avoided energy cost included the cost of capacity. There is significant variation between the annual values EDCs associate with not having to expand generation capacity. The variation in the avoided capacity costs leads to significant differences in the financial benefits attributed to measures which reduce peak demand.

A TRC Test section is included in the EDC-specific sections of this Annual Report, providing greater detail on the SWE audit findings for the review of TRC inputs, assumptions, and calculations for energy efficiency programs.

[28] The avoided cost of capacity values shown in Figure 3-2 were provided by Duquesne to the SWE upon request but are otherwise included in the avoided cost of energy forecast.

3.8 Net-to-Gross Issues

The SWE conducted an audit of the net-to-gross ratio (NTGR) evaluation methodologies used by each of the EDCs in PY3.

Gross savings are the change in energy consumption that results directly from program-promoted actions taken by participants, regardless of the extent or nature of program influence on their actions. Net savings refer to the portion of gross savings that is attributable to the program. This involves separating out the impacts that are a result of other influences, such as customer self-motivation. The NTGR is the proportion of gross savings that would not have occurred in the absence of the program. The equation below shows how a net-to-gross ratio (NTGR) is applied to gross savings to calculate the net savings of a program.

$$Gross\ Savings * NTGR = Net\ Savings$$

A NTGR helps define the energy savings attributable to program activities and influence and to distinguish them from energy savings that occur naturally in the absence of the program. In Pennsylvania, gross verified savings are what are used to assess compliance, but NTG research is required for program planning purposes. Low NTGRs should not be ignored even though they will not negatively impact an EDC meeting its compliance targets. The EDCs should always incorporate NTG findings into program planning activities and pursue savings above and beyond what would have occurred naturally in the marketplace.

The primary considerations that define NTGRs are “free-riders” and participant and nonparticipant “spillover.” Free riders are program participants who would have taken the recommended energy efficiency actions on their own, even if the program did not exist. Spillover describes customers who implement energy efficiency actions, but don’t claim a utility program incentive for the measure. Spillover can include “like” and “unlike” spillover. “Like” spillover occurs when a customer installs energy-saving measures through the program, and installs additional measures of the same type due to the influence of the program but do not receive an incentive for the additional measures. “Unlike” spillover occurs when a customer installs energy-saving measures that are not offered through the program, but are influenced by their experience with the program to do so. The equation below shows how free ridership and spillover rates are used in the NTGR calculation.

$$NTGR = 1 - Free\ Ridership + Spillover$$

The SWE defined levels of rigor of analysis to develop NTGRs in the SWE Net-to-Gross Study Methods guidance document distributed to the EDCs and their evaluators on February 27, 2012. The levels of rigor (basic, standard, and enhanced) and the methods involved in each are outlined below.

Basic

- Deemed/Stipulated NTGR
- Participant self-reporting surveys
- Expert judgment

Standard

- Billing analysis of participants and non-participants
- Enhanced self-report method using other data sources relevant to the decision to install or adopt a measure, which could include among other measures record/business policy and paper review, examination of other similar decisions, interviews with multiple actors and end-users, interviews with mid-stream and upstream market actors, and interviews with program delivery staff.
- Market sales data analysis
- Other econometric or market based studies

Enhanced

- Triangulation, which typically involves using multiple methods from the standard and basic levels, including an analysis and justification of how the results were combined

The SWE recommended a threshold guideline based on a program's contribution to total portfolio savings. For example, if the energy savings of an EDC's program is less than or equal to 5% of the EDC's total portfolio savings, a Basic level of rigor analysis (e.g., stipulated/deemed or simple survey) was recommended to estimate NTGRs. If the energy savings of an EDC's program is greater than 5%, the SWE recommended a more complex guideline to determine whether the Basic, Standard or Enhanced level of rigor was appropriate. These recommendations were based on benefit/cost considerations, as the added costs of a higher level of rigor are generally unwarranted for programs with low savings contributions. The SWE's PY3 audit of net savings analysis presented in this Report focused on comparing the levels of rigor used by the EDCs in PY3 NTG research with regard to the levels of rigor suggested in the SWE guidance document.

Self-report surveys were the primary method of gathering data across the EDCs. On several occasions, the suggested level of rigor for a program was not adopted by the EDC Program Evaluator, and in some cases no NTG study was performed. Most EDCs included a broad description of the methods utilized to conduct NTG research in their respective PY3 final annual reports. For the most part it is suggested that, for future reports, a more detailed description of methodologies be included. In certain circumstances, the NTGRs reported by the EDCs varied greatly even though the programs and evaluation methodologies were almost identical. Additional detail will help the SWE explore these discrepancies and examine possible root causes for differing results between service territories.

The EDC Program Evaluators found low NTGRs for several types of programs in PY3 due to high free ridership. C&I equipment, appliance recycling, new construction and upstream CFL programs reported consistently low NTGRs across the Commonwealth. These findings are consistent with evaluations of similar program types in other jurisdictions. The SWE recommends that EDCs employ the following general tactics for reducing free ridership, noting that some of these recommendations (if implemented) could compromise participation and therefore reportable savings under Act 129, thus negatively impacting an EDC's ability to meet compliance targets.

- Assess eligibility of projects - Limit or disqualify projects that have already commenced or that apply retroactively for program incentives
- Optimize program incentive levels
  - Provide a tiered measure incentive design
  - Increase rebates for premium or ultra-high efficiency equipment
  - Reduce incentive amount for commonly installed measures or efficiency levels
- Assess stringency of measure efficiency
  - Ensure program measures surpass current code requirements
  - As CFL bulbs become more commonplace, transition lighting rebates from CFLs to more efficient LED bulbs
- Encourage trade ally participation - push trade allies to engage in projects at early stage to help influence customer's decision to install measure

3.9 Demand Response Study Updates

The Commission directed the SWE to conduct a Demand Response (DR) Study to evaluate the effectiveness of Act 129 DR programs in Phase I, and inform decisions about whether peak load reduction targets can be justified in future phases of Act 129.[29] An interim report for the Study was submitted on January 4, 2013 and the final version of the Study will be completed in April 2013. The interim report presented the preliminary findings and recommendations of the SWE DR Study based on a review of DR goals and protocols in other jurisdictions and a historical analysis of market conditions in the Commonwealth. The report also provides a brief overview of DR and presents the methodology the SWE will utilize to develop final recommendations in April 2013 once impacts from the Summer 2012 DR season have been analyzed.

The final report for the SWE DR Study will build upon the findings of the interim report through an analysis of the Summer 2012 DR programs implemented by the EDCs. Benefit-cost modeling will be conducted based on the incremental impacts of the Act 129 programs given the existing DR framework in the Commonwealth in place via the PJM DR markets. The finalized Study will include a sensitivity analysis which examines the potential effect on benefit-cost ratios of adopting TRC guidelines used in other jurisdictions. Based on this analysis, the SWE will issue final recommendations on whether DR

[29] Pennsylvania Public Utility Commission, *Energy Efficiency and Conservation Program Secretarial Letter*, served March 4, 2011, Docket No. M-2008-2069887.

goals should be established in future phases of Act 129 and how the DR programs can be structured to deliver cost-effective savings.

3.10 Baseline Study Updates

In an effort to inform the implementation of Phase II of Act 129, the SWE was tasked with conducting an electric energy efficiency market potential study. As a first step in this process, the SWE conducted residential, commercial, and industrial end use and saturation “baseline” studies to characterize the energy usage and electric energy efficiency opportunities in the Commonwealth for each of the EDCs subject to Act 129.

The SWE completed 420 residential and 418 commercial/industrial on-site surveys within six of the seven EDC territories over an approximately 18 week period from September 2011 through January 2012. Early on in the process, it was decided on-site surveys would not be performed in the PECO service area because a contemporary and comprehensive baseline study had already been performed for PECO (report published February 2011). Using data collected from the existing PECO baseline studies, where applicable, the SWE was generally able to incorporate 68 additional residential surveys and 70 non-residential surveys when producing results at the statewide level.

The SWE compiled, reviewed, and analyzed the on-site survey data in early 2012 and issued final reports to the Commission in April 2012. Based on the selected sample size per EDC, results carried a precision of ±10%, with 90% confidence. The data for all EDC’s were then aggregated to the statewide level, with estimates carrying precision of ±5%, with 95% confidence. The results of these studies supply information that is useful for future energy efficiency and demand response program development, system planning, and obtaining a basic understanding of the energy consuming equipment located throughout the state of Pennsylvania.

The two final reports, Pennsylvania Statewide Residential End-Use and Saturation Study and Pennsylvania Statewide Commercial & Industrial End-Use and Saturation Study, are available for download on the Commission’s Act 129 website.[30]

3.11 Potential Study Updates

The purpose of the energy efficiency potential study is to determine the remaining opportunities for cost-effective electricity savings in the service areas of the EDCs subject to the energy efficiency requirements of Act 129. The SWE began its analysis in December 2011 and a final draft report of the study was issued in May 2012. All results were developed using customized residential and C&I sector-level potential assessment analytic models and Pennsylvania-specific avoided cost projections for electricity. To help inform these energy efficiency potential models, up-to-date measure data was obtained from a variety of sources including: the 2012 PA TRM, the SWE residential and C&I baseline studies, appliance saturation studies conducted by the EDCs, and additional input received from the individual EDCs regarding measure costs and savings.

30 http://www.puc.state.pa.us/filing_resources/issues_laws_regulations/act_129_information.aspx

The results of the analysis include estimates of technical, economic and achievable potential for electric energy efficiency programs in the service area of each EDC. In addition, two program potentials for electric energy efficiency programs were calculated for the next three and five-year time periods. Program potential Scenario 1 considered an annual spending ceiling that limits the program spending to 2% of 2006 annual revenue as prescribed within Act 129. Program potential Scenario 2 adjusted annual energy efficiency kWh savings so that they are 1% of the forecast for Pennsylvania EDC annual kWh sales each year. The development of program potential included estimates of annual program incentives, non-incentive costs, and EDC-specific acquisition costs.

The report, *Electric Energy Efficiency Potential for Pennsylvania*, as well as supporting appendices, is available on the Commission's Act 129 website.[31]

[31] Ibid.

4 Duquesne Light Company

This section summarizes Duquesne Light Company (Duquesne) performance in PY3, as well as the cumulative energy savings and demand reductions achieved by Duquesne's Act 129 EE&C programs through the end of PY3. This section presents the evaluation activity completed by both Navigant Consulting (the current Duquesne Program Evaluator) and the SWE in the calculation of the cost-effectiveness and the measurement and verification (M&V) of Duquesne's EE&C programs. This section also provides the SWE's recommendations for Duquesne's programs going forward.

4.1 Summary of Energy and Demand Reductions

Table 4-1 highlights Duquesne's cumulative reported gross impact and verified gross impact since the EE&C programs' inception through the end of PY3.

Table 4-1: Summary of Duquesne CPITD Impacts

	CPITD Reported Gross Impact[f]	CPITD Verified Gross Impact[h]	Savings Achieved as % of 2013 Targets[i]
Total Energy Savings (MWh/yr)	315,998	308,414	73%
Total Demand Reduction (MW)	33.9	34.1	30%
TRC Benefits ($1,000) [a]	Not Applicable[g]	$99,037	Not Applicable
TRC Costs ($1,000) [b]	Not Applicable[g]	$29,327	Not Applicable
TRC Benefit-Cost Ratio[c]	Not Applicable[g]	3.38	Not Applicable
CO_2 Emissions Reduction (Tons) [d][e]	255,958	249,815	Not Applicable

NOTES:
[a] 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. 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 TRC Order.
[d] 8.1x10-4 metric tons of CO_2 per kWh (EPC's eGRID2007 Version 1.1, RFCE Region annual non-baseload CO_2 output emissions rate, year 2005 data). This is included in this report per the approved SWE work plan.
[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] Defined as the gross energy savings that were reported during the period since date of program implementation through the current reporting period (i.e., reporting period of this report). CPITD = Cumulative Program Inception To-Date.
[g] TRC Benefits and Costs are calculated only for verified savings, which reflect actual program results.
[h] Defined as the energy savings that have been verified by the Duquesne Program Evaluator and audited by the SWE, and since the date of program implementation through the end of PY3.
[i] Savings achieved based on CPITD Verified Gross Impact.

As shown, Duquesne has achieved 73% of its Act 129 2013 energy savings target and 30% of its Act 129 demand reduction target at the end of PY3. The TRC Benefit-Cost Ratio (or TRC Ratio) of 3.38 indicates Duquesne's EE&C programs are cost-effective on an aggregate (portfolio) basis.

Table 4-2 contains a listing of Duquesne's EE&C programs that reported participation and had energy and/or demand savings that were evaluated in PY3, and programs that are yet to be implemented or had no reported savings in PY3.

Table 4-2: Duquesne EE&C Programs

Programs Reporting PY3 Gross Savings:
• Residential: EE Program (REEP) - Rebate Program • Residential: EE Program - Upstream Lighting • Residential: School Energy Pledge • Residential: Appliance Recycling • Residential: Low-Income EE • Residential: Low-Income EE - Upstream Lighting • Commercial Sector Umbrella EE • Healthcare EE • Industrial Sector Umbrella EE • Chemical Products EE • Mixed Industrial EE • Office Building - Large – EE • Office Building - Small – EE • Primary Metals EE • Public Agency/Non-Profit • Retail Stores - Small – EE • Retail Stores - Large – EE
Programs to be Implemented or with No Reported PY3 Savings:
• Curtailable Load • Residential Direct Load Control • C&I Direct Load Control

Duquesne has reported PY3 gross energy and/or demand savings for 17 programs. Table 4-3 below provides a breakdown of the contribution of each program's gross energy savings and gross demand savings towards the CPITD portfolio savings. As shown, the Residential: EE Program – Upstream Lighting Program[32] accounts for 35% of the total CPITD verified gross energy savings for Duquesne's portfolio, and represents 68% of the energy savings from all residential energy efficiency programs. In the commercial and industrial (C&I) sector, the largest savings come from the Public Agency/Non-Profit Program and the Office Building – Large – EE Program, which collectively account for 20% of the total EE&C portfolio energy savings and almost 40% of the energy savings from all C&I programs.

[32] An Upstream Lighting Program provides point of purchase discounts on CFL light bulbs for customers purchasing bulbs in retail stores.

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

Program:	CPITD Verified Gross MWh/yr Savings	Percent of Portfolio CPITD Verified Gross MWh/yr Savings	CPITD Verified Gross MW Reductions	Percent of Portfolio CPITD Verified Gross MW Reductions
Residential: EE Program - Upstream Lighting	106,611	35%	5.578	16%
Residential: Low-Income EE - Upstream Lighting	20,561	7%	1.141	3%
Residential: EE Program (REEP) - Rebate Program	10,508	3%	0.864	3%
Residential: Appliance Recycling	10,271	3%	1.421	4%
Residential: School Energy Pledge	3,920	1%	0.818	2%
Residential: Low-Income EE	2,995	1%	0.383	1%
Public Agency/Non-Profit	30,576	10%	4.173	12%
Office Building - Large – EE	30,059	10%	4.288	13%
Primary Metals EE	24,074	8%	2.951	9%
Chemical Products EE	14,869	5%	2.005	6%
Mixed Industrial EE	13,417	4%	2.175	6%
Retail Stores - Small – EE	12,876	4%	3.094	9%
Retail Stores - Large – EE	10,123	3%	1.526	4%
Office Building - Small – EE	5,424	2%	1.459	4%
Commercial Sector Umbrella EE	5,003	2%	0.937	3%
Healthcare EE	3,905	1%	0.527	2%
Industrial Sector Umbrella EE	3,224	1%	0.711	2%
TOTAL	**308,416**	**100%**	**34.051**	**100%**

4.2 Total Resource Cost Test

Table 4-4 provides a breakdown of the contribution of each EE&C program's Program Year-to-Date (PYTD) verified gross energy savings and demand reductions as well as each program's PY3 TRC Benefit-Cost ratios.

Table 4-4: Summary of Duquesne EE&C Program Impacts on TRC Ratios

Program:	PY3 Verified MWh/yr Savings	PY3 Verified MW Reductions	TRC Ratio
Residential: EE Program - Upstream Lighting	68,657	3.37	5.75
Residential: EE Program (REEP) - Rebate Program	6,979	0.54	5.75[33]
Residential: Low- Income EE - Upstream Lighting	5,992	0.29	5.10
Residential: Appliance Recycling	4,216	0.56	2.34
Residential: Low- Income EE	1,411	0.12	5.10
Residential: School Energy Pledge	982	0.03	1.18
Office Building - Large – EE	11,988	1.33	4.19
Retail Stores - Large – EE	7,757	1.25	3.37
Mixed Industrial EE	6,711	1.03	3.57
Retail Stores - Small – EE	6,653	1.88	3.37
Office Building - Small – EE	3,691	1.08	3.97
Public Agency/Non-Profit	3,220	1.04	0.97
Primary Metals EE	3,045	0.31	1.41
Commercial Sector Umbrella EE	2,950	0.41	3.48
Healthcare EE	2,889	0.43	1.32
Industrial Sector Umbrella EE	2,638	0.51	1.44
Chemical Products EE	290	0.03	0.70
TOTAL	**140,069**	**14.217**	**3.38**

Fifteen out of the 17 programs are found to be cost-effective by the TRC Ratio (i.e., the Ratio exceeds 1). An important finding is that the programs with the largest savings in the residential and C&I sectors have high TRC ratios. This means that not only are they performing well in terms of generating savings, they are also cost-effective programs. Conversely, the program with the lowest amount of savings in PY3 (Chemical Products EE) is also the least cost-effective.

[33] The Residential: EE Program is evaluated for cost-effectiveness as a whole. Therefore, the TRC ratios are the same for the Residential: EE Program – Upstream Lighting and Residential: EE Program (REEP) – Rebate Program.

4.2.1 Assumption and Inputs

The Duquesne TRC model is the most granular of the TRC models reviewed by the SWE team for PY3. Costs and benefits are calculated for each record in the Duquesne's Program Management and Reporting System (PMRS) database. Administrative costs are allocated to each measure and costs and benefits are then aggregated prior to calculation of the TRC Ratio. Duquesne uses a weighted average cost of capital, or discount rate, of 6.90% to discount program benefits and costs. This rate is used to compare the Net Present Value of program benefits which will occur later in a measure's lifetime, to the upfront costs of installation and implementation. Discount rates vary between the EDCs[34] because each company used what was filed in their original EE&C plan. Duquesne uses the lowest discount rate used by any of the EDCs in PY3 TRC calculations and this plays some role in the high portfolio TRC ratio shown in Table 4-4. Therefore, the present value of Duquesne's TRC costs and benefits are higher with lower discount rates compared to other EDC's whose discount rates are higher.

A line loss factor of 6.90% is used for all programs per Duquesne's 2009 EE&C Plan. An effective useful life (EUL) was assigned to each measure in the Duquesne TRC model. Measures such as commercial lighting, motors, and variable frequency drives (VFDs) as well residential appliances, fixtures, and HVAC, which are included in Appendix A of the TRM, were assigned a EUL consistent with the TRM specified value. Duquesne's TRC model assigns measure lives for measures not specified in the TRM, however, a reference source was not provided. The SWE examined several of these values and found them to be reasonable, but requests that Duquesne provide some insight into how these values were determined. **Error! Reference source not found.** provides further detail regarding the SWE audit of Duquesne's TRC Test calculations.

Incremental costs were also applied at the measure level in the Duquesne TRC model, which contained several tabs that detailed the cost calculations often using the Database for Energy Efficient Resources (DEER) cost references as inputs. The measure unit cost of the base case is subtracted from the measure unit cost of the efficient case to return an incremental cost per unit of the measure for "replace on burnout" measures, whereas the measure unit cost for early replacement measures is the full cost of the efficient equipment plus a labor estimate.

The energy and demand savings used in the TRC model were drawn from the PMRS database, which used TRM values and equations to assign *ex ante* annual savings to completed measures. The TRC analysis is based on *ex post* verified gross savings, so program impacts are adjusted by an applicable realization rate. Separate realization rates were applied to energy and demand impacts.

4.2.2 Avoided Cost of Energy

The Duquesne TRC model assigns a value ($/kWh) to the avoided cost of energy for each year from 2009 through 2023 under four different load conditions – summer on-peak, summer off-peak, winter on-peak and winter off-peak. Duquesne filed avoided costs forecast from 2009 until 2029 in its 2009 EE&C Plan which was approved by the Commission. The SWE believes that savings should be applied to the avoided

[34] See Table 3-5.

cost values from the year that they will actually occur, rather than a fixed, 15-year cost structure, to accurately calculate benefit-cost ratios. The SWE performed a sensitivity analysis using Duquesne's avoided cost values from 2012-2026 and found that the increase in the PY3 TRC Ratio is over 15% at the portfolio level.

Each measure in Duquesne's EE&C programs' portfolio is assigned to an end-use load shape that is the most correlated with the affected equipment. The energy impacts of a given measure are divided across the four load conditions based on the associated load profile. The impacts under a given load condition are multiplied by the avoided cost of energy for that condition and summed across the effective lifetime of the measure to calculate the avoided energy benefits produced by the measures. The use of specific end-use load shapes makes the TRC findings more realistic because measures which yield energy savings during periods with high energy costs are more cost-effective per kWh saved than measures which produce savings during off-peak periods.

4.2.3 Avoided Cost of Capacity

The Duquesne TRC model does not assign a separate value ($/kW) to the cost of adding generation capacity. Avoided costs of capacity are included in the avoided energy costs, and are based on PJM RPM Auction prices. This is converted to a cost per unit of energy saved based on Duquesne's system load factor. Consequently, the peak demand savings attributed to a measure are not used in the cost-effectiveness calculations.

4.2.4 Conclusions and Recommendations

The Duquesne TRC model was very transparent and all inputs were well documented and consistent with other documentation provided to the SWE for review. The use of end-use load shapes to determine on-peak and off-peak energy use by season associates larger avoided cost benefits to measures that reduce consumption during periods of high system load. The SWE recommends that Duquesne consider moving its avoided cost stream forward each program year when calculating and reporting TRC ratios to provide the most realistic estimate of cost-effectiveness. The Duquesne TRC model relies on a single, 15 year avoided cost stream for each of the program years in Phase I of Act 129. Using this approach, the 15 year avoided cost forecast is the same for each of the four program years in Phase I. A review of the avoided cost forecasts used by each of the EDCs shows that avoided costs of energy and capacity follow an upward trajectory over time. As a result, beginning the 15 year avoided cost stream in the calendar year at the close of the program will produce slightly larger TRC ratios. For example, the SWE performed analysis using Duquesne's correct avoided cost values from 2012-2026 for PY3 and found that the increase in the PY3 TRC ratio is over 15% at the portfolio level.

4.3 Status of Evaluation Activities

4.3.1 Status of EM&V Plans

Per the guidelines outlined in the Audit Plan,[35] the SWE has reviewed EM&V plans submitted by the EDCs to verify that the plans comply with the TRM and TRC Orders and meet the minimum evaluation requirements set forth in the Audit Plan. The Audit Plan provides an outline for the evaluation framework expectations and guidelines necessary to address the following research objectives:

- determine realization rates for gross savings;
- determine net to gross (NTG) ratios;
- determine method for calculating savings; and,
- set acceptable levels of rigor, precision and bias for measurement and verification (M&V) activities.

Duquesne submitted Evaluation, Measurement and Verification (EM&V) Plans for its Curtailable Load, Residential Direct Load Control and C&I Direct Load Control Programs to the SWE on May 17, 2012. The Plans outlined sampling strategy, data collection methods and impact evaluation. The SWE reviewed each Plan and found the approaches to be consistent with the guidelines set forth in the PJM Operating Agreement for each program type.

The SWE was initially concerned that Duquesne was planning to use devices in its M&V sample in the calculation of the Switch Operability Rate for the two Direct Load Control Programs. This figure is an estimate of the percentage of the population of load control switches that are properly functioning during any given event. Duquesne agreed to review the results of the CSP's switch operability study to ensure that there was not a discrepancy between the operability rate of the devices in the M&V sample and devices that were not part of the M&V sample. The SWE approved Duquesne's EM&V Plans during a biweekly teleconference on May 24, 2012.

On September 11, 2012 Duquesne and the Duquesne Program Evaluator issued a memo to the SWE requesting permission to modify the methodology outlined in its original EM&V Plans for the Residential and C&I Direct Load Control Programs. The change centered around which hours were to be used in the calculation of the Symmetric Additive Adjustment (SAA). Duquesne's preliminary analysis had shown the original SAA methodology of using a three-hour window, and excluding the hour prior to the beginning of curtailment event, was systematically underestimating the load reduction. Duquesne proposed moving to a one-hour window that included only the hour prior to the event. The SWE requested that additional research be conducted on the stability of estimates based on a one-hour SAA period. Duquesne provided this analysis and the SWE was satisfied that the proposed methodology change would produce more accurate estimates of the per-participant load reduction achieved by the Direct Load Control Programs. The SWE approved the change to the EM&V Plan via email on September 27, 2012.

[35] See Statewide Evaluation Team, *Audit Plan and Evaluation Framework for Pennsylvania Energy Efficiency and Conservation Programs*, November 4, 2011.

4.3.2 M&V Activities and Findings

Table 4-5 provides a summary of M&V based on activities conducted by the Duquesne Program Evaluator based on details provided in Duquesne's PY3 Annual Report, and on information obtained from SWE data requests and audits.

4.3.2.1 Gross Impact Evaluation

Table 4-5 shows the realization rates for energy and demand savings for each of Duquesne's energy efficiency programs.

Table 4-5: Duquesne Energy Efficiency Programs - Realization Rates for Energy and Demand Savings

Program	Realization Rate-Energy Savings	Realization Rate-Demand Savings
Residential: EE Program (REEP) - Rebate Program	73%	92%
Residential: EE Program - Upstream Lighting	99%	98%
Residential: School Energy Pledge	63%	67%
Residential: Appliance Recycling	100%	100%
Residential: Low-Income EE	73%	98%
Residential: Low-Income EE - Upstream Lighting	101%	99%
Commercial Sector Umbrella EE	105%	118%
Healthcare EE	105%	118%
Industrial Sector Umbrella EE	91%	93%
Chemical Products EE	91%	93%
Mixed Industrial EE	91%	93%
Office Building - Large - EE	105%	118%
Office Building - Small - EE	105%	118%
Primary Metals EE	91%	93%
Public Agency/Non-Profit	113%	117%
Retail Stores - Small - EE	105%	118%
Retail Stores - Large - EE	105%	118%
TOTAL PORTFOLIO	98%	106%

The realization rate is a factor that compares the gross savings reported by the EDC to the verified gross savings determined by the EDC's program evaluator through M&V activities. The calculation for a realization rate is as follows.

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

Depending on the program, realization rates are calculated either based on a sample of program participants and then applied to all participants or calculated on a census of all program participants and then applied to all participants. A realization rate of 100% indicates that the evaluation team was able to verify all reported savings (this is the case with Duquesne's Residential: Appliance Recycling Program). A realization rate of less than 100% indicates that the gross savings were an over-estimate and a realization rate of over 100% indicates that gross savings were an under-estimate.

Realization rates for energy savings from Duquesne's programs range from 63% (Residential: School Energy Pledge Program) to 113% (Public Agency/Non-Profit Program). Realization rates for demand reductions from Duquesne's programs range from 67% (Residential: School Energy Pledge Program) to 118% (Commercial Sector Umbrella – EE, Healthcare - EE, Office Building - Large – EE, Office Building - Small – EE, Retail Stores - Small – EE, Retail Stores - Large – EE).

4.3.2.1.1 Residential School Energy Pledge Program

The reason for the low savings realization rate of the Residential: School Energy Pledge Program is that the 2,017 Program kits distributed in PY3Q4 did not apply the in-service rate from the 2011 TRM to the light bulbs within the kits. Therefore, energy and demand savings had to be updated for those kits.

4.3.2.1.2 Residential: EE Program (REEP) - Rebate Program

The low energy savings realization rate for the Residential: EE Program (REEP) - Rebate Program is due to the need to have adjusted savings for several measures (CFLs, ENERGY STAR® dehumidifiers, interior compact fluorescent fixtures, programmable thermostats and whole house fans) to be consistent with the 2011 TRM.

4.3.2.1.3 Low-Income Energy Efficiency Program (LIEEP)

The low realization rate for the Low-Income Energy Efficiency Program (LIEEP) is due to the fact that the in-service rates determined through participant surveys during the evaluation for the School Energy Pledge kits and the Residential Energy Efficiency Program (REEP) kits were less than the in-service rates deemed for the individual kit measures in the 2011 TRM, which Duquesne used to report savings. Thus, the in-service rate adjustments based on the participant surveys resulted in less savings relative to the reported savings.

4.3.2.1.4 Commercial Program Group

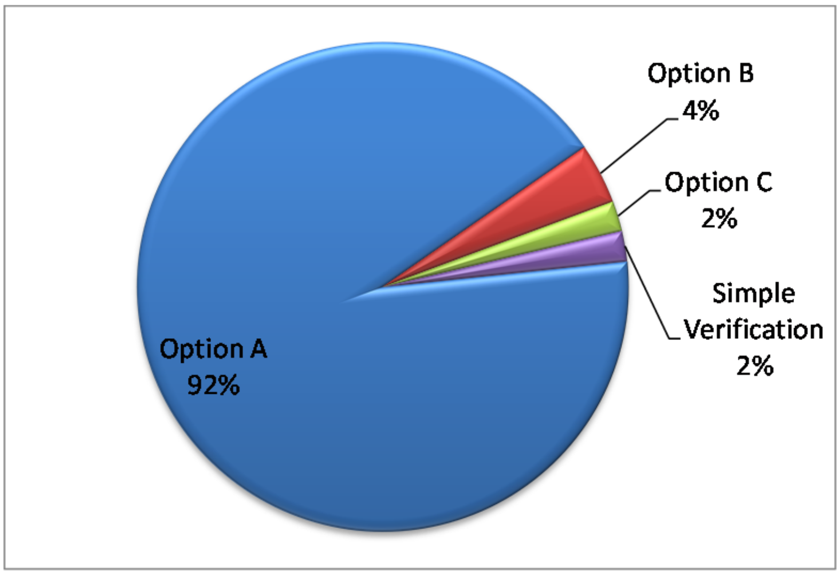
Duquesne's Commercial Program Group consists of several programs offering similar measures and incentive levels with various mechanisms geared towards specific customer segments. Segment programs, such as Office Building - Small - EE, Office Building - Large - EE, Office, Public Agency/Non-Profit, Retail Stores – Small – EE, Retail Stores – Large - EE, and Healthcare – EE, each have a devoted sub-program, while an additional Commercial Sector Umbrella EE Program delivers energy efficiency opportunities to the remaining commercial customer segments. The Duquesne Program Evaluator employed a stratified sampling approach to generate a representative sample of projects.

M&V activities took two different levels of rigor. The basic level of rigor, involving document review and as-needed interviews with applicable parties, was undertaken for projects with rebates less than $2,000.

For projects with rebates larger than $2,000, the Duquesne Program Evaluator used an enhanced level of rigor which included the added component of on-site verification of installed equipment, as well as verification of equipment operating characteristics.

Inspection of the evaluation documentation submitted to the SWE for the Commercial Program Group shows that 92% of projects sampled were evaluated using an IPMVP[36] Option A approach (Partially Measured Retrofit Isolation). This approach uses a combination of measurement of key parameters of the retrofitted equipment and the use of stipulated values for other parameters. The distribution of M&V techniques used for the sampled projects is shown in Figure 4-1.

Figure 4-1: Distribution of M&V Approaches - Duquesne Commercial Program Group



IPMVP Option B (Retrofit Isolation: All Parameter Measurement) involves more robust measurement of the retrofitted system's energy usage, typically using short-term data logging. IPMVP Option C (Whole Facility Billing Analysis) involves utility billing analysis to identify energy savings associated with an upgrade. Typically, 12 months of pre- and post-retrofit billing data is required for this approach. Simple Verification, in this case, refers to a phone interview with the customer to identify whether or not the rebated equipment was installed. Although the projects selected for an Option B approach were a relatively small proportion of the total number of evaluated projects, these projects represented a much larger share of the evaluated savings. The SWE supports this "value-of-information" technique of reserving expensive metering activities for projects which account for the largest share of savings.

The primary approach used to determine verified savings was simple on-site verification of the installed equipment. Calculation of verified energy and demand savings typically applied hours-of-use assumptions from the TRM, rather than metering the hours-of-use (HOU) or using the actual building

[36] International Performance Measurement and Verification Protocol (IPMVP) is an overview of best practice techniques available for verifying results of energy efficiency, water efficiency and renewable energy projects.

operating schedules. Using this type of approach typically results in near-100% realization rates and high precision. The resulting weighted mean energy realization rate for the Commercial Program Group was 1.06 and the weighted mean demand realization rate was 1.18. The relative precision of the verified savings estimates for energy and demand savings was 2.7% and 7.6%, respectively at the 85% confidence level. The SWE reviewed the Duquesne Program Evaluator's calculations and confirmed that the stratified ratio estimator (realization rate) was applied correctly and the reported precision values were accurate.

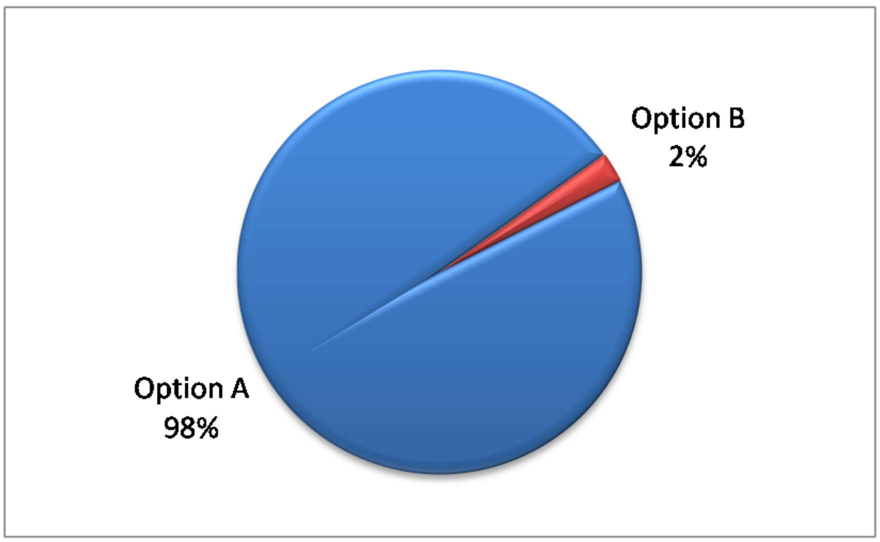
The SWE recommends increasing in PY4 the number of sampled projects evaluated using IPMVP Option B, or deploying data loggers on a greater portion of sampled projects evaluated using IPMVP Option A. The Duquesne Program Evaluator deployed logging equipment at only 1 of 50 evaluated sites in the Commercial Program Group in PY3. While the 2012 TRM requires metering for lighting projects where the connected load exceeds 200 kW, efforts should be made to deploy lighting loggers for projects exceeding 20 kW, especially under high uncertainty. The 2012 TRM also requires metering to determine energy savings for motor and VFD measures where the reported savings are greater than 50,000 kWh, or greater than 25,000 kWh when the "other" category is used to stipulate hours. While this was not a requirement for the evaluation of PY3 projects, the Duquesne Program Evaluator should be aware of the increased requirement for evaluation of PY4 projects.

4.3.2.1.5 Industrial Program Group

Duquesne's Industrial Program Group is structured similarly to the Commercial Program Group. The specific customer program segments include Primary Metals EE, Chemical Products EE, and Mixed Industrials EE. The Industrial Sector Umbrella EE Program delivers energy efficiency opportunities to the remaining industrial customer segments.

M&V activities took the same two levels of rigor identified for the Commercial Program Group evaluation. The same $2,000 incentive threshold defined which level of rigor was used. Inspections of the evaluation sample spreadsheet for the Industrial Program Group shows that 98% of projects sampled were evaluated using IPMVP Option A. The breakdown of M&V techniques used for the sampled projects is shown in Figure 4-2. Although the projects selected for an Option B approach were a relatively small proportion of the total number of evaluated projects, these projects represented a much larger share of the evaluated savings. The SWE supports this "value-of-information" approach of reserving expensive metering activities for projects which account for the largest share of savings.

Figure 4-2: Distribution of M&V Approaches – Duquesne Industrial Program Group



Eighty-two out of 84 industrial measures were evaluated using IPMVP Option A and involved site inspections to verify the installation of equipment. The other two measures were evaluated using IPMVP Option B involving metered data. Since sampling took place at the measure level for the Industrial Program Group, it is expected that multiple measures from a single project may be sampled in some cases. In PY3, 60 of the 84 sampled measures came from only two projects (30 each). Although these two projects account for over 70% of the sampled measures, the verified energy savings from the measures accounts for less than 8% of the total sample verified energy savings. Conversely, only four distinct measures account for nearly 60% of the total sample verified energy savings. The SWE recommends a more balanced sampling approach in PY4 to reduce the amount of attribution any single project has on the realization rate for the program. Two options for accomplishing this are sampling at the project level or verifying only measures selected in the sample.

The resulting weighted mean energy realization rate for the Industrial Program Group was 0.91 and the peak demand realization was 0.79. The low realization rates were largely due to the stratum made up of a single new construction project for which the *ex ante* savings estimates were over-estimated. The relative precision of the energy savings estimates was 3.1% and the relative precision of the demand savings estimate was 9.4%. Both precision values were reported at the 85% confidence level.

An audit of the evaluation sample documentation and findings shows that 72 of the 84 measures analyzed had verified energy savings identical to the reported energy savings and the evaluation contractor deployed logging equipment for two of 84 evaluated measures in the Industrial Program Group in PY3. The SWE recommends increasing in PY4 the number of sampled measures evaluated using IPMVP Option B or employing data loggers on a greater portion of sampled projects using Option A. This will promote a more independent savings calculation. While the 2012 TRM requires metering for lighting projects where the connected load exceeds 200 kW, efforts should be made to deploy lighting loggers for projects exceeding 20 kW, especially under high uncertainty. The 2012 TRM also requires metering to determine energy savings for motor and VFD measures where the reported savings is greater than 50,000 kWh, or great than 25,000 kWh when the “other” category is used to stipulate hours. While this was not a requirement for the evaluation of PY3 projects, the Duquesne Program Evaluator should be aware of the increased requirement for evaluation of PY4 projects.

4.3.2.2 Net Impact Evaluation

Net-to-Gross (NTG) analyses are conducted as part of an impact evaluation to determine what proportion of evaluated savings is attributable to a program. That is, a NTG ratio (NTGR) represents the percentage of savings that would not have occurred in the absence of a program. To calculate a NTGR for a given program, evaluators will typically assess the level of free ridership (FR) and spillover (SO) among program participants. Free ridership is an assessment of how likely a program participant would have implemented a program measure regardless of the program incentive or existence of the program. Spillover is an assessment of additional energy saving actions taken by a participant or non-participant that were a result of the program. The NTGR is calculated using the following formula:

$$NTGR = 1 - FR + SO$$

The NTG analysis undertaken by the Duquesne Program Evaluator followed an industry-standard approach. Both residential and non-residential programs were evaluated through administration of survey instruments developed with program-specific algorithms and scored at the measure level. The level of rigor performed by the evaluation contractor is considered to be Basic in accordance with the NTG Study Methods prepared by the SWE.

Results from Duquesne’s NTG evaluation are presented in Table 4-6 below. Additional information on Duquesne’s NTG methodology is provided in Appendix B.1. The SWE’s evaluation of the NTG methodology is provided in Section 4.4.5.

Table 4-6: Duquesne NTG Results

Program	Total Surveys	Free Ridership	Spillover	NTG Ratio
Residential: EE Program (REEP) Group	86	24%	N/A	76%
Residential: School Energy Pledge (SEP)	70	14%	N/A	86%
Residential: Appliance Recycling	108	33%	N/A	67%
Residential: Low-Income EE (LIEEP)	NA[1]	26%	N/A	74%
Commercial Program Group	50	17%	N/A	83%
Industrial Program Group	19	31%	N/A	69%

1 NA indicates that no NTG analysis was undertaken.

4.4 Statewide Evaluator Audit Activities and Findings

4.4.1 Residential Program Audit Summary

4.4.1.1.1 Residential: EE Program – Upstream Lighting

The SWE 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 2011 TRM. The SWE also selected a sample of 10 bulbs for the review of baseline assumptions to ensure that the CFL wattages fell within the ranges specified in the TRM. Lastly, the SWE team selected 5 retail invoices per quarter from Duquesne's buy-down program to review and verify that the bulb counts were accurately tracked in the PMRS database and tracking system. The SWE found that Duquesne used the correct values and algorithms, and the correct baseline assumptions, from the 2011 TRM. Additionally, no issues were identified in the review of invoices from PY3.

4.4.1.1.2 Residential: Appliance Recycling

The SWE requested samples of Duquesne's JACO[37] work orders and corresponding database entries for each quarter. The SWE then checked the database entries for these participants and verified them against the individual database entries from JACO for each customer. For each participant, the SWE verified that number and type of appliances removed was consistent across both databases. The SWE also verified that the savings value used for each sampled participant reflected the characteristics of the recycled appliance. The SWE observed that all participant data was consistent in both Duquesne and

37 JACO is the vendor for all EDCs' appliance recycling programs.

JACO's databases. Duquesne used the updated values for energy savings of replaced and retired refrigerators from the 2011 TRM in the calculation of net savings.

4.4.1.1.3 Residential: EE Program (REEP) – Rebate Program

The SWE requested samples of Duquesne's customer rebate applications and corresponding database entries for each quarter. The SWE then checked these participants' rebate applications against the Duquesne database. The SWE found that all participants sampled had active Duquesne accounts and all measures that were rebated were on the approved list. Each measure could either be found in the energy catalog (which required the participant to submit an application and receipt) or was a part of a Duquesne approved kit energy efficiency (in which case the CSP invoices to Duquesne were cross-checked with shipping receipts and payment vouchers.)

The SWE found no quality control errors In the PY3 samples. In the latter part of PY2, the SWE informed Duquesne that the SWE would start choosing the sample from Duquesne's residential database. This gave the SWE a higher level of confidence in the random sample audited in PY3.

4.4.1.1.4 New Construction Program

Duquesne did not have an active new construction program in PY3.

4.4.2 Low-Income Programs Audit Summary

The SWE conducted site inspections of eight PY3Q1 low-income installations. For the remaining three quarters, Duquesne elected to use a local, third-party contractor to perform the site inspections. The SWE provided Duquesne a site inspection report template for the contractor to use to ensure all of the necessary information was captured and documented.

For the site inspections of installations in PY3Q1, the SWE found that all measures were installed as reported. A key finding from the PY3 Q2, Q3 and Q4 site inspections was that smart power strips were not installed at all or were installed improperly by several participants. The SWE recommended that the educational materials provided with the smart strip be revised to stress the importance of proper installation of the measure to achieve expected energy savings. Duquesne agreed with this recommendation and plans to implement changes. The SWE also found that the installation rate of furnace whistles[38] was low, likely for similar reasons as the smart power strips. Lastly, for the Q3 and Q4 inspections, a minor modification was made to the template to have the contractor query program participants whether installed LED nightlights were replacing incandescent nightlights or were incremental household energy users. The SWE site inspection reports indicated that, of those receiving LED nightlights, just over half replaced incandescent nightlights. However, there were not enough data points in PY3 to draw any conclusions about the population. If in PY4 the data continues to indicate that LED nightlights are generally increasing participants' energy use, the SWE may recommend adjustments to savings calculations and reporting for this low-income measure.

[38] A furnace whistle is a device that provides an alert when it is time for the furnace filter to be changed. Savings result from reduced furnace blower fan motor power requirements for winter and summer use of the blower fan motor.

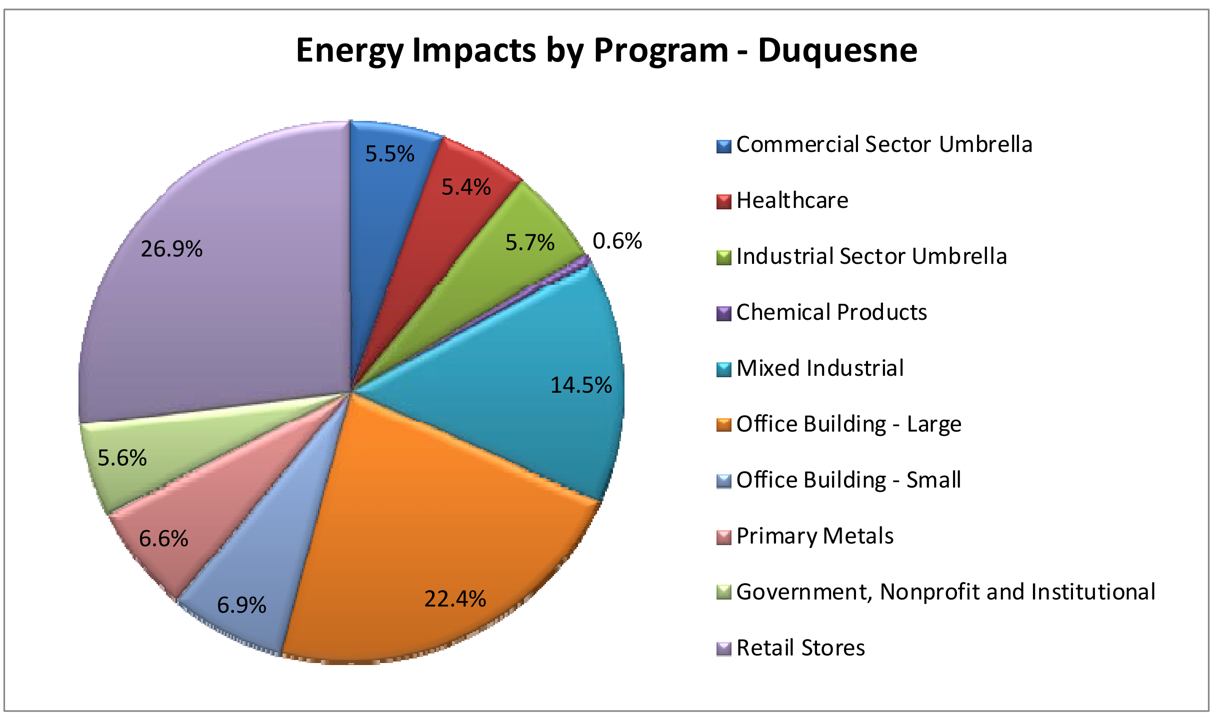
The SWE reviewed quarterly database extracts for Duquesne's low-income programs. The Residential: Low-Income EE Program (LEEP) reported energy and demand savings for PY3 were calculated per the 2011 TRM. The SWE confirmed that all verified per-measure savings, participant counts, in-service rates and program energy and demand impacts were consistent with the TRM. The program evaluation found that in-service rates, as determined through participant surveys, for energy efficiency kits were less than those in-service rates deemed for the individual kit measures in the 2011 TRM. Therefore, the SWE confirmed that verified savings for the kits was appropriately adjusted downward relative to the reported savings based on the in-service rates determined through the surveys.

The SWE verified that Duquesne was in compliance with the requirement that the number of energy conservation measures offered to low-income households is proportionate to those households' share of the total energy usage in Duquesne's service territory. Duquesne offered 27 types of measures to the low-income sector in PY3, which was 38.57% of the total number of the types of measures offered across all customer sectors. This level of measures substantially exceeds Duquesne's Act 129 compliance target, which is 7.88%.

4.4.3 Non-Residential Program Audit Summary

Duquesne's non-residential EE&C programs are defined by customer segment. Figure 4-3: Distribution of Gross Reported Energy Impacts among Duquesne Non-Residential Programs shows the distribution of savings in Duquesne's non-residential portfolio by customer segment.

Figure 4-3: Distribution of Gross Reported Energy Impacts among Duquesne Non-Residential Programs



Only 5.6% of the non-residential energy savings in the Duquesne portfolio comes from the Government/Educational/Non-Profit (GNP) sector in PY3. This is a significant decrease from PY2 when

the GNP sector produced 27% of Duquesne's non-residential energy savings. Retail stores and office buildings were the largest contributors to savings, accounting for 56.2% of the reported gross savings for PY3. Lighting retrofit projects provided the majority of PY3 savings across all sectors.

The SWE performed an audit of the reported participant counts, energy savings and demand savings from Duquesne's PY3 non-residential programs by comparing the figures in Duquesne's PY3 Final Annual Report to the program tracking data which is submitted to the SWE on quarterly basis. The SWE found no discrepancies between the program tracking data and the reported impacts from non-residential programs. Based on this review, the SWE believes that Duquesne's process for transferring data from its PMRS tracking system into extracts for the SWE and into quarterly and annual reports is performing well and no modifications are needed. Appendix G.1 contains additional detail on the SWE review of Duquesne's savings database.

The SWE also performed desk audits of project files from a sample of PY3 non-residential projects which were submitted as part of the SWE Quarterly Data Request. 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 2011 TRM. 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 found the supporting documentation to be comprehensive, detailed, well-organized and allowed for a complete review of all uploaded projects. Based on this review, the SWE has no concerns about the accuracy of Duquesne's reported savings impacts. However, four potential opportunities for improvement were identified in the project file review that the SWE recommends Duquesne address in PY4.

1. The Effective Full Load Hour (EFLH) values for commercial lighting retrofit projects did not always correspond to the values deemed in Table 3-2 and 3-5 of the 2011 TRM. If the hours-of-use in a facility differ significantly from the deemed EFLH values for that building type in the TRM, Duquesne uses facility-specific operating hours in the reported savings calculation. The SWE supports this practice and believes it produces the most accurate estimates of project savings, but requests that supporting documentation for the project include an explanation of how the EFLH value was determined.
2. The fixture wattage values in Duquesne's PMRS tracking system are sometimes slightly different than the values specified in the TRM's Appendix C: Lighting Audit and Design Tool. The variations observed were very small, but the SWE recommends Duquesne modify the fixture wattage lookup table in its PMRS system to match the TRM's Appendix C Tool moving forward.
3. Interactive effects, or HVAC savings due to cooler more efficient lighting, should only be applied to lighting projects installed in air conditioned spaces. One of the projects reviewed by the SWE in PY3 was a lighting retrofit in the production area of a steel plant. The savings calculation worksheet for the project did not include savings from interactive effects and it was unclear from the project documentation if the space was air conditioned, but the interactive effects were applied to the savings calculation in the PMRS tracking system. The SWE recommends

Duquesne only apply interactive effects when the presence of air conditioning in the space is confirmed and documented.

4. One apparent data entry error was noted during the SWE desk reviews. An EFLH value of 260 was used in the savings calculation for one of the measures reviewed. Other measures completed as part of the same project used EFLH values of 2600. The SWE recommends Duquesne consider QA/QC processes that screen for unrealistically high or low values for key parameters.

Lastly, the SWE performed seven ride-along inspections and two independent site inspections of Duquesne's PY3 non-residential projects. An overview of the site inspection process and common findings is provided in Section 3.1.3.1 and Duquesne-specific project findings and resolutions are provided in Appendix G.1.

4.4.4 Demand Response Audit Summary

There was no audit work completed on Demand Response programs as these programs had not yet been implemented in PY3.

4.4.5 Net-to-Gross and Process Evaluation Audit Summary

The SWE's review of the net-to-gross (NTG) analyses and process evaluations for Duquesne's energy efficiency programs focused on the level of rigor employed for programs evaluation, the level of transparency provided regarding the evaluation methodology and the level of consistency in methodology, and reporting practices for each evaluated program. Findings and recommendations from this review are presented in this section.

4.4.5.1 Net-to-Gross (NTG) Ratio

As described in Section 3.8, the SWE defined three levels of rigor for NTG analysis: Basic, Standard, and Enhanced. **Error! Reference source not found.** shows the results of Duquesne's NTG analyses. Six programs or program groups were considered for NTG analysis. The SWE recommended a Basic rigor be used for the analysis of each program with the exception of the Residential: EE Program - Upstream Lighting (within the REEP Group). NTG research is more challenging for upstream programs because program participants are not tracked so the SWE recommended that the evaluator's discretion be used to determine the appropriate NTG research tactics for this program.

The Duquesne Program Evaluator conducted NTG analyses for all six of Duquesne's energy efficiency programs or program groups. All six analyses were conducted at the Basic rigor level. Five of the six analyses administered self-reporting surveys to program participants to arrive at free ridership scores and an assessment of program spillover. The Residential: Low-Income EE Program (LIEEP) used a weighted average of NTG ratios from other Duquesne programs to determine its NTG ratio.

Instead of conducting individual NTG analyses for each program within each of the Commercial Program Group and the Industrial Program Group, the Duquesne Program Evaluator aggregated survey responses from each individual sub-program within each evaluation group to determine an overall NTG ratio for each of the Commercial Program Group and Industrial Program Group.

With respect to the Residential Upstream Lighting Program, the Duquesne Program Evaluator did not perform a NTG analysis. The Program Evaluator decided that it would be most helpful to assess NTG for the Upstream Lighting program in PY4.

For PY3, several commercial energy efficiency programs constituted a significant portion of portfolio savings. These included the Office Building – Large – EE, Office Building – Small –EE, Retail Stores – Small – EE and Retail Stores – Large – EE. Despite the large savings achieved by these programs, the Duquesne Program Evaluator provided a single NTG ratio to represent all of Duquesne’s commercial programs. The Duquesne Program Evaluator stated in the Duquesne PY3 Annual Report that certain commercial programs were grouped based on shared characteristics to conduct cost effective EM&V per direction of the Duquesne’s EM&V Plan and PY3 Sampling Design Memorandum. It is recommended that those programs that account for more than 5% of portfolio savings undergo an individual NTG analysis at the level of rigor recommended in the SWE NTG Study Methods paper.

It is also recommended that a NTG analysis be conducted for the Residential: EE Program - Upstream Lighting in PY4. This program achieved the highest savings among the residential programs. Despite the fact that the impact evaluation for this program is a census approach only involving document review, it is recommended that surveys and interviews be added to the scope of the evaluation in order to achieve the recommended Enhanced level of rigor for the net savings analysis.

The overall transparency of the NTG analysis of Duquesne programs was very high. The Duquesne Program Evaluator provided descriptions of the survey instrument, and how the instrument was developed, as well as the free ridership algorithms used for each program. Survey result scores were provided based on the free ridership algorithm and the calculation of programs’ free ridership were easily understood. Spillover methodologies were equally transparent. The Duquesne Program Evaluator explained how it scored surveys and provided the scoring results in its report. Deemed savings values for spillover measures were documented along with an explanation for the rationale of using selected deemed values. The spillover methodology used in PY3 was robust and delivered an estimated spillover kWh per participant for each program. In future program years the SWE recommends that the spillover kWh savings per participant be used to calculate a spillover rate for the programs and that rate should be incorporated into the NTG ratios for the programs.

NTG methodologies and results were reported consistently among programs. The Duquesne Program Evaluator used the same methodology for each residential program and a similar methodology for the commercial and industrial programs. The Duquesne Program Evaluator was also very consistent in its reporting of the number of surveys conducted and subsequent results. It is recommended that the Duquesne Program Evaluator continue this level of consistency in subsequent evaluation reports.

4.4.5.2 Process Evaluation

The process evaluation conducted by the Duquesne Program Evaluator for Duquesne’s EE&C programs was reviewed in the same manner as the NTG analysis. Findings and recommendations from the SWE’s review are presented below.

The Duquesne Program Evaluator provided limited details regarding its methodology for conducting the process evaluation for each program. For instance, information was not provided on the survey instrument, how the survey was scored, the number of surveys administered, or specifics on which programs and program stakeholders and/or participants responded to the surveys. The Duquesne Program Evaluator instead provided high level action items involved with the process evaluation, such as reviews of the 2011 TRM and Duquesne's PMRS tracking system, interviews with program staff, and survey results. Little insight was provided on what was involved in these reviews and interviews, and in survey analysis.

Due to this lack of information, it is difficult to assess how rigorous the process evaluations are for each program. No pre-determined level of rigor was described nor recommended by the SWE, as was for the NTG analysis.

It is recommended that the Duquesne Program Evaluator provide greater detail and insight into the process evaluations it conducted. More specific information gained from program staff interviews will be helpful to identify what aspects of the program are working well and what aspects need improvement. Similarly, more explanation regarding the participant survey methodology and expanded analysis of survey results will provide feedback on the program's current status and future outlook.

Additionally, the scope of the process evaluation can be expanded. For instance, feedback from additional program stakeholders, such as trade allies, may help uncover missed opportunities or unknown issues that may be addressed to improve the program's performance. Moreover, developing and/or reviewing program logic models will help identify any gaps in the program and ensure the program is on track to meet its goals and outcomes.

In general, the process evaluation for each program was reported similarly. The exception to this occurred in the results presented for residential and non-residential programs. While both sectors were described in the report to have undergone very similar analyses, more comprehensive findings and recommendations were presented for the non-residential programs than for the residential programs. This occurred because the process issues in PY3 were largely a check on whether progress had been made on issues identified in the PY2 process evaluation, which found more issues in the non-residential sector than the residential sector. The additional content was appreciated; however, the findings were at times out of context. A more thorough description of the program, such as a logic model, may alleviate this issue in future reports.

4.5 Statewide Evaluator Recommendations

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

1. A number of findings and recommendations were presented by the Duquesne Program Evaluator based on the PY3 process evaluation. The SWE recommends that Duquesne consider incorporating the recommended actions in PY4 and in Phase II of Act 129.
2. For Duquesne's residential low-income program, the site inspections indicate that many participants are not utilizing smart power strips correctly and are unaware of the intended energy saving functions of the measure. The SWE recommends that Duquesne provide additional education to customers with regard to the proper use of smart power strips. Similarly, furnace whistles had a low installation rate and additional education may be necessary to explain the energy saving value of the measure and installation instructions.
3. The first year of avoided cost values should be advanced each program year so that savings are applied to the avoided cost values from the year that they will actually occur. Duquesne should consider whether making this adjustment in PY4 or Phase II of Act 129 is most logical given its internal systems and processes.
4. For measures not included in Appendix A of the TRM, additional detail should be provided on how the effective useful life of the measure was determined.
5. In the PY4 evaluation of non-residential programs, the Duquesne Program Evaluator should increase the number of projects evaluated using IPMVP Option B or deploy data loggers on a greater portion of sampled projects evaluated using IPMVP Option A. Repeating the savings calculations using the *ex ante* savings assumptions produces artificially high precision values. This can be avoided in PY4 by using actual project parameters in the verified savings calculations rather than TRM assumptions.
6. For the Industrial Program Group, the SWE recommends a more balanced sampling approach in PY4 to reduce the amount of attribution any single project has on the realization rate for the program. Two options for accomplishing this are sampling at the project level or verifying only measures selected in the sample.
7. The SWE project file review for non-residential programs found that the Effective Full Load Hour (EFLH) values for commercial lighting retrofit projects did not always correspond to the values deemed in Table 3-2 and 3-5 of the 2011 PA TRM. The use of facility-specific operating schedules is encouraged, but if *ex ante* EFLH values are not based on the TRM, the supporting documentation for the project should include an explanation of how the EFLH value was determined.
8. A NTG analysis should be conducted in PY4 for the Residential: EE Program - Upstream Lighting at the Enhanced level of rigor as defined in the SWE NTG Study Methods paper.
9. The SWE recommends that Duquesne modify the fixture wattage lookup table in its PMRS system to match the TRM's Appendix C (Lighting Inventory Tool) moving forward.
10. The SWE recommends that Duquesne only apply interactive effects, or HVAC savings due to cooler more efficient lighting, when the presence of air conditioning in the space is confirmed and documented.

11. Additional detail regarding the process evaluation methodology should be included in future annual reports.

4.6 Statewide Evaluator Best Practice Analysis

One of the best practices identified in Appendix D is the importance of strong relationships among contractors, retailers, and trade allies. Duquesne developed strong working relationships with many retailers in PY3. Specifically, during PY3, Duquesne worked with the program’s Upstream Lighting CSP and with retailers to promote residential rebates in their stores through events. These events took place at large retailers, such as Lowes and Sam’s club, on a monthly basis. These events used significant program signage and information sheets, along with special pricing. For PY4, Duquesne and its CSP, ECOVA, have targeted promotions in 58 major appliance stores in the Pittsburgh area to display program signage on or next to qualifying appliances.

5 PECO Energy Company

This section summarizes PECO Energy Company (PECO) performance in PY3, as well as the cumulative energy savings and demand reductions achieved by PECO's Act 129 EE&C programs through the end of PY3. This section presents the evaluation activity completed by both Navigant Consulting (the current PECO Program Evaluator) and the SWE in the calculation of the cost-effectiveness, and the measurement and verification (M&V), of PECO's EE&C programs. This section also provides the SWE's recommendations for PECO's programs going forward.

5.1 Summary of Energy and Demand Reductions

Table 5-1 highlights PECO's cumulative reported gross impact and verified gross impact since the EE&C programs' inception through the end of PY3.

Table 5-1: Summary of PECO CPITD Impacts

	CPITD Reported Gross Impact[f]	CPITD Verified Gross Impact[h]	Savings Achieved as % of 2013 Targets[i]
Total Energy Savings (MWh/yr)	1,096,933	1,072,448	90.8%
Total Demand Reduction (MW)	188	186	52.4%
TRC Benefits ($1,000) [a]	Not Applicable[g]	$1,053,185	Not Applicable
TRC Costs ($1,000) [b]	Not Applicable[g]	$282,333	Not Applicable
TRC Benefit-Cost Ratio [c]	Not Applicable[g]	3.73	Not Applicable
CO_2 Emissions Reduction (Tons) [d][e]	888,516	868,683	Not Applicable

NOTES:
[a] 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. 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 TRC Order.
[d] 8.1x10-4 metric tons of CO_2 per kWh (EPC's eGRID2007 Version 1.1, RFCE Region annual non-baseload CO_2 output emissions rate, year 2005 data). This is included in this report per the approved SWE work plan.
[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] Defined as the gross energy savings that were reported during the period since date of program implementation through the current reporting period (i.e., reporting period of this report). CPITD = Cumulative Program Inception To-Date.
[g] TRC Benefits and Costs are calculated only for verified savings, which reflect actual program results.
[h] Defined as the energy savings that have been verified by the PECO Program Evaluator and audited by the SWE, and since the date of program implementation through the end of PY3.
[i] Savings achieved based on CPITD Verified Gross Impact.

As shown, PECO has achieved 90.8% of its Act 129 2013 energy savings target and 52.4% of its Act 129 demand savings at the end of PY3. The TRC Benefit-Cost Ratio (or TRC Ratio) of 3.73 indicates PECO's EE&C programs are cost-effective on an aggregate (portfolio) basis.

Table 5-2 contains a listing of PECO's EE&C programs that reported participation and had energy and/or demand savings that were evaluated in PY3, and programs that are yet to be implemented or had no reported savings in PY3.

Table 5-2: PECO EE&C Programs

Programs Reporting PY3 Gross Savings:
• Smart Lighting Discounts Program • Smart Appliance Recycling Program • Smart Home Rebates Program • Low-Income Energy Efficiency Program • Smart Equipment Incentives - C&I • Smart Construction Incentives • Smart Equipment Incentives – GNP
Programs to be Implemented or with No Reported PY3 Savings:
• Residential Direct Load Control • Commercial Direct Load Control • Demand Response Aggregators • Distributed Energy Resources • Conservation Voltage Reduction

PECO has reported PY3 gross energy and/or demand savings for eight programs. Table 5-3 below provides a breakdown of the contribution of each program's verified gross energy savings and verified gross demand savings towards the CPITD portfolio savings. As shown, the Smart Lighting Discounts Program accounts for 33% of the total CPITD verified gross energy savings for PECO's portfolio, and represents approximately 45% of such savings from all residential energy efficiency programs. In the commercial and industrial sector (C&I), the largest savings comes from the Smart Equipment Incentives Program, which accounts for 15% of the total portfolio savings and 65% of the savings from commercial and industrial energy efficiency programs.

Table 5-3: Summary of PECO EE&C Programs Impacts on Gross Reported Portfolio Savings – PY3

Program:	CPITD Verified Gross MWH/YR Savings	Percent of Portfolio CPITD Verified Gross MWh/yr Savings	CPITD Verified Gross MW Reductions	Percent of Portfolio CPITD Verified Gross MW Reductions
Smart Lighting Discounts Program	351,039	33%	22.8	12%
Conservation Voltage Reduction	320,373	30%	89.3	48%
Smart Home Rebates Program	64,499	6%	18.2	10%
Smart Appliance Recycling Program	43,293	4%	8.9	5%
Low-Income Energy Efficiency Program	52,533	5%	4.1	2%
Smart Equipment Incentives - C&I	157,836	15%	29.5	16%
Smart Equipment Incentives - GNP	77,320	7%	11.2	6%
Smart Construction Incentives	4,848	0%	2.0	1%
TOTAL PORTFOLIO	**1,071,741**	**100%**	**187.9**	**100%**

1 Programs to be implemented or with no reported PY3 savings are not shown. See Table 5-2.

5.2 Total Resource Cost Test

Table 5-4 provides a breakdown of the contribution of each EE&C program's Program Year-to-Date (PYTD) verified gross energy savings and demand reductions as well as the TRC Ratios.

Table 5-4: Summary of PECO EE&C Program Impacts on TRC Ratios

Program	PY3 Verified Energy Savings (MWh/yr)	PY3 Verified Demand Reductions (MW)	TRC Ratio
Smart Lighting Discounts Program	28,580	1.7	6.9
Smart Home Rebates Program	20,819	5.7	1.5
Smart Appliance Recycling Program	12,309	2.2	6.65
Low-Income Energy Efficiency Program	24,652	0.0	2.2
Smart Equipment Incentives - C&I	68,409	1.5	2.21
Smart Equipment Incentives - GNP	39,155	5.6	1.9
Smart Construction Incentives	4,385	13.1	2.11
TOTAL PORTFOLIO	198,309	31.7	3.37

1 Programs to be implemented or with no reported PY3 savings are not shown. See Table 5-2.

All seven of PECO's programs are found to be cost-effective by the TRC Ratio (i.e., the Ratio exceeds 1). An important finding is that the programs with the largest savings in the residential and C&I sectors have high TRC ratios. This means that not only are they performing well in terms of generating savings, they are also cost-effective programs. It is also important to note that even programs that generated the least amount of savings in comparison to other programs are still deemed cost-effective.

5.2.1 Assumption and Inputs

The PECO TRC model uses a weighted average cost of capital, or discount rate, of 7.6% to discount program benefits and costs. This rate is used to compare the Net Present Value (NPV) of program benefits that will occur later in a measure's lifetime to the upfront costs of installation and implementation. PECO's discount rate used for PY3 TRC Test calculations was 7.6%. This is slightly higher than the value used in their PY2 TRC calculations and 2009 EE&C Plan (7.45%). The modification was made to reflect the current discount rate. A single line loss factor of 7.1% is used to calculate energy savings for all programs. However, PECO uses different line loss factors for peak demand savings than for energy savings. These peak demand savings line loss factors vary by sector, in contrast to the energy savings line loss factors. A line loss factor of 16.1% is applied to all residential programs, whereas different line loss factors are used for each non-residential program. Table 5-5 shows line loss factors used for energy and demand savings for all programs.

Table 5-5: PECO Line Loss Factors for Energy and Demand

Line Loss Factors	Energy	Demand
PECO Smart Lighting Discounts Program	7.1%	16.1%
Low-Income Energy Efficiency Program	7.1%	16.1%
Residential Smart Appliance Recycling Program	7.1%	16.1%
Smart Homes Rebates Program	7.1%	16.1%
Smart Equipment Incentives Program for Commercial and Industrial Customers	7.1%	10.0%
Smart Equipment Incentives Program for Government and Nonprofit Customers	7.1%	10.5%
Conservation Voltage Reduction Program	7.1%	7.1%
Residential Direct Load Control	7.1%	7.1%
Commercial Direct Load Control	7.1%	7.1%
Smart Construction Incentives Program	7.1%	10.1%
Demand Response Aggregators	7.1%	7.1%
Distributed Energy Resources	7.1%	7.1%

PECO submitted two workbooks to the SWE for review, which contained all data inputs, assumptions and calculations. In one of the workbooks, two tabs were devoted to each program in the PECO portfolio. The first tab consisted of measure level inputs such as the number of participants, the effective measure life, the sum of the energy and demand impacts and realization rates. The second tab for each program compiled the data inputs contained in the first tab, determined the associated financial benefits and showed the TRC ratio. The other workbook contained similar data, but also showed calculations used to estimate the TRC ratios for all programs. This workbook is a replicate of inputs, calculations, and results obtained from PECO's proprietary TRC model.

The gross annual energy and demand savings reported for each measure were allocated each year until the end of the measure's effective lifetime. The effective measure lives used in the PECO TRC model were consistent with Appendix A of the TRM. Measures such as motors and variable frequency drives

(VFDs) were assigned measure lives greater than 15 years in the PECO TRC model, but no energy or demand savings were associated with the measure after 15 years as directed by the TRC Order. A source for measure life was clearly mentioned for each of the measures in TRC model. Sources included the 2011 TRM, PECO EE&C Plan, DEER 2008 database and the PECO tracking database.

Incremental costs were also applied at the measure level in the PECO's TRC model. The TRC model clearly specified the source for cost assumptions. The list of sources included the DEER database, PECO EE&C Plan, TRMs from other jurisdictions, program staff, ENERGY STAR® and the PECO database.

The energy and demand impacts used in the PECO TRC model were drawn from the tracking database which used TRM specified values and equations to assign *ex ante* annual savings values to completed measures. The SWE compared the *ex ante* impacts used in the TRC model with the PECO PY3 measure-level database extract for several measures and found perfect agreement between the participation counts, energy impacts and demand impacts. The TRC model's analysis is based on *ex post* verified savings, so program impacts are adjusted by an applicable realization rate. Realization rates were determined at the program level and separate realization rates were applied to energy and demand impacts. The *ex post* verified savings are extended over the effective measure life and summed, by year, for each program.

5.2.2 Avoided Cost of Energy

The PECO TRC model assigns a value ($/kWh) to the avoided cost of energy for each year from 2011 through 2027 under four different load conditions – summer on-peak, summer off-peak, winter on-peak and winter off-peak. Each measure in PECO's portfolio is assigned to an end-use load shape that is the most correlated with the affected equipment. The energy impacts of a given measure are divided across the four load conditions based on the associated load profile. The impacts under a given load condition are multiplied by the avoided cost of energy for that condition and summed across the effective lifetime of the measure to calculate the avoided energy benefits produced by the measures. The use of specific end-use load shapes makes the TRC model results more realistic because measures yielding energy savings during 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 assigns a value ($/kWh) to the avoided cost of transmission & distribution (T&D) for each year from 2011 through 2027. Avoided costs of T&D are applied for the residential, small commercial and large commercial sectors. A weighted average is calculated for both small commercial and large commercial sectors based on the estimated sales from the SWE Market Potential study. Avoided T&D costs are escalated at 2% per year from PY 2013 (the start of Phase II). Avoided T&D costs are highest for the residential sector and lowest for the C&I sector. The measure-level *ex post* savings impacts are adjusted for line loss and then multiplied by the appropriate avoided energy cost stream to calculate avoided energy benefits.

5.2.3 Avoided Cost of Capacity

The PECO TRC model assigns a flat annual amount ($/kW) to the cost of adding generation capacity, which is used for the avoided cost of capacity for all programs and sectors. The PECO forecasted avoided costs of capacity figures increase steadily over the next 15 years and are the highest of any EDC from

2022 through 2027. *Ex post* demand savings are adjusted for line loss and multiplied by the avoided capacity estimate to determine the financial benefit of peak demand impacts.

5.2.4 Conclusions and Recommendations

The PECO spreadsheet TRC model was very transparent and all inputs were well documented and consistent with other documentation provided to the SWE for review. The SWE team feels that the PECO TRC model provided adequate detail regarding the determination of financial benefits from energy and demand impacts. Measure life assumptions were consistent with Appendix A of the TRM and gross energy and demand impacts were consistent with reported figures and database extracts provided to the SWE for review. The use of end-use load shapes to determine on-peak and off-peak energy use by season associates larger avoided cost benefits to measures which reduce consumption during periods of high system load. The SWE team recommends that PECO use the same discount rates filed in their 2009 EE&C Plan for TRC calculations for all program years.

5.3 Status of Evaluation Activities

5.3.1 Status of EM&V Plans

Per the guidelines outlined in the Audit Plan,[39] the SWE has reviewed EM&V plans submitted by the EDCs to verify that the plans comply with the TRM and TRC Orders and meet the minimum evaluation requirements set forth in the Audit Plan. The Audit Plan provides an outline for the evaluation framework expectations and guidelines necessary to address the following research objectives:

- determine realization rates for gross savings;
- determine net to gross (NTG) ratios;
- determine method for calculating savings; and,
- set acceptable levels of rigor, precision and bias for measurement and verification (M&V) activities.

PECO submitted an Evaluation, Measurement and Verification (EM&V) Plan for PY3 and PY4 to the SWE on March 27, 2012. The Plan contained the key research questions, data collection methods and approaches for the impact and process evaluations of each of PECO's EE&C programs. Changes from previous versions of the Plan were limited to the three programs – Smart Lighting Discounts, Residential Direct Load Control and Commercial Direct Load Control.

The SWE reviewed the EM&V Plan and discussed the changes during biweekly teleconferences. The primary change to the Direct Load Control programs methodology was to utilize a "comparable day" method rather than a regression analysis to determine the average load reduction per home. This change is consistent with PJM Manual 19 and was approved by the SWE. PECO originally proposed a sample size of 13 homes be used to determine the Switch Operability Rate. The SWE requested that this sample size be increased because of the importance that this statistic has in the overall load reduction

[39] See Statewide Evaluation Team, *Audit Plan and Evaluation Framework for Pennsylvania Energy Efficiency and Conservation Programs*, November 4, 2011.

estimates of the program. PECO revised the Plan to include a sample size of 30. This revised EM&V Plan was approved by the SWE in May 2012.

On July 20, 2012 PECO submitted a memo to the SWE requesting permission to use deemed savings values instead of the results of its M&V efforts for the verified savings results of its Direct Load Control programs. Attachment B to PJM Manual 19 approves the use of values from the Manual's Table 13 of "Deemed Savings Estimates for Legacy Air Conditioning and Water Heating Direct Load Control Programs in PJM Region" in the absence of a load research study. The SWE approved this change and issued a Guidance Memo on August 22, 2012 to each of the EDCs and their program evaluators approving this methodology for the calculation of verified demand reductions for Act 129 Direct Load Control programs.

5.3.2 M&V Activities and Findings

The following section provides a summary of the Measurement and Verification (M&V) activities conducted by the PECO Program Evaluator based on details provided in PECO's PY3 Annual Report as well as information gathered from SWE data requests and audits.

5.3.2.1.1 Gross Impact Evaluation

Table 5-6 provides a summary of M&V based on activities conducted by the PECO Program Evaluator based on details provided in PECO's PY3 Annual Report, and on information obtained from SWE data requests and audits.

Table 5-6: PECO Energy Efficiency Programs - Realization Rates for Energy and Demand Savings

Program	Realization Rate-Energy Savings	Realization Rate-Demand Savings
Smart Lighting Discounts Program	100%	100%
Smart Home Rebates Program	99%	100%
Smart Appliance Recycling Program	96%	100%
Low-Income Energy Efficiency Program	96%	60%
Smart Equipment Incentives - C&I	103%	110%
Smart Equipment Incentives - GNP	81%	90%
Smart Construction Incentives	104%	190%
TOTAL PORTFOLIO	**96%**	**100%**

1 Programs to be implemented or with no reported PY3 savings are not shown. See Table 5-2.

The realization rate is a factor that compares the gross savings reported by the EDC to the verified gross savings determined by the EDC's program evaluator through M&V activities. The calculation for a realization rate is as follows.

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

Depending on the program, realization rates are calculated either based on a sample of program participants and then applied to all participants or on a census of all program participants and then applied to all participants. A realization rate of 100% indicates that the evaluation team was able to verify all reported savings (this is the case with PECO's Smart Lighting Discounts Program). A realization rate of less than 100% indicates that the gross savings were an over-estimate and a realization rate of over 100% indicates that gross savings were an under-estimate.

Realization rates for energy savings from PECO's programs range from 81% (Smart Equipment Incentives - GNP) to 104% (Smart Construction Incentives) for energy savings. Realization rates for demand reductions from PECO's programs range from 60% (Low-Income Energy Efficiency Program) to 190% (Smart Construction Incentives).

5.3.2.1.2 **Low-Income Energy Efficiency Program (LEEP**)

The low demand impact realization rate for the Low-Income Energy Efficiency Program (LEEP) is a result of the incorporation of program inputs into a calibrated simulation model for calculating demand impact. The *ex ante* demand impact was calculated by multiplying energy savings by a coincident peak demand savings conversion factor of 0.000122 kW/kWh. The conversion factor was a best available estimate derived from modeling and was approved by the SWE as part of a 2010 LEEP custom measure protocol. For PY3, the *ex post* demand impact was based on Low-Income Usage Reduction Program (LIURP) evaluations and LEEP tracking data, which were both input into the calibrated simulation model. The change in evaluation approach resulted in a reduction in verified peak demand impact as compared to the reported impact.

5.3.2.1.3 Smart Equipment Incentives C&I

PECO's Smart Equipment Incentives C&I Program consists of three sub-components – C&I retrofit projects, C&I multi-tenant projects, and C&I appliance recycling projects. The multi-tenant and appliance recycling portions were evaluated similarly to their residential program counterparts due to the similarity of the measures. Project documentation from a sample of rebated measures (14 of the 361 total) was reviewed to confirm that the documentation matched the PECO tracking system. If the project files were deemed complete, the reported savings estimates based on the 2011 TRM were used as the verified savings estimates. This low rigor approach is consistent with the relatively small contribution of multi-tenant projects to the Program savings. The appliance recycling portion of the Program was not evaluated separately from the Residential Appliance Recycling Program. Instead, the PECO Program Evaluator applied the energy and demand realization rates of 96% from the evaluation of the Residential Appliance Recycling Program to the reported savings of appliances recycled in the C&I sector.

The overall realization rates of the Program were 103% for energy and 110% for demand, and none of the strata proved to be significant outliers. The relative precision of the verified savings estimate of energy savings was 8.3% at the 90% confidence level. The PY3 verified gross energy savings estimate for the program was 68,409 MWh/yr, thus it can said with 90% confidence that the actual energy savings produced by the Program was within plus or minus 8.3%, or between 62,731 MWh/yr and 74,087 MWh/yr. Relative precision expressed at a lower confidence level (such as 85%) would be smaller because we can state with less confidence that the actual program savings are within a smaller window above and below the program savings estimate.

The SWE requested M&V approaches and verified savings estimates for each project in the evaluation sample, as well as the calculation of the reported relative precision values as part of its Annual Data Request. While auditing these documents, the SWE observed that the relative precision values shown for the energy realization rate of Strata 1-3 in Table 6-4 of PECO's PY3 Annual Report were incorrect. The precision of the evaluation was actually much better than was reported. The SWE performed an independent calculation and the results matched the supporting spreadsheet provided by the PECO Program Evaluator. The correct relative precision values for strata 1-3 were 8.0%, 14.5% and 12.7%, respectively. The relative precision of the PY3 savings estimates at the program level were calculated and reported correctly in accordance with the guidelines for stratified ratio estimation set forth in the Audit Plan.

5.3.2.1.4 Smart Equipment Incentives – GNP (Government, Educational, and Non-Profit)

PECO's Smart Equipment Incentives - GNP Program consists of four sub-components – GNP retrofit projects, GNP multi-tenant projects, GNP new construction projects, and GNP appliance recycling projects. As was the case for the Smart Equipment Incentives C&I program, the appliance recycling and multi-tenant components of the GNP program were evaluated using the same approach as their residential counterparts.

The PECO Program Evaluator separated the retrofit component of the program into four strata. Stratum 1 was made up of the projects with a reported energy savings of greater than 900,000 kWh. Stratum 2 was made up of projects with reported energy savings between 250,000 and 900,000 kWh and Stratum 3 was composed of projects reporting less than 250,000 kWh. Stratum 4 was made up of all municipal lighting projects. A total of 16 projects from Strata 1-3 were selected for on-site verification. The reason for the small sample was an assumption that the variation between reported and verified savings would be similar to the previous program year (PY2). This is typically a sound practice, but the composition of projects in the GNP program in PY3 was very different from PY2. In PY2, most projects were lighting retrofits and the reported savings were highly correlated with the verified savings estimates. In PY3, there were a number of variable frequency drive (VFD) and energy management system (EMS) projects in the sample, and the relationship between *ex ante* and *ex post* savings was much more volatile.

Because of the lack of correlation between *ex ante* and *ex post* savings estimates, the observed coefficient of variation (Cv) for GNP retrofit was greater than expected for both energy and demand. PECO was able to offset some of the variation in the demand realization rate by using the project-level energy realization rate as a proxy for the demand realization rate. The SWE recommends that PECO avoid this approach in PY4 and develop independent estimates of peak demand savings.

The energy savings realization rate for the Smart Equipment Incentives- GNP program was 81% for PY3 and the demand reduction realization rate was 90%. This means that the verified savings for the Program were somewhat lower than the reported savings. The relative precision of the energy savings realization rate was 17.4%[40] at the 85% confidence level. This misses the annual program targets set

[40] Table 7-4 of the PECO PY3 Annual Report shows a relative precision of 19.9% for energy at the program level. This figure was calculated at the 90% confidence level, rather than the 85% confidence level.

forth in the Audit Plan. PECO provided an in-depth discussion and explanation of why the realization rates and relative precisions fell short of their respective targets, both in the PECO PY3 Annual Report and in a memorandum addressed to the SWE. The SWE agrees with the PECO Program Evaluator's recommendations for increasing precision values in future analyses. Corrective action will include increasing sample sizes, considering more VFD projects as custom, and requiring more robust *ex ante* savings calculations for EMS measures.

5.3.2.1.5 Smart Construction Incentives Program

The impact evaluation for the Smart Construction Incentives Program consisted of desk reviews, whole building simulations, and on-site M&V. Desk reviews were used for six prescriptive projects and included a review of project applications, associated calculations, invoices, and specification sheets. Whole building simulations were used for six projects and consisted of a site visit and subsequent analysis that included comparing energy model inputs to parameters verified on-site and making adjustment where necessary. The on-site M&V approach was used for two of the sampled projects. Logging equipment was deployed at these sites to check the hours of use of a lighting system and collect trend data for a custom HVAC system.

The PY3 realization rate for energy savings in the Program was 104% and the realization rate for demand reduction was 190%. The high realization for demand reduction was primarily the result of two projects that had a verified demand savings estimate over twice the reported demand savings value. The SWE recommends PECO examine these projects with its Program implementation contractor to determine if corrective action is needed in the way *ex ante* savings are calculated.

5.3.2.2 Net Impact Evaluation

Net-to-Gross (NTG) analyses are conducted as part of an impact evaluation to determine what proportion of evaluated savings is attributable to a program. That is, a NTG ratio (NTGR) represents the percentage of savings that would not have occurred in the absence of a program. To calculate a NTGR for a given program, evaluators will typically assess the level of free ridership (FR) and spillover (SO) among program participants. Free ridership is an assessment of how likely a program participant would have implemented a program measure regardless of the program incentive or existence of the program. Spillover is an assessment of additional energy saving actions taken by a participant or non-participant that were a result of the program. The NTGR is calculated using the following formula:

$$NTGR = 1 - FR + SO$$

The NTG approach taken by the PECO Program Evaluator in evaluating PECO's programs followed an industry-standard approach. Both residential and commercial and industrial programs were evaluated through administration of survey instruments, and responses were scored to arrive at a free ridership score, and in some cases, a spillover score. The level of rigor performed by the PECO Program Evaluator is considered to be Basic in accordance with the SWE's NTG Study Methods.

Results from PECO's NTG evaluation are presented in

Table **5-7** below. Additional information on PECO's NTG methodology is provided in Appendix B.2. The SWE's evaluation of the NTG methodology is provided in Section 5.4.5.

Table 5-7: PECO NTG Results

Program	Total Surveys	Free Ridership	Spillover	NTG Ratio
Smart Lighting Discounts Program	NA[2]	62.55%	0.65%	38.1%
Smart Appliance Recycling Program	255	36.0%	0.0%	64.0%
Smart Home Rebates Program	200	16.0%	6.0%	90.0%
Smart Equipment Incentives C&I[1]	35	30-43%	N/A	57-70%
Smart Equipment Incentives GNP[1]	43	38-41%	N/A	51-62%
Smart Construction Incentives	13	70.4%	0.0%	29.6%

1 **NTG ratios for Smart Equipment Incentives programs were not complete at time of the report submission. Ranges listed above represent potential final NTG values.**

2 **NA for the Smart Lighting Discounts Program indicates no surveys were undertaken in the NTG analysis. No NTG analysis was undertaken for the Low-Income Efficiency Program.**

5.4 Statewide Evaluator Audit Activities and Findings

5.41 Residential Program Audit Summary

5.4.1.1 Smart Lighting Discounts Program

The SWE reviewed the data tracked in the PECO's database and tracking system to verify that PECO was using the appropriate savings values and algorithms from the 2011 TRM. The SWE also selected a sample of 10 bulbs for the review of baseline assumptions to ensure the CFL wattages fell within the ranges specified in the TRM. Lastly, the SWE team selected 5 retail invoices per quarter from PECO's buy-down program to review and verify that the bulb counts were accurately tracked in the PECO's database and tracking system. The SWE found that PECO used the correct values and algorithms, and the correct baseline assumptions, from the 2011 TRM. Additionally, no issues were identified in the review of invoices from PY3.

5.4.1.2 Smart Appliance Recycling Program

The SWE requested samples of PECO's JACO[41] work orders and corresponding database entries for each quarter. The SWE then checked the database entries for these participants and verified them against the individual database entries from JACO for each customer. For each participant, the SWE verified that number and type of appliances removed was consistent across both databases. The SWE also verified that the savings value used for each sampled participant reflected the characteristics of the recycled appliance. The SWE observed that all participant data was consistent in both PECO and JACO's

[41] JACO is the vendor for all EDCs' appliance recycling programs.

databases. PECO used the updated values for energy savings of replaced and retired refrigerators from the 2011 TRM in the calculation of net savings.

5.4.1.3 Efficient Equipment Program

The SWE requested samples of PECO's customer rebate applications and corresponding database entries for each quarter. The SWE then checked these participants' rebate applications against the PECO database. The SWE found that all participants sampled had active PECO accounts and all measures that were rebated were on the approved list. PECO used the correct deemed savings from the 2011 TRM. The SWE found no quality control errors In the PY3 samples. In the latter part of PY2, the SWE informed PECO that the SWE would start choosing the sample from PECO's residential database. This gave the SWE a higher level of confidence in the random sample audited in PY3.

5.4.1.4 New Construction Program

PECO did not have an active new construction program in PY3.

5.4.2 Low-Income Programs Audit Summary

The SWE conducted 39 site inspections of Low-Income Energy Efficiency Program (LEEP) installations. The inspections consisted of verifying invoiced measures and comparing the invoices and site visit findings to the PECO low-income database extracts. The SWE also looked for missed opportunities for additional measure installations. Most measures were found to be installed as reported and very few missed opportunities were noted. Following the site inspections, the SWE reviewed PECO's quarterly LEEP participant tracking database extracts to confirm that Component one[42] participants were assigned the proper job type based on site visit findings and invoices. Written feedback containing the SWE's findings, recommendations, and commendations was provided following each quarterly visit. The most common issue found during the inspections was that CFLs were removed, missing, or were prematurely burning out. This issue is likely at least partially a result of customer actions following the audit, such as customers removing or breaking bulbs. However, PECO was encouraged to emphasize the importance of not replacing CFLs with incandescent bulbs and not having its program implementer install CFLs in faulty fixtures. The SWE commends PECO for the number of customers that reported purchasing additional bulbs following the audit, citing the program education and bill impacts of the program as reasons, for fixtures that may not have qualified for LEEP incentives (e.g., low-use). Therefore, the education and bill impacts of the Program appear to be fostering spillover energy savings benefits.

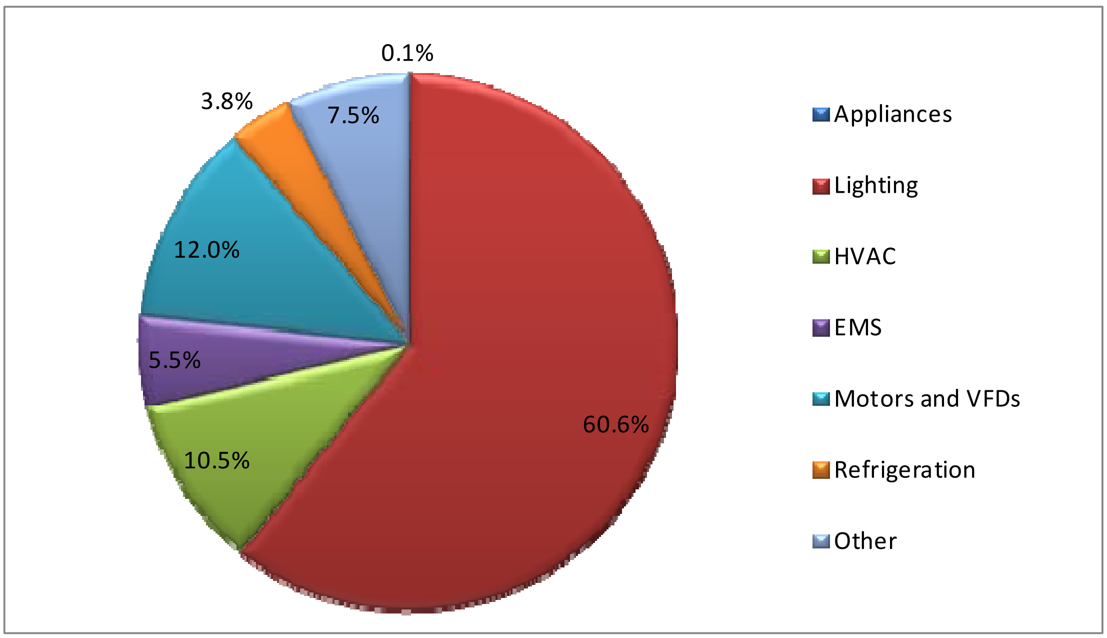
The SWE reviewed PECO's PY3 Annual Report and compared the savings reported to the program tracking database. PECO's evaluation of LEEP Component One consisted of a billing analysis, which used a four-year rolling average of LIURP and LEEP data to calculate verified energy savings. The SWE reviewed the results and confirmed that the participant counts and savings by job type were consistent with the verified energy savings. LEEP Components Two and Three involve distribution of CFLs, LEEP Component Four consists of refrigerator replacements and Component Five involves weatherization measures.[43] All measure savings in Components Two2 through Five were calculated using TRM protocols. The SWE reviewed tracking database extracts quarterly to confirm that savings were being reported in accordance with the 2011 TRM. In addition, the SWE confirmed that the data extracts were consistent with PECO's PY3 Annual Report.[44] The SWE confirmed that this information and the Component Four verified savings were consistent with the program tracking database.

The SWE 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 17 types measures to the low-income sector in PY3, which was 13.71% of the total number of measures offered across all sectors, compared to its Act 129 compliance target of 8.05%.

5.4.3 Non-Residential Program Audit Summary

Figure 5-1 shows the relative contribution of various types of energy efficiency measures to PECO's non-residential energy savings in PY3. Lighting projects were responsible for the majority of the savings in PY3. Energy management systems (EMS) were responsible for a much larger share of PECO's non-residential savings in PY3 than in PY2.

Figure 5-1: Distribution of Annual Gross Energy Impacts among PECO Non-Residential Measure Types



The SWE conducted a detailed review of PECO's program tracking data after each quarter of PY3 and found it to be thorough and accurate. PECO submits program tracking data to the SWE at both the measure level and the project level. The project-level data is useful for verifying the program and sector

43 In PY3 all measures installed as part of Component 5 were ENERGY STAR Room Air Conditioners

44 The one discrepancy found was that PECO's annual report stated that 836 refrigerators were replaced as part of Component 4. PECO explained that 836 *projects* were completed and 959 refrigerators replaced.

impacts in quarterly and annual reports and the measure-level data provides the specific equipment types and quantities needed for desk reviews.

In PY3Q4 PECO changed the sector classification of a number of PY3 projects that had previously been submitted as part of the Smart Equipment Incentives – GNP Program. In the PY3Q4 tracking data submission, PECO identified each of the projects and documented the change. The SWE was able to alter the records in the SWE database based on this exception report and recreate all of the reported impacts in PECO's PY3 Annual Report. The SWE understands that program tracking is a continuous process and commends PECO for documenting these changes to the SWE in a transparent fashion. After applying the historical record changes, the SWE was able to reconcile all of the participant counts, energy and demand impacts reported in PECO's final annual report to the program tracking data. Additional detail on the SWE audit of PECO tracking data can be found in Appendix G.2.

The SWE also performed desk audits of project files from a sample of PY3 non-residential projects which were submitted as part of the SWE Quarterly Data Request. 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 2011 TRM. The uploaded project files included project level savings calculation workbooks, specification sheets for equipment installed, invoices, customer incentive agreements and post-inspection forms.

PECO uploaded supporting documentation to the SWE SharePoint site for the required number of projects for each quarter in PY3. For most of the projects reviewed, the project files agreed with the program tracking regarding the type and quantity of the equipment that was installed. One exception was a ground source heat pump (GSHP) project, for which the equipment invoice showed the purchase of 37 units, but only seven units were reported in the program tracking data. The SWE also noted that the energy efficiency ratio (EER) values of the purchased units were below the minimum level required for the program. It was unclear why the units were rebated and how the reported quantity was determined. Savings calculations were not always documented in the project files, but the SWE was typically able to recreate the calculations and confirm that TRM protocols were followed.

Lastly, the SWE performed seven ride-along inspections and one independent site inspection of PECO's PY3 non-residential projects. An overview of the site inspection process and common findings is provided in Section 3.1.3.1. Additional detail on the SWE audit of PECO non-residential project files and site inspections can be found in Appendix G.2.

5.4.4 Demand Response Audit Summary

There was no audit work completed on Demand Response programs as these programs had not yet been implemented in PY3.

5.4.5 Net-to-Gross and Process Evaluation Audit Summary

The SWE's review of the net-to-gross (NTG) analyses and process evaluations for PECO's energy efficiency programs in general focused on the level of rigor employed for programs evaluation, the level of transparency provided regarding the evaluation methodology and the level of consistency in methodology, and reporting practices for each evaluated program. Findings and recommendations from this review are presented in this section.

5.4.5.1 Net-to-Gross (NTG) Analyses

As described in Section 3.8, the SWE defined three levels of rigor for the NTG analysis – Basic, Standard, and Enhanced. PECO has implemented seven energy efficiency programs; six of these programs were considered candidates for a NTG analysis according to the SWE. The SWE recommended a Basic rigor be used for the analysis of each program with the exception of one program, the Smart Lighting Discounts program, for which an Enhanced level of rigor was recommended.

The PECO Program Evaluator conducted NTG analyses in PY3 for five of the six programs recommended for analysis by the SWE[45]. PECO's PY3 Annual Report provided limited and varying levels of information on the NTG methodology for each program. Five analyses were conducted at the Basic level of rigor, and the Smart Lighting Discounts Program was evaluated at the Enhanced level of rigor. The analyses included self-reporting surveys with program participants to determine free ridership scores and an assessment of program spillover, however, the PECO Program Evaluator did not always specify the source of the data or how it was collected. The PECO Program Evaluator did not collect data in PY3 for a NTG analysis of the Smart Lighting Discounts Program due to a change in the Program's strategy, but the PY2 evaluation was conducted at the level recommended by the SWE.

The SWE recommends that the PECO Program Evaluator continue the above-stated methodological approach for future NTG analyses of PECO programs. Despite its dramatic reduction in participation, the Smart Lighting Discounts Program contributed the largest energy savings of PECO's residential programs in PY3. The SWE understands that the Smart Lighting Discounts program design in Phase II will be somewhat different from the program offered in PY4. Because NTG research in PY4 will not be relevant to the Phase II program design, the SWE recommends the PECO Program Evaluator wait and conduct NTG research at the Enhanced level of rigor early in Phase II once the new program design is implemented.

The overall transparency provided for the NTG analysis of PECO's programs was low. While the explanation of free ridership methodologies varied by program, information regarding the methodology, data collection, sampling, survey design, algorithm design, or analysis was often lacking. In certain instances, overall free ridership or NTG ratios were presented with minimal explanation or description for how they were derived. The exception to this was the report of the NTG analysis for the non-residential programs. These programs did include a description of the survey instrument and how scores were calculated.

[45] The NTG ratio for the Smart Lighting Discounts Program was based on PY2 research. The Program Evaluator felt that conducting a new NTG evaluation in PY3 was not a prudent use of resources because the PY2 research was extensive and thorough and the findings were likely applicable to PY3 program structure.

Spillover methodologies for applicable programs were somewhat more descriptive than the free ridership sections. General descriptions for how spillover was calculated were provided, and for certain programs, such as the Smart Lighting Discounts Program,[46] a description of the survey instrument was provided. The PECO Program Evaluator described, when applicable, how the spillover score affected the overall NTG ratio. It is recommended that the PECO Program Evaluator improve the level of transparency into net savings analysis in future annual reports. A description of the full NTG methodology should be provided along with descriptions of the algorithms and surveys used and an explanation for how free ridership and spillover scores were calculated to arrive at the final NTG ratio.

Presentation of NTG methodologies and results were not always consistent across programs. As noted above, the level of detail provided for residential versus non-residential programs varied considerably. Due to the general lack of methodology description, it is unknown how consistent analysis steps such as sampling or data collection were among programs; however, the report is consistent in presenting free ridership scores as well as spillover scores when applicable. It is recommended that future reports provide similar descriptions of NTG methodologies for all evaluated programs. Free ridership and spillover findings were presented consistently throughout the report and are suitable for future evaluations.

5.4.5.2 Process Evaluation

The process evaluation conducted by the PECO Program Evaluator for PECO's programs was reviewed in the same manner as the NTG analysis. Findings and recommendations from the SWE's review are presented below.

No pre-determined level of rigor was described nor recommended by the SWE, as was the case for the NTG analysis. Nevertheless, the PECO Program Evaluator provided good descriptions regarding its methodology for conducting the process evaluation for each program. For instance, the PECO Program Evaluator often described what the process evaluation focused on and explained what and how data was obtained. Findings from the process evaluation were also well detailed.

The level of rigor for the PECO Program Evaluator's process evaluations may be described as Basic to Standard, per the rigor standards established for the NTG analyses. Program documentation review, interviews with program staff and program implementers, and participant surveys were conducted for all programs. Additionally, some programs also included interviews with trade allies and site visits to enhance the process evaluation. The PECO Program Evaluator provided detailed summaries of findings from these efforts to help inform the status of each program.

The SWE recommends that the PECO Program Evaluator continue its level of rigor for and expand the scope of its process evaluation to include interviews with additional stakeholders and market actors to help uncover missed opportunities or unknown issues that may be addressed to improve the program's

46 Spillover descriptions of the Smart Lighting Discounts program referred to the analysis conducted in PY2.

performance. Moreover, developing and/or reviewing program logic models will help identify any gaps in the EE&C programs and ensure the programs are on track to meet their goals and outcomes.

Data collection processes were well documented and described in the PY3 Annual Report as were survey sample sizes. The Report also made clear how findings were derived based on collected data. The SWE recommends that the PECO Program Evaluator continue this level of transparency in future reports.

The most common metric and topic discussed across programs was participant satisfaction. While each program was supported by a comprehensive process evaluation, there were not always consistent topics and metrics across the set of programs. The process evaluations for the programs ranged from a focus entirely on the rebated measure and participants' relations to the measure, to a focus on the program as a whole.

5.5 Statewide Evaluator Recommendations

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

1. A number of findings and recommendations were presented by the PECO Program Evaluator based on the PY3 process evaluation. The SWE recommends that PECO consider incorporating the recommended actions in PY4 and in Phase II of Act 129. Include additional stakeholders and market actors in the process evaluation to help uncover missed opportunities or unknown issues that may be addressed to improve programs performance.
2. Attempt to eliminate the waiting list for non-residential programs. A waiting list hurts program satisfaction and discourages customers from implementing energy efficient measures.
3. The PECO Program Evaluator used energy realization rates as a proxy for project demand realization rates to offset some of the variation observed in the PY3 evaluation of the Smart Equipment Incentive – GNP Program. This practice should be avoided and the PECO Program Evaluator should develop independent estimates of peak demand savings.
4. The SWE recommends that PECO and the PECO Program Evaluator implement corrective actions to ensure that required precision targets are not missed in future program years. Corrective actions will include increasing sample sizes, considering more VFD projects as custom and requiring more robust *ex ante* savings calculations for EMS measures.
5. In the PY4 evaluation of non-residential programs, the PECO Program Evaluator should increase the number projects which receive on-site verification of the installation of efficient equipment and deploy a greater number of data loggers to capture actual equipment operating parameters for use in verified savings calculations.

5.6 Statewide Evaluator Best Practice Analysis

One of the best practices listed in Appendix D is to "know your target consumer demographic and tailor your messages, incentive structures and promotional messages to the audience." Knowing its target audience gives PECO the opportunity to cross-sell other residential energy efficiency products to its customers who participate in the Smart Appliance Recycling Program. PECO recognizes that the Program may be a customer's first experience with PECO's energy efficiency programs. As such, PECO should direct its Program CSP to provide information to customers about PECO's other residential EE&C programs when picking up appliances.

6 PPL Electric Utilities

This section summarizes PPL Electric Utilities (PPL) performance in PY3, as well as the cumulative energy savings and demand reductions achieved by PPL's Act 129 EE&C programs through the end of PY3. This section presents the evaluation activity completed by both The Cadmus Group (the current PPL Program Evaluator) and the SWE in the calculation of the cost-effectiveness, and the measurement and verification (M&V), of PPL's EE&C programs. This section also provides the SWE's recommendations for PPL's programs going forward.

6.1 Summary of Energy and Demand Reductions

Table 6-1 highlights PPL's cumulative reported gross impact and verified gross impact since the EE&C programs' inception through the end of PY3.

Table 6-1: Summary of PPL CPITD Impacts

	CPITD Reported Gross Impact[f]	CPITD Verified Gross Impact[h]	Savings Achieved as % of 2013 Targets[i]
Total Energy Savings (MWh/yr)	1,036,103	1,002,688	87.5%
Total Demand Reduction (MW)	150.8	143.7	48.4%
TRC Benefits ($1,000) [a]	Not Applicable[g]	$473,186	Not Applicable
TRC Costs ($1,000) [b]	Not Applicable[g]	$212,496	Not Applicable
TRC Benefit-Cost Ratio[c]	Not Applicable[g]	2.23	Not Applicable
CO_2 Emissions Reduction (Tons) [d][e]	839,243	812,177	Not Applicable

NOTES:

[a] 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. 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 TRC Order.

[d] 8.1x10-4 metric tons of CO_2 per kWh (EPC's eGRID2007 Version 1.1, RFCE Region annual non-baseload CO_2 output emissions rate, year 2005 data). This is included in this report per the approved SWE work plan.

[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] Defined as the gross energy savings that were reported during the period since date of program implementation through the current reporting period (i.e., reporting period of this report). CPITD = Cumulative Program Inception To-Date.

[g] TRC Benefits and Costs are calculated only for verified savings, which reflect actual program results.

[h] Defined as the energy savings that have been verified by the PPL Program Evaluator and audited by the SWE, and since the date of program implementation through the end of PY3.

[i] Savings achieved based on CPITD Verified Gross Impact.

As shown, PPL has achieved 87.5% of its Act 129 2013 energy savings target and 48.4% of its Act 129 demand savings at the end of PY3. The TRC Benefit-Cost Ratio (or TRC Ratio) of 2.23 indicates PPL's EE&C programs are cost-effective on an aggregate (portfolio) basis.

Table 6-2 contains a listing of PPL's EE&C programs that reported participation and had energy and/or demand savings that were evaluated in PY3, and programs that are yet to be implemented or had no reported savings in PY3.

Table 6-2: PPL EE&C Programs

Programs Reporting PY3 Gross Savings:
• Appliance Recycling Program • Residential Lighting Program • Custom Incentive Program • Energy Efficiency Behavior & Education Program • Efficient Equipment Incentive Program • E-Power Wise Program • Low-Income WRAP • Renewable Energy Program • HVAC Tune-Up Program • Residential Energy Assessment & Weatherization Program
Programs to be Implemented or with No Reported PY3 Savings:
12. Direct Load Control Program 13. C&I Load Curtailment Program

PPL has reported PY3 gross energy and/or demand savings for 10 programs. Table 6-3 below provides a breakdown of the contribution of each program's verified gross energy savings and verified gross demand savings towards the CPITD portfolio savings. As shown, Efficient Equipment Incentive Program accounts for 43% of the total CPITD verified gross savings, and 65% of its verified gross demand reductions, for PPL's portfolio. This Program is available to both residential and C&I customers. Consistent with other EDCs, PPL's Residential Lighting Program represents a significant portion of PPL's portfolio verified gross energy savings (33%).

Table 6-3: Summary of PPL EE&C Program Impacts on Gross Reported Portfolio Savings – Through PY3

Program:	CPITD Verified Gross MWh/yr Savings	Percent of Portfolio CPITD Verified Gross MWh/yr Savings	CPITD Verified Gross MW Reductions	Percent of Portfolio CPITD Verified Gross MW Reductions
Efficient Equipment Incentive Program	429,906	43%	92.95	65%
Residential Lighting Program	335,640	33%	18.81	13%
Appliance Recycling Program	52,985	5%	10.40	7%
Energy Efficiency Behavior & Education Program	29,370	3%	0.00	0%
Residential Energy Assessment & Weatherization Program	2,837	0%	0.27	0%
Low-Income WRAP	13,735	1%	1.79	1%
Custom Incentive Program	116,359	12%	14.12	10%
Renewable Energy Program	16,958	2%	3.61	3%
E-Power Wise Program	3,613	0%	0.57	0%
HVAC Tune-Up Program	1,285	0%	1.13	1%
TOTAL PORTFOLIO	**1,002,688**	**100%**	**143.65**	**100%**

6.2 Total Resource Cost Test

Table 6-4 provides a breakdown of the contribution of each EE&C program's Program Year-to-Date (PYTD) verified gross energy savings and demand reductions as well as the TRC Ratios.

Table 6-4: Summary of PPL EE&C Program Impacts on TRC Ratios

Program	PY3 Verified MWh/yr Savings	PY3 Verified MW Reductions	TRC Ratio
Efficient Equipment Incentive Program	216,620	53.26	2.34
Residential Lighting Program	127,802	6.42	7.66
Energy Efficiency Behavior & Education Program	29,370	0.00	2.57
Appliance Recycling Program	18,841	3.29	6.34
Residential Energy Assessment & Weatherization Program	2,144	0.17	1.25
Low-Income WRAP	7,548	1.03	1.14
Custom Incentive Program	99,627	12.08	2.02
Renewable Energy Program	2,380	0.71	0.32
E-Power Wise Program	1,490	0.39	4.97
HVAC Tune-Up Program	817	0.65	2.84
TOTAL PORTFOLIO	**506,612**	**77.99**	**2.23**

Nine of the 10 programs are found to be cost-effective by the TRC Ratio. (i.e., the Ratio exceeds 1). The Renewable Energy Program has a TRC Ratio below 1 (found to not be cost-effective) primarily because of high participant costs and limited savings during PY3. In PY3, PPL provided incentives to two institutional solar photovoltaic (PV) projects and 15 institutional ground source heat pumps (GSHP) projects as part of the Renewable Energy program.

An important finding is that programs with the large savings in the residential and C&I sectors such as the Efficient Equipment Incentive Program, Residential Lighting, Appliance Recycling, and Custom Incentive Program have TRC ratios above 1.0. This means that not only are they generating high MWh/yr savings, they are deemed cost-effective by the TRC test.

6.2.1 Assumption and Inputs

PPL uses a discount rate of 8% in its TRC model to discount program benefits and costs. This rate is used to compare the Net Present Value (NPV) of program benefits that will occur later in a measure's lifetime to the upfront costs of installation and implementation. A line loss factor of 8.33% is used for residential and commercial projects. A line loss factor of 4.12% is applied for industrial projects. Energy is lost steadily as it is carried along transmission and distribution lines as well as when voltage is stepped down so line loss is a function of both line length and the voltage at which a customer is supplied power. Industrial customers are supplied at a higher voltage than commercial and residential customers, so there is less line loss. Based on the documentation received from PPL, the SWE found that the assumptions including avoided costs for energy and demand, line loss factors, and discount rates used in PPL's PY3 TRC model are consistent with the information supporting PPL's 2009 EE&C Plan.

An effective life was associated with each measure in PPL's EE&C portfolio in order to determine the number of years of savings to attribute to that measure. The SWE checked the measure lives in the PPL TRC model against the measure lives per Appendix A of the 2011 TRM and found no variances. The measure lives applied to custom measures not explicitly stated in the TRM were found to be reasonable.

Several different methods were used to assign incremental costs to measures in the PPL TRC model. For the Efficient Equipment Incentive Program, incremental costs were based on a mixture of engineering calculations and weather adjusted figures from the Database for Energy Efficient Resources (DEER) or ENERGY STAR®. The scope of the measures in the C&I lighting program (within the Efficient Equipment Incentive Program) were larger than estimated in the PPL EE&C Plan, so incremental costs were determined by the actual cost of customers' projects through an analysis of the project files and tracking data. Appendix K of the PPL PY3 Annual Report provides a complete table detailing incremental costs by measure and the data source used to determine the incremental cost.

As required by the TRC Order, PPL's TRC modeling analysis is based on *ex post* verified savings, so measure impacts are adjusted by an applicable realization rate. Realization rates were calculated by program, sector and stratum. Realization rates for demand impacts are calculated separately and are used to adjust the reported demand impacts prior to entering the TRC model calculations.

SWE reviewed the participant counts and found the energy impacts and demand impacts used in the PPL TRC model to be consistent with the contents of the measure level database extracts provided to the SWE for review. Energy and demand impacts in the PPL database were calculated at the meter level and a line loss factor was appropriately applied prior to the calculation of avoided cost benefits.

Due to the number and variety of measures in the C&I lighting program, cost-effectiveness was modeled at the program level. Participation was determined by the number of distinct combinations of participant and measure. The *ex post* savings value for each sector was divided by this participation figure to produce a per-unit figure for the TRC model. As specified in the TRM, a measure life of 15 years is used for the C&I lighting program.

6.2.2 Avoided Cost of Energy

The PPL TRC model assigns a value ($/MWh/yr) to the avoided cost of energy for each hour of each year from 2012 through 2026 for each sector – residential, small commercial and large commercial. 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 is assigned to the end-use load shape that is the most correlated with the affected equipment and the associated avoided cost value. The SWE feels that this is an excellent way to determine the actual avoided cost of energy for each measure because it quantifies the value of when a measure saves energy. Measures yielding energy savings during periods with high energy costs are more cost-effective per kWh saved than measures which produce savings during off-peak periods. This is because the avoided costs of energy during on-peak periods is higher than those during off-peak periods which results in higher TRC benefits for the same amount of energy saved and measure costs and thus are more cost-effective.

6.2.3 Avoided Cost of Capacity

PPL's TRC model assigns a flat annual cost ($/kW) to the cost of generation capacity for each year from 2012 to 2019. These values are multiplied by the gross demand savings of each measure to estimate the avoided cost of capacity. For 2020 and beyond, the avoided cost of energy in the PPL TRC model are based upon the EIA Annual Energy Outlook forecast and are assumed to include capacity costs. Consequently, measures with lives beyond 2019 do not include a separately estimated avoided cost of capacity for those years.

6.2.4 Conclusions and Recommendations

PPL's EE&C programs are designed to produce impacts across sectors. However, avoided cost estimates, load profiles and line loss factors vary significantly between the residential, commercial and industrial sectors. This variation was handled expertly in the TRC calculation workbooks and TRC Ratios were calculated for each sector and for each program (across multiple sectors).

6.3 Status of Evaluation Activities

6.3.1 Status of EM&V Plans

Per the guidelines outlined in the Audit Plan,[47] the SWE has reviewed EM&V plans submitted by the EDCs to verify that the plans comply with the TRM and TRC Orders and meet the minimum evaluation requirements set forth in the Audit Plan. The Audit Plan provides an outline for the evaluation framework expectations and guidelines necessary to address the following research objectives:

- determine realization rates for gross savings;
- determine net to gross (NTG) ratios;
- determine method for calculating savings; and
- Set acceptable levels of rigor, precision and bias for measurement and verification (M&V) activities.

PPL uploaded a PY3-PY4 evaluation, measurement and verification (EM&V) plan for each of its EE&C programs to the SWE SharePoint site. The SWE observed some minor adjustments from the PY2 plans for PPL's energy efficiency programs and performed a detailed review of the EM&V plans for PPL's Direct Load Control and Load Curtailment programs. The SWE provided comments on the plans for these two Demand Response (DR) programs and discussed them with PPL during biweekly teleconferences.

[47] See Statewide Evaluation Team, *Audit Plan and Evaluation Framework for Pennsylvania Energy Efficiency and Conservation Programs,* November 4, 2011.

PPL intends to use a census approach for the impact evaluation of its C&I Load Curtailment Program. Hourly load data from each participating business will be used to develop customer-specific baselines and to estimate the load reductions produced by the participant's site. PPL's implementation CSP will provide the *ex ante* savings estimates and the PPL Program Evaluator will review the methodology and calculations and develop *ex post* savings estimates. The PPL Program Evaluator will also conduct attribution surveys with participants of this program for use in the SWE Demand Response Study.

The PPL impact evaluation methodology for its Direct Load Control Program involved installing metering equipment on the AC compressor of 100 participating homes. During a given curtailment event, 50 customers would have their units cycled and 50 customers would be allowed to operate normally. The difference in load between these ad hoc control and experimental groups will be used to estimate the per-home load reductions achieved by the program. Using this methodology, the Switch Operability Rate is determined using the same sample because an inoperable switch in the M&V sample will produce lower load reduction estimates. The SWE expressed concern over the possibility of inoperable switches in the M&V sample being discovered through a review of the metered data and repaired during the summer. This corrective action would not be possible for a typical member of the program population so the SWE requested that any inoperable devices discovered in the M&V sample remain untouched to provide the best possible simulation of the program as a whole. PPL agreed with this approach, updated its EM&V plan accordingly, and the SWE approved the plan on May 17, 2012.

6.3.2 M&V Activities and Findings

The following section provides a summary of the Measurement and Verification (M&V) activities conducted by the PPL Program Evaluator based on details provided in PPL's PY3 Annual Report as well as information gathered from SWE data requests and audits.

6.3.2.1 Gross Impact Evaluation

Table 6-5 provides a summary of M&V based on activities conducted by the PPL Program Evaluator based on details provided in PPL's PY3 Annual Report, and on information obtained from SWE data requests and audits.

Table 6-5: PPL Energy Efficiency Programs - Realization Rates for Energy and Demand Savings

Program	Realization Rate- Energy Savings	Realization Rate- Demand Savings
Efficient Equipment Incentive Program	95.3%	92.0%
Residential Lighting Program	100.1%	87.2%
Energy Efficiency Behavior & Education Program	100.6%	NA[1]
Appliance Recycling Program	84.4%	84.4%
Residential Energy Assessment & Weatherization Program	100.0%	NA[1]
Low-Income WRAP	97.9%	108.0%
Custom Incentive Program	103.5%	98.8%
Renewable Energy Program	80.9%	98.0%
E-Power Wise Program	93.7%	93.7%
HVAC Tune-Up Program	100.0%	100.0%
TOTAL PORTFOLIO	**97.8%**	**92.5%**

1 NA indicates no demand reductions (savings) are claimed for these programs.

The realization rate is a factor that compares the gross savings reported by the EDC to the verified savings determined by the EM&V contractor through M&V activities. The calculation for a realization rate is as follows.

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

Depending on the program, realization rates are calculated either based on a sample of program participants and then applied to all participants or the realization rate is calculated on a census of all program participants and then applied to all participants. A realization rate of 100% indicates that the evaluation team was able to verify all reported savings (this is the case with PPL's Residential Energy Assessment & Weatherization Program and with the HVAC Tune-Up Program). A realization rate of less than 100% indicates that the gross savings were an over-estimate and a realization rate of over 100% indicates that gross savings were an under-estimate.

Realization rates for energy savings from PPL's programs range from 80.9% (Renewable Energy Program) to 103.5% (Custom Incentive Program). PPL's realization rates for demand reductions range from 84.4% (Appliance Recycling Program) to 108.0% (Low-Income WRAP).

6.3.2.1.1 Appliance Recycling Program

The reason for the low realization rate on the Appliance Recycling Program is due to two important savings adjustments made by the PPL Program Evaluator, which found program discrepancies between replaced appliances reported in PPL's database (as claimed by the CSP) and the survey responses (as verified by PPL's Program Evaluator). Survey results show that significantly more customers reported replacing their refrigerator or freezer (70% replacement rate) than reported to the Appliance Recycling Program CSP through the sign-up process (15% replacement rate). The survey responses indicated that 4% of the units reported as replaced were replaced with non-ENERGY STAR® appliances, and 96% were replaced with ENERGY STAR® appliances. The PPL Program Evaluator adjusted the savings using appropriate 2011 TRM values to reflect the allocation of replaced units. Additionally, the PPL Program Evaluator also made adjustments to *ex ante* reported savings for room air conditioner savings values to meet 2011 TRM specifications. For room air conditioners, the 2011 TRM savings are based on the geographic location of each participant's home and the corresponding savings assumption in the TRM. The savings are then weighted by the relative distribution of zip codes that correspond to units in the PPL's database. The PPL Program Evaluator adjusted savings to reflect the distribution observed in the PPL's database with a final weighted savings value of 295 kWh/yr per unit for room air conditioners.

The observed coefficient of variation (Cv)[48] of the evaluated results was 0.208, which is much lower than the assumed Cv value of 0.5. Because the relationship between reported and verified savings was very consistent in the evaluation sample, the relative precision of the PY3 verified energy and demand savings estimates were both 3.5% at the 90% confidence level. Based on the PY3 results, the SWE believes PPL should consider lowering the Cv assumption in its PY4 sample design for the Appliance Recycling Program.

6.3.2.1.2 Custom Incentive Program

The Custom Incentive Program serves projects that are not covered by other PPL Electric programs, and includes as retro-commissioning, equipment optimization and operational and process improvements.

The realization rate for 29 of the large stratum's projects in this Program was 100%. For these projects, reported savings equaled verified savings because full or partial incentive payment was delayed on these projects until the verified savings was known, since the incentive payment was based on the verified savings. For the remaining nine large stratum projects, PPL paid the incentive and claimed savings before the verification was complete, leading to an overall realization rate of 104% for the large stratum. The relative precision in savings for the Custom Incentive Program is very good, at 1.1% for energy savings and 0.6% for demand savings. These results are largely due to the census evaluation performed of the large stratum, which accounts for 94% of the program's energy savings. The SWE commends PPL for exceeding the required confidence and precision targets for the Custom Incentive Program because it accounted for almost 20% of PPL's PY3 verified gross energy savings and savings from custom measures are frequently a large source of uncertainty in evaluations.

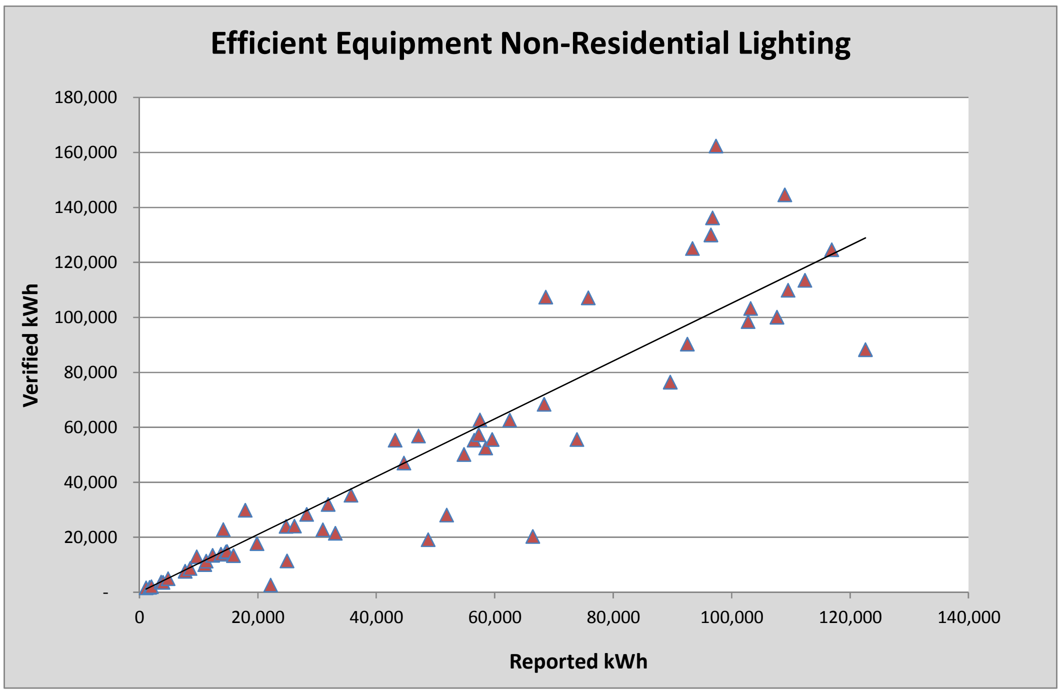
[48] Ratio estimation was used to determine the realization rate for the Program, so the error ratio was reported in place of Cv.

6.3.2.1.3 Efficient Equipment Incentive Program

The Efficient Equipment Incentive Program encourages the use of a wide range of energy efficient equipment including electric heating, cooling, lighting, water heating and appliances. The non-residential projects were separated into three strata based on *ex ante* savings – small (HVAC, appliances, office equipment), medium (commercial refrigeration and motors), and large (commercial lighting).

Figure 6-1 shows the relationship between the reported kWh savings and verified kWh savings for the projects in small and medium stratum of PPL's non-residential lighting sample.

Figure 6-1: Relationship between Reported kWh and Verified kWh – PPL PY3 Data for Non-Residential Lighting



The realization rate can be thought of as the slope of the fitted line in the graph. The Figure illustrates the importance of a robust sampling scheme. Some projects produced verified savings estimates greater than the reported savings estimate, and others had the opposite relationship. Even though variation was observed at the project level, the sample size for the non-residential lighting evaluation group was sufficient to produce a precise estimate of the overall relationship between reported and verified savings. The final realization rate of the non-residential lighting evaluation group was 95%, which means that the verified savings were 5% lower on average than the reported savings.

While the Efficient Equipment Incentive Program's overall realization rate is 95.3% for energy savings, the realization rate of the small non-residential stratum was much lower, at 65.2%. The report indicates multiple reasons for this result. For appliances, 35 of the 60 clothes washer records reported an electric water heater but were later found to be served by a gas or another type of water heater, thus reducing the energy savings. A possible solution used by other EDCs is to use a blended average of the electric water heating and gas water heating savings estimates for all rebated clothes washers. The weighting of the two fuel types in the estimate would be based on water heating fuel proportionate shares in the PPL service territory.

6.3.2.1.4 Renewable Energy Program

The Renewable Energy Program offered a financial incentive to install a solar photovoltaic (PV) array or ground source heat pump (GSHP). All of the non-residential projects in PY3 were institutional – 15 GSHP and two solar PV systems. The non-residential program stratum had a target confidence and precision of 85/10 and an assumed Cv of 0.5. With a total population of 17, the minimum number of samples needed to achieve the target confidence/precision is 10. All 17 project records were reviewed to ensure that all of the data needed was available to calculate savings for at least 10 projects. Next, two projects were surveyed via phone and nine received site visits, exceeding the minimum samples needed by one project. From these verification activities, the energy savings realization rate calculated for solar PV and GSHP systems were 108.8% and 49.5%, respectively. The low GSHP realization rate was due to a combination of three primary factors – distinguishing between water-source, groundwater source and GHSPs, taking into account the ground loop pump’s energy use, and defining a correct roof-top unit (RTU) baseline. The SWE recognizes that these three factors play a significant role in determining savings and all of these factors should be considered proactively in the future. The SWE recommends the following actions to stabilize realization rates in PY4:

1. require all heat-pump projects have their heat source/sink be validated before receiving incentive funds;
2. use the TRM methodology for ground loop pumps in the reported savings as well as the verified savings; and
3. initiate a means to standardize cooling-only RTU baselines such as considering them all Air Source Heat Pumps or all wet-source air cooling systems.

6.3.2.1.5 HVAC Tune-Up Program

The HVAC Tune-Up Program offers incentives to contractors to help offset the cost of energy-saving retrofits for small C&I customers. This Program’s evaluation included a census of PY3 program participants via a full tracking database review. Thus, there was no sampling performed. The *ex ante* savings were determined through the program implementer’s proprietary Savings Estimator software tool. The PPL Program Evaluator completed an independent calculation review of the Savings Estimator tool in PY2. The results of the review were compared to the 2011 TRM standard savings algorithms and were found to be reasonable. Since the savings algorithms were found to be reasonable in PY2, no additional review was performed in PY3. An engineering review including contractor recorded measurements and thermostat set points was performed for all reported measures. The resulting realization rate for the program was 100% for both energy and demand savings. The basic level of rigor used in the HVAC Tune-Up Program evaluation is reasonable because it contributes less than 1% of the energy savings in PPL’s portfolio. No modifications are recommended for PY4.

6.3.2.2 Net Impact Evaluation

Net-to-Gross (NTG) analyses are conducted as part of an impact evaluation to determine what proportion of evaluated savings is attributable to the program. That is, a NTG ratio (NTGR) represents the percentage of savings that would not have occurred in the absence of the program. To calculate a NTGR for a given program, evaluators will typically assess the level of free ridership (FR) and spillover (SO) among program participants. Free ridership is an assessment of how likely a program participant would have implemented a program measure regardless of the program incentive or existence of the program. Spillover is an assessment of additional energy saving actions taken by a participant or non-participant that were a result of the program. The NTGR is calculated using the following formula:

$$NTGR = 1 - FR + SO$$

The NTG approach taken by the PPL Program Evaluator in evaluating PPL's programs followed an industry-standard approach. Both residential and commercial and industrial programs were evaluated through administration of survey instruments and responses were scored to arrive at a free ridership score, and in some cases, a spillover score. The level of rigor performed by the PPL Program Evaluator for a majority of the programs is considered to be Basic in accordance with the SWE's NTG Study Methods.

Results from PPL's NTG evaluation are presented in Table 6-6. Additional information on PPL's NTG methodology is provided in Appendix B.3. The SWE's evaluation of the NTG methodology is provided in Section 6.3.2.1.

Table 6-6: PPL Energy Efficiency Programs - Realization Rates for Energy and Demand Savings

Program	Total Surveys	Free Ridership	Spillover	NTG Ratio
Appliance Recycling Program	75	39%	2%	63%
Residential Lighting Program	266	44% - 52%	48% - 56%	70%
Custom Incentive Program[1]	0	69%	0%	31%
Efficient Equipment Incentive Program – Residential	72	35%	0%	65%
Efficient Equipment Incentive Program – Commercial Non-Lighting	49	67%	0%	33%
Efficient Equipment Incentive Program – Commercial Lighting	71	19%	0%	81%
Efficient Equipment Incentive Program– Direct Discount	49	10%	0%	90%
HVAC Tune-Up Program[2]	0	0%	0%	100%
Residential Energy Assessment & Weatherization Program	43	18%	1%	83%
Renewable Energy Program	2	NA[3]	NA	NA

1 **Survey postponed until PY4; data based on PY2 survey results.**
2 **PY2 contractor survey results used to estimate NTG for PY3.**
3 **PPL indicated that the 2 surveys did not provide conclusive results.**

6.4 Statewide Evaluator Audit Activities and Findings

6.4.1 Residential Program Audit Summary

6.4.1.1 Residential Lighting Program

The SWE reviewed the data tracked in the PPL's database and tracking system to verify that PPL was using the appropriate savings values and algorithms from the 2011 TRM. The SWE also selected a sample of 10 bulbs for the review of baseline assumptions to ensure the CFL wattages fell within the ranges specified in the TRM. Lastly, the SWE team selected 5 retail invoices per quarter from PPL's buy-down program to review and verify that the bulb counts were accurately tracked in the PPL database and tracking system. The SWE found that PPL used the correct values and algorithms, and the correct baseline assumptions, from the 2011 TRM. Additionally, no issues were identified in the review of invoices from PY3.

6.4.1.2 Appliance Recycling Program

The SWE requested samples of PPL's JACO[49] work orders and corresponding database entries for each quarter. The SWE then checked the database entries for these participants and verified them against the individual database entries from JACO for each customer. For each participant, the SWE verified that number and type of appliances removed was consistent across both databases. The SWE also verified that the savings value used for each sampled participant reflected the characteristics of the recycled appliance. The SWE observed that all participant data was consistent in both PPL and JACO's databases. PPL used the updated values for energy savings of replaced and retired refrigerators from the 2011 TRM in the calculation of net savings.

6.4.1.3 Efficient Equipment Incentive Program

The SWE requested samples of PPL's customer rebate applications and corresponding database entries for each quarter. The SWE then checked these participants' rebate applications against the PPL database. The SWE found that all participants sampled had active PPL accounts and all measures that were rebated were on the approved list. PPL used the correct deemed savings from the 2011 TRM. The SWE found no quality control errors In the PY3 samples. In the latter part of PY2, the SWE informed PPL that the SWE would start choosing the sample from PPL's residential database. This gave the SWE a higher level of confidence in the random sample audited in PY3.

6.4.1.4 New Construction Program

PPL did not have an active new construction program in PY3.

6.4.2 Low-Income Programs Audit Summary

PPL's Act 129 Winter Relief Assistance Program (WRAP) is an extension of WRAP offered by PPL through its LIURP program since 1985. PPL's third party inspection contractor conducted 461 site inspections of Act 129 WRAP installations in PY3, from which the SWE selected a sample of 40 reports for review. PY3 WRAP savings are deemed by job type based on a billing analysis of participants in prior program years. Therefore, the SWE reviewed the audit forms and site reports to verify that the correct job type had been assigned in the participant database extract based on the comprehensiveness of measures installed, space heating fuel and/or domestic hot water heating fuel. The SWE also confirmed that Act 129 WRAP participant counts, and verified savings by job type in the quarterly database extracts, were consistent with the counts and savings reported in PPL's PY3 Annual Report.

The site inspection reports were also reviewed to determine whether all measures were being installed by contractors. The SWE did not find any major issues such as incorrect job types being assigned or a preponderance of measures not installed. However, some of the PPL inspection forms lacked sufficient detail or clarity to determine whether the inspector had verified the installation of all measures. In its guidance memo on low-income site visit processes, the SWE explained the level of detail expected in low-income site inspection reports submitted by EDCs. The SWE worked with PPL to address any necessary modifications to inspection forms to include information such as CFL wattage.

[49] JACO is the vendor for all EDCs' appliance recycling programs.

For PPL's E-PowerWise program, which provides low-income customers with kits containing basic measures such as CFLs, faucet aerators, low flow showerheads and LED nightlights, the PPL Program Evaluator adjusted the energy and demand savings resulting from 2011 TRM algorithms by applying in-service rates determined through surveys of program participants. The SWE reproduced the Evaluator's per-measure calculations using these in-service rates and verified energy and demand savings reported in PPL's PY3 Annual Report were accurate.

The SWE verified that PPL was in compliance with the Act 129 requirement for the number of energy conservation measures offered to low-income households. PPL offered 54 types of measures to the low-income sector in PY3, which was 36.99% of the total number of measures offered across all sectors, compared to its Act 129 compliance target of 8.64%.

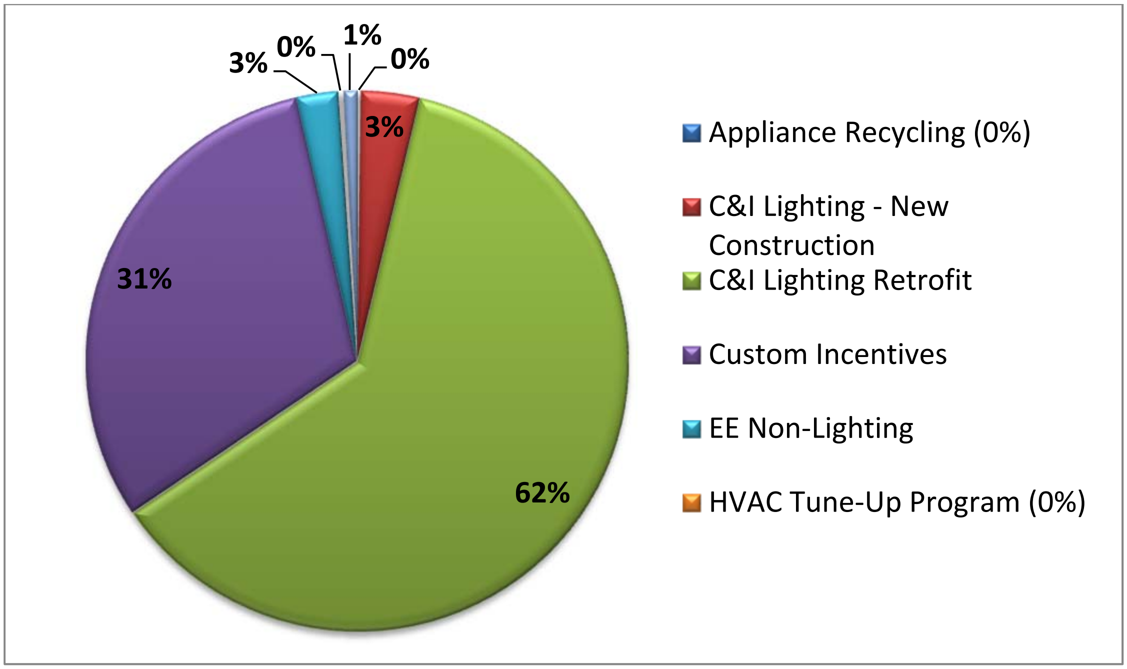
6.4.3 Non-Residential Programs Audit Summary

The SWE conducted a review of PPL's program tracking data after each quarter of PY3 and found it to be detailed and well-organized. Auditing PPL's non-residential program tracking data presented some challenges because the programs are designed to be cross-cutting, allowing customers from all rate classes to participate. PPL organizes the program tracking submissions to the SWE by sector, but does not separate the reported impacts from its programs by sector in quarterly and annual reports.[50] Residential and non-residential portions of several programs were separated by sector for evaluation in PY3, so the SWE was able to audit the accuracy of these figures compared to the program tracking data. The SWE was able to reconcile the majority of the program impacts shown in PPL's PY3 Annual Report to the PY3 quarterly tracking data. Additional detail on the SWE audit of PPL non-residential tracking data can be found in Appendix G.3.

[50] The PUC's template for quarterly and annual reports does not require EDCs to report impacts and costs by customer sector.

Over 98% of PPL's non-residential energy savings in PY3 came from the Efficient Equipment and Custom Incentives Programs. Figure 6-2 shows the distribution of savings by program for PY3.

Figure 6-2: Non-Residential Energy Savings by Program: PPL PY3



The Efficient Equipment Incentive Program is separated into three components in the graph – C&I Lighting – New Construction, C&I Lighting Retrofit and EE Non-Lighting. The Custom Incentives Program contributed a much larger share to PPL's non-residential programs energy savings in PY3 (31%) compared to PY2 (7%).

The SWE also performed desk audits of project files from a sample of PY3 non-residential projects, which were submitted as part of the SWE Quarterly Data Request. Project file reviews are designed to audit the accuracy of the savings values stored in the PPL tracking system (EEMIS) and to confirm that calculations are being performed in accordance with the 2011 TRM. 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 found the supporting documentation to be comprehensive, detailed, well-organized and allowed for a complete review of all uploaded projects. Two issues were identified in the project file review that the SWE recommends PPL address in PY4.

1. Supporting forms for the Direct Discount segment of the Efficient Equipment Incentives Program do not always use the TRM specified EFLH values. The correct EFLH values are applied to the project in PPL's EEMIS tracking system, but this creates discrepancies between the tracking system and the supporting documentation. The SWE recommends PPL incorporate TRM EFLH values into all supporting documents to avoid future discrepancies.

2. PPL and some of the other EDCs use the version of the TRM that was in place at the time the project was installed. Some EDCs use the version of the TRM that was in place at the time the project was recorded in the EDC's tracking system (which may be a different program year and different TRM than the installed date). The issue of whether the installation date or the reporting date is the date which determines the proper TRM to use in savings calculation will be discussed in upcoming PEG meetings. If changes are required to the TRM, then those changes will be included in the 2014 TRM.

Lastly, the SWE performed 11 ride-along inspections and three independent site inspections of PPL's PY3 non-residential projects. An overview of the site inspection process and common findings is provided in Section 3.1.3.1 and PPL-specific project findings and resolutions are provided in Appendix G.3.

6.4.4 Demand Response Audit Summary

There was no audit work completed on Demand Response programs as these programs had not yet been implemented in PY3.

6.4.5 Net-to-Gross and Process Evaluation Audit Summary

The SWE's review of the net-to-gross (NTG) analyses and process evaluations for PPL's energy efficiency programs in general focused on the level of rigor employed for programs evaluation, the level of transparency provided regarding the evaluation methodology and the level of consistency in methodology, and reporting practices for each evaluated program. Findings and recommendations from this review are presented in this section.

6.4.5.1 Net-to-Gross

As described in Section 3.8 the SWE defined three levels of rigor for the NTG analysis – Basic, Standard, and Enhanced. PPL has implemented 12 EE&C programs, of which 10 are energy efficiency programs (the remaining two were demand response programs that do not undergo NTG analysis). Of the 10 energy efficiency programs, nine were considered candidates for a NTG analysis according to the SWE. The SWE recommended a Basic level of rigor be used for the analysis of each program with the exception of one program, the Residential Lighting Program (CFL Campaign), for which an Enhanced level of rigor was recommended.

The PPL Program Evaluator reported NTG ratios for eight of PPL's 10 energy efficiency programs. Seven of the eight analyses were considered as Basic rigor while the analysis for the Residential Lighting Program was considered Standard rigor. The PPL Program Evaluator administered self-reporting surveys to program participants to arrive at free ridership scores and an assessment of program spillover. Additionally, an analysis of a ninth program, the Renewable Energy Program, was attempted; however, the analysis could not be conducted due to insufficient survey responses.

For all programs, the level of rigor used by the PPL Program Evaluator in its NTG analyses was specified in its Evaluation Plans that were approved by the SWE. Based on PY3 results, the SWE recommends increasing the level of rigor for the PY4 evaluation of the Residential Lighting Program. The Program did receive a heightened level of analysis by the PPL Program Evaluator that involved self-reporting surveys in addition to a review of CFL sales data, which allowed the Evaluator to create a more appropriate metric to evaluate free ridership and spillover. However, based on the SWE definition of Enhanced rigor, which includes using multiple NTG methods and conducting an analysis for combining these methods, the analysis conducted for the Residential Lighting Program fell short of the recommended level of rigor. As the Program was one of the largest energy savings program in the PPL portfolio, it is recommended that the PPL Program Evaluator expand the scope of its NTG analysis to achieve the recommended Enhanced level of rigor for the net savings analysis starting in PY4. The SWE has discussed this recommendation with PPL and its Program Evaluation contractor is currently considering additional actions and data sources which can be incorporated in the PY4 NTG analysis for the Residential Lighting Program.

The overall transparency provided in the PY3 Annual Report for the NTG analysis of PPL's programs was good. The PPL Program Evaluator provided an appendix that described the NTG methodology, which included a description of the survey instrument and the number of surveys administered to assess free ridership and spillover. The survey descriptions provided an understanding of what type of questions were asked to assess the level of free ridership and spillover and how these questions varied between residential and non-residential surveys.

The PPL Program Evaluator also included a summary of how free ridership and spillover were scored based on survey responses. While the scoring description was helpful to understand the logic and some of the assumptions behind the scores, the SWE will request PPL's Program Evaluator to provide a detailed account of its scoring algorithm to increase the level of transparency associated with reported free ridership scores. Spillover calculations were more straightforward with regard to how they were scored and ultimately factored into the NTG ratio.

After scores for free ridership and spillover had been derived, the PPL Program Evaluator did provide formulaic descriptions for how the final NTG ratio was calculated. Moreover, the Evaluator provided confidence and precision statistical metrics for each NTG ratio based on the number of surveys administered. It is recommended that the PPL Program Evaluator disclose greater detail on its scoring model to the extent that such information does not divulge trade secret or proprietary knowledge. More detail or presentation of the algorithm used to score survey responses and how the scores for individual participant responses are combined into a program-level free ridership score will help alleviate questions about how the final NTG ratio is computed.

PPL's NTG methodologies and results were very consistent among programs. The PPL Program Evaluator used the same methodology for each program while tailoring survey questions for certain programs. The Evaluator was also very consistent in the reporting of the number of surveys conducted and subsequent results. This consistency facilitated the PY3 Annual Report's review by having consistent metrics that could be compared among programs. It is recommended that the PPL Program Evaluator continue this level of consistency in subsequent evaluation reports.

6.4.5.2 Process Evaluation

The process evaluation conducted by the PPL Program Evaluator for PPL's programs was reviewed in the same manner as the NTG analysis. Findings and recommendations from the SWE's review are presented below.

No pre-determined level of rigor was described nor recommended by the SWE, as was the case for the NTG analysis. Nevertheless, the PPL Program Evaluator provided a separate report for its process evaluation of PPL's programs. The report included a brief description of the PPL Program Evaluator's scope and methodology, an assessment of the program portfolio, process evaluation findings and recommendations at the program level. The Evaluator described the focus of the process evaluation and explained what and how the data was obtained. The findings from the process evaluation were often quantified and detailed and provided excellent insights into the programs. The portfolio assessment provided a consistent understanding for basic program components such as participant feedback and marketing efforts. The program-level evaluations provided additional insight into these program components while expanding into program-specific topics.

The level of rigor for the PPL Program Evaluator's process evaluations may be described as Standard relevant to the rigor qualifications defined for the NTG analysis. Program documentation review, interviews with program staff and program implementers, along with participant surveys, were conducted for all programs. Additionally, some programs also included interviews with trade allies and other stakeholders to enhance the process evaluation. The PPL Program Evaluator provided detailed summaries of findings from these efforts to help inform the status of each program.

The SWE recommends that the PPL Program Evaluator continue this level of rigor for future evaluations of PPL's programs. PPL's PY1 and PY2 Process Evaluations included a review of program logic models. There were no material changes to program logic models in PY3. Therefore, it was not necessary to review the logic models again in PY3.

6.5 SWE Recommendations

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

1. A number of findings and recommendations were presented by the PPL Program Evaluator based on the PY3 process evaluation. The SWE recommends that PPL consider incorporating the recommended actions in PY4 and in Phase II of Act 129. Include additional stakeholders and market actors in the process evaluation to help uncover missed opportunities or unknown issues that may be addressed to improve programs performance.
2. Take corrective actions to stabilize the realization rate of ground source heat pump (GHSP) projects, including validation of heat source/sink, application of TRM methodology for ground loop pumps in the reported savings calculations, and standardization of cooling-only RTU baselines.
3. The level of rigor (sample size, evaluation activities, metering) for the Efficient Equipment Incentive Program's gross impact evaluation was excellent in PY3. The SWE recommends that the PPL Program Evaluator continue this approach in future program years as the program is responsible for over 40% of the energy savings in PPL's portfolio.
4. The SWE recommends that the PPL Program Evaluator expand the scope of its NTG analysis for the Residential Lighting Program in PY4 to achieve the recommended Enhanced level of rigor for the net savings analysis.

6.6 Statewide Evaluator Best Practice Analysis

PPL's Direct Discount delivery channel was used to successfully increase participation in lighting projects for the small C&I sector in PY3. This focus on a particular customer class is found in the best practice of "efficiently delivering integrated programs to all end-users regardless of their size." See Appendix D. PPL's focus on the small C&I sector allows customers in that sector to participate in and take advantage of energy efficiency opportunities.

7 Metropolitan Edison Company

This section summarizes Metropolitan Edison Company's (Met-Ed) performance in PY3, as well as the cumulative energy savings and demand reductions achieved by Met-Ed's Act 129 EE&C programs through the end of PY3. This section presents the evaluation activity completed by both ADM (the current FirstEnergy Program Evaluator) and the SWE in the calculation of the cost-effectiveness, and the measurement and verification (M&V), of Met-Ed's EE&C programs. This section also provides the SWE's recommendations for Met-Ed's programs going forward.

7.1 Summary of Energy and Demand Reductions

Table 7-1 highlights Met-Ed's cumulative reported gross impact and verified gross impact since the EE&C programs' inception through the end of PY3.

Table 7-1: Summary of Met-Ed CPITD Impacts

	CPITD Reported Gross Impact[f]	CPITD Verified Gross Impact[h]	Savings Achieved as % of 2013 Targets[i]
Total Energy Savings (MWh/yr)	322,878	301,398	67.6%
Total Demand Reduction (MW)	47	39	32.8%
TRC Benefits ($1,000) [a]	Not Applicable[g]	$79,698	Not Applicable
TRC Costs ($1,000) [b]	Not Applicable[g]	$33,616	Not Applicable
TRC Benefit-Cost Ratio[c]	Not Applicable[g]	2.37	Not Applicable
CO_2 Emissions Reduction (Tons) [d][e]	261,531	244,132	Not Applicable

NOTES:

[a] 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. 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 TRC Order.

[d] 8.1x10-4 metric tons of CO_2 per kWh (EPC's eGRID2007 Version 1.1, RFCE Region annual non-baseload CO_2 output emissions rate, year 2005 data). This is included in this report per the approved SWE work plan.

[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] Defined as the gross energy savings that were reported during the period since date of program implementation through the current reporting period (i.e., reporting period of this report). CPITD = Cumulative Program Inception To-Date.

[g] TRC Benefits and Costs are calculated only for verified savings, which reflect actual program results.

[h] Defined as the energy savings that have been verified by the FirstEnergy Program Evaluator and audited by the SWE, and since the date of program implementation through the end of PY3.

[i] Savings achieved based on CPITD Verified Gross Impact.

As shown, Met-Ed has achieved 67.6% of its Act 129 2013 energy savings target and 32.8% of its Act 129 demand savings at the end of PY3. The TRC Benefit-Cost Ratio (or TRC Ratio) of 2.37 indicates Met-Ed's EE&C programs are cost-effective on an aggregate (portfolio) basis.

Table 7-2 contains a listing of Met-Ed's EE&C programs that reported participation and had energy and/or demand savings that were evaluated in PY3, and programs that are yet to be implemented or had no reported savings in PY3.

Table 7-2: Met-Ed EE&C Programs[51]

Programs Reporting PY3 Gross Savings:
4. Home Energy Audits and Outreach
5. Appliance Turn-In
6. EE HVAC
7. EE Products
8. New Construction
9. WARM Programs
10. Small C&I Equipment
11. Large C&I Equipment
12. Street Lighting
13. Non-Profit
14. Remaining Government/Non-Profit
Programs to be Implemented or with No Reported PY3 Savings:
15. Behavioral Modification and Education
16. PJM Demand Response
17. Multiple Family
18. Integrated Distributed Energy Resources (IDER)
Commercial and Industrial Demand Response

Met-Ed has reported PY3 gross energy and/or demand savings for 12 programs. Table 7-3 below provides a breakdown of the contribution of each program's verified gross energy savings and verified gross demand savings towards the CPITD portfolio savings. As shown, the Energy Efficient (EE) Products Program accounts for 26% of the total CPITD verified gross energy savings for Met-Ed's portfolio. This Program also represents approximately 48% of the savings from Met-Ed's residential energy efficiency programs. The EE Products Program includes a residential lighting component buy-down component and rebates for appliances. The Small C&I Equipment and Large C&I Equipment Programs also account for a large percentage (together 35%) of Met-Ed's portfolio verified gross energy savings.

51 Program names are as presented in EDC annual report, Figure 1-5.

Table 7-3: Summary of Met-Ed EE&C Program Impacts on Gross Reported Portfolio Savings – Through PY3

Program	CPITD Verified Gross MWh/yr Savings	Percent of Portfolio CPITD Verified Gross MWh/yr Savings	CPITD Verified Gross MW Reductions	Percent of Portfolio CPITD Verified Gross MW Reductions
EE Products	78,381	26%	4.4	11%
Home Energy Audits and Outreach	41,135	14%	2.0	5%
Appliance Turn-In	27,657	9%	5.3	13%
EE HVAC	11,678	4%	3.7	9%
Multiple Family	2,895	1%	0.1	0%
New Construction	1,808	1%	0.6	2%
WARM Programs	4,632	2%	0.8	2%
Large C&I Equipment	53,654	18%	7.2	18%
Small C&I Equipment	52,106	17%	9.7	25%
Remaining Government/Non-Profit	21,686	7%	5.2	13%
Street Lighting	4,970	2%	0.0	0%
Non-Profit	743	0%	0.2	1%
TOTAL PORTFOLIO	**301,398**	**100%**	**39.3**	**100%**

Programs to be implemented or with no reported PY3 savings are not shown. See Table 7-2.

7.2 Total Resource Cost Test

Table 7-4 provides a breakdown of the contribution of each EE&C program's Program Year-to-Date (PYTD) verified gross energy savings and demand reductions as well as the TRC Ratios.

Table 7-4: Summary of Met-Ed EE&C Program Impacts on TRC Ratios

Program	PY3 Verified MWh/yr Savings	PY3 Verified MW Reductions	TRC Ratio
EE Products	40,142	2.13	4.03
Home Energy Audits and Outreach	13,977	0.71	3.62
Appliance Turn-In	10,785	2.03	4.98
EE HVAC	5,756	1.81	1.26
New Construction	1,248	0.46	1.33
WARM Programs	799	0.35	0.87
Small C&I Equipment	30,623	4.72	4.20
Large C&I Equipment	11,142	1.44	3.23
Remaining Government/Non-Profit	4,370	2.11	3.85
Street Lighting	777	0.00	1.74
Non-Profit	99	0.03	1.91
TOTAL PORTFOLIO	119,717	15.79	2.37

1 **Programs to be implemented or with no reported PY3 savings are not shown. See Table 7-2.**

Ten of the 11 programs are found cost-effective by the TRC Ratio. (i.e., the Ratio exceeds 1). The only programs that generated savings in PY3 but were not found to be cost-effective are the WARM Programs (Met-Ed's Low-Income Program.)

An important finding is that the programs with the largest amount of savings in the residential and C&I sectors generally have high TRC Ratios. This means that not only are they performing well in terms of generating savings, they are also cost-effective programs.

7.2.1 Assumption and Inputs

TRC Model calculations are handled independently for Met-Ed, Penelec and Penn Power, but each EDC uses the same FirstEnergy TRC model. FirstEnergy uses a TRC Model discount rate of 7.92% to discount program benefits and costs. This rate is used to compare the Net Present Value (NPV) of program benefits that will occur later in a measure's lifetime to the upfront costs of installation and implementation. A line loss factor of 11% is used for all programs.

In the residential sector, measure lifetime was reported on a measure-by-measure basis and is consistent with the 2011 TRM. In the non-residential sector, effective measure life was applied to the FirstEnergy TRC model calculations at the project level rather than at the measure level. In order to determine the measure life for a program, a weighted average of the effective lives of the program measures was calculated and rounded to the nearest year, and this integer value was used in the avoided supply and avoided capacity benefits calculations. The measures rebated for non-residential programs include lighting, motors and variable frequency drives (VFDs). In addition to these measures, CFL lighting was installed as part of the Small C&I Equipment and Remaining Government/Non-Profit Programs. Non-residential CFLs were assigned an effective measure life of 3.7 years (compared to 6.4 years for residential CFLs) in FirstEnergy's TRC model because bulbs in these sectors will see more annual hours of use than in the residential sector, which will shorten their effective measure life. The sources used for measure lives mainly include 2011 TRM and DSMore Michigan database.

Incremental costs were also assigned at the measure level in the residential sector and program level in the non-residential sectors in the FirstEnergy TRC model. Met-Ed's EE&C Plan and the DEER were the sources of incremental costs for individual measures. These incremental measure costs were multiplied by the weight of that measure in the program. Measure weighting within a program was a function of the quantity and savings from that measure within a given rebate type.

The energy and demand impacts used in the FirstEnergy TRC model analysis were drawn 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.

7.2.2 Avoided Cost of Energy

The FirstEnergy TRC model assigns a value ($/kWh) to the avoided cost of energy for each year from 2012 through 2026 for each sector – residential, small commercial and large commercial – as well as for each sector in specific seasons. The unit impacts are multiplied 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 FirstEnergy model assigns a flat annual figure ($/kW) to the cost of adding generation capacity. A single value is used for the avoided cost of capacity for all programs and sectors. The forecasted avoided cost of capacity figures are the same for Met-Ed and Penelec. The figures used for Penn Power are slightly higher than those used for Met-Ed and Penelec. This value is multiplied by the *ex post* demand savings for each combination of program and sector to determine the benefits incurred by the applicable FirstEnergy company from not having to expand capacity.

7.2.4 Conclusions and Recommendations

The SWE recommends that FirstEnergy explore the feasibility of performing avoided cost calculations in the non-residential sectors at the measure level so a measure-specific effective life can be imposed. The SWE also recommends that FirstEnergy more clearly show how the measure life at the program level was determined and specify the measure lives used for all measures in the TRC model. This would also allow the measure-specific incremental costs in the non-residential sectors to be used and would provide insight into the relative performance of measures within a program. FirstEnergy should also explore the benefits, costs and ability to more effectively incorporate load shapes into the TRC model, and address the fact that some measures save energy during periods when it is more valuable than others. It should be noted that the time-dependent value of avoided electric service is reflected in FirstEnergy's current TRC calculator. This is achieved through usage of four different avoided cost structures for each rate class, corresponding to measures that provide year-round savings (e.g., lighting), primarily winter savings (e.g., LED holiday lights), primarily summer savings (e.g., AC), or peak summer savings (e.g., demand response).

7.3 Status of Evaluation Activities

7.3.1 Status of EM&V Plans

Per the guidelines outlined in the Audit Plan,[52] the SWE has reviewed EM&V plans submitted by the EDCs to verify that the plans comply with the TRM and TRC Orders and meet the minimum evaluation requirements set forth in the Audit Plan. The Audit Plan provides an outline for the evaluation framework expectations and guidelines necessary to address the following research objectives:

- determine realization rates for gross savings;
- determine net to gross (NTG) ratios;
- determine method for calculating savings; and
- Set acceptable levels of rigor, precision and bias for measurement and verification (M&V) activities.

No changes were made to the EM&V plans for Met-Ed's energy efficiency programs in PY3. In March, 2012, the Company submitted EM&V plans for two Demand Response programs that would be active during the summer of 2012. The Integrated Distributed Energy Resources (IDER) and Commercial and Industrial (C&I) Demand Response Programs were designed to produce temporary demand reductions during the top 100 hours of the summer.

Evaluation of the IDER program involves the use of a control group of 200 customers who do not have their air conditioning load interrupted during curtailment events, and a population of Program participants who have their call for air conditioning interrupted during peak hours. The difference in metered load between these two groups is used to estimate the demand reduction produced by the program. The SWE reviewed the approach and found it to be well documented and thorough, and approved the plan during a biweekly teleconference on May 17, 2012.

The EM&V plan for Met-Ed's C&I Demand Response program calls for verified savings estimates to be developed for a census of program participants. Depending on the load profile of the participant's site, one of three potential models will be selected to estimate the baseline consumption, or how much energy the site would have consumed if it had not participated in the curtailment event:

1. Weather Sensitive Adjustment Model;
2. Customer Baseline Load; or
3. Symmetric Additive Adjustment (SAA).

The SWE agrees with FirstEnergy's approach of choosing from several possible baseline calculation methodologies because of the variation in customer load profiles in the C&I sector. However, the SWE

[52] See Statewide Evaluator Team, *Audit Plan and Evaluation Framework for Pennsylvania Energy Efficiency and Conservation Programs*, November 4, 2011.

feels it is important for the baseline methodology be chosen which provides the most accurate results, not necessarily the largest load reduction.

7.3.2 M&V Activities and Findings

The following section provides a summary of the Measurement and Verification (M&V) activities conducted by the FirstEnergy Program Evaluator based on details provided in Met-Ed's PY3 Annual Report as well as information gathered from SWE data requests and audits.

7.3.2.1 Gross Impact Evaluation

Table 7-5 provides a summary of M&V based on activities conducted by the FirstEnergy Program Evaluator based on details provided in Met-Ed's PY3 Annual Report, and on information obtained from SWE data requests and audits.

Table 7-5: Met-Ed Energy Efficiency Programs – Realization Rates for Energy and Demand

Program	Realization Rate-Energy Savings	Realization Rate-Demand Savings
EE Products	100%	88%
Home Energy Audits and Outreach	96%	61%
Appliance Turn-In	72%	74%
EE HVAC	110%	87%
New Construction	84%	170%
WARM Programs	51%	111%
Small C&I Equipment	75%	55%
Large C&I Equipment	94%	98%
Remaining Government/Non-Profit	81%	53%
Street Lighting	100%	NA[1]
Non-Profit	114%	90%
TOTAL PORTFOLIO	**87%**	**69%**

1 Street Lighting occurs at night and thus no peak demand reduction will be realized.

2 Programs to be implemented or with no reported PY3 savings are not shown. See Table 7-2.

The realization rate is a factor that compares the gross savings reported by the EDC to the verified savings determined by the EM&V contractor through M&V activities. The calculation for a realization rate is as follows.

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

Depending on the program, realization rates are calculated either based on a sample of program participants and then applied to all participants or the realization rate is calculated on a census of all program participants and then applied to all participants. A realization rate of 100% indicates that the FirstEnergy Program Evaluator was able to verify all reported savings (this is the case with the energy savings of Met-Ed's EE Products Program and Street Lighting Program). A realization rate of less than 100% indicates that the gross savings were overestimated and a realization rate of over 100% indicates that gross savings were underestimated.

Realization rates for energy savings from Met-Ed's programs range from 51% (WARM Program) to 114% (Non-Profit Program). Met-Ed's realization rates for program demand reductions range from 53% (Remaining Government/Non-Profit Program) to 170% (New Construction Program.)

7.3.2.1.1 Appliance Turn-In Program

The low realization rate for the Appliance Turn-In Program is a reflection of a TRM update that took place in PY3 and reduced the per-unit savings for this Program. Because Met-Ed estimated savings for this Program using PY2 TRM protocols, the gross savings had to be adjusted to reflect the update.

7.3.2.1.2 Residential New Construction

The energy savings realization rate of 84% for Met-Ed's Residential New Construction program resulted from a combination of two factors. The first factor is that an overstatement of energy savings from ground-source heat pumps (GSHPs) frequently occurred in REM/Rate™ due to an overestimated baseline usage.

The second factor is that an adjustment was needed to make the reported *ex ante* savings consistent with TRM protocols. Per the 2011 TRM, energy savings from lighting and appliances in the residential new construction program are a function of the TRM algorithms. The *ex ante* savings reported by Met-Ed were based on the direct output from REM/Rate™ rather than calculated from the TRM algorithms, and thus were adjusted. The adjustment is specific to each home audited and can be either an increase or a decrease in the energy savings compared to the output from REM/Rate™. Factors affecting the magnitude and direction of the adjustment include the level of efficiency of the appliances installed, the percentage of efficient lighting installed, and home size.

The demand savings realization rate of 170% for the Residential New Construction Program resulted from an adjustment to the *ex ante* demand savings reported by Met-Ed to achieve consistency with the requirements of the 2011 TRM. Per the TRM, demand savings should be calculated using the algorithms contained in the TRM and should not be direct outputs of REM/Rate™. The *ex ante* savings reported by Met-Ed were based on the direct output from REM/Rate™, and thus were adjusted. In all homes audited by the SWE, the TRM algorithms produced greater demand savings estimates than REM/Rate™, which resulted in a realization rate significantly greater than 100%.

7.3.2.1.3 Home Energy Audits and Outreach Program

Overall realization rates were generally over 90% for energy savings. The low realization rate for demand savings for the Home Energy Audits and Outreach Program was primarily the result of the EDCs factoring in the effect of furnace whistles in their demand reduction calculations even though the 2011 TRM does not recognize demand reductions attributed to furnace whistles. A secondary source of variance is due to the findings of a participant web-survey conducted by the FirstEnergy Program Evaluator. The survey found a wide variance in savings due to the corresponding variance in installation rates. The survey indicated that customers did not install the same proportion of measures included in the energy conservation kit that were assumed by Met-Ed and therefore the savings generated by each measure varied from tracking estimates.

7.3.2.1.4 WARM Programs

The reported savings for the WARM Programs were based on 2008 LIURP data by job type. The reason LIURP data was used is because the Program is evaluated using a billing analysis, which requires at least 12 months of pre- and post-installation billing data. The WARM program, which has been offered for over 20 years through LIURP, is essentially identical to the WARM Programs offered through Act 129 and is also evaluated using statistical billing analysis. Therefore, in September 2010 the SWE approved a custom measure protocol to use recent LIURP billing analysis results to report the energy savings until WARM Programs results were available. At the conclusion of PY3, the FirstEnergy Program Evaluator conducted an independent billing analysis of 2010 Program participants to calculate verified energy savings for PY3. The results of the analysis were smaller baseline energy usage and per-job savings as compared to the 2008 LIURP data that was used for the report savings, which led to the low realization rate. The SWE recommends that Met-Ed update the participant tracking database with the most recent billing analysis results to mitigate realization rate anomalies.

The WARM Programs’ demand impact realization rate was high due to a change in the evaluation approach. Because LIURP billing analysis results do not provide enough information to develop coincident peak demand savings, the reported demand impact was based on a conservative kWh to kW conversion factor. The verified demand impact was based on modeling results using program inputs and average historical dry bulb temperature for the 100 hours of highest peak summer demand. The realization rate was thus a result of the conservative approach to calculating the reported savings.

7.3.2.1.5 Non-Residential Programs

Met-Ed defines and reports impacts from non-residential programs by sectors. In PY3, energy and demand savings were reported for the Small C&I Equipment, Large C&I Equipment, Street Lighting, Non-Profit and Remaining Government/Non-Profit Programs. Completed projects within each program were further segmented by equipment type to create homogenous groups for evaluation. These equipment types, or measure categories, were the basis of the sample design. M&V approach, sampling assumptions and level of rigor of the evaluation were a function of the savings contribution and relative uncertainty associated with the measure category.

The sample design assumptions were based on the results of the PY2 evaluation. The required sample sizes for prescriptive measure categories, which tend to have homogenous realization rates among sampled projects, were calculated using a coefficient of variation (Cv) of 0.5. Sample sizes for custom measure categories were calculated using a coefficient of variation of 1.0 because verified savings estimates for these measures were found to show high variance in PY2. The SWE commends Met-Ed for using a high Cv assumption for these measure categories because the larger required sample size ensures that the confidence and precision levels established in the Audit Plan will be met.

Each program in the Met-Ed non-residential portfolio was evaluated using stratified ratio estimation. This means a separate realization rate was calculated for each measure category within a program based on the observed ratio of the evaluators verified savings estimates to the reported savings estimates. The realization rate for the measure category was applied to all projects in that measure category for the year to calculate the gross verified savings estimate for the measure category.

Table 7-6 shows the energy and demand savings realization rates for each of the non-residential programs in Met-Ed's portfolio for PY3.

Table 7-6: Met-Ed Realization Rates and Relative Precision Values – Non-Residential Programs

Program	Energy Savings Realization Rate	Relative Precision (Energy)	Demand Savings Realization Rate	Relative Precision (Demand)
Small C&I Equipment	75%	8%	55%	14%
Large C&I Equipment	94%	11%	98%	12%
Street Lighting	100%	13%	NA[1]	NA[1]
Non-Profit	114%	6%	90%	5%
Remaining Government/Non-Profit	81%	13%	53%	18%

1 **Streetlighting occurs at night and thus no peak demand reduction will be realized.**

The relative precision values in Table 7-6 are presented at the 85% confidence level and can be used to assess uncertainty associated with the realization rate due to sampling error. For example, the gross verified energy savings estimate for the Small C&I Equipment program in PY3 was 30,623 MWh/yr after applying the realization rate of 75%. The relative precision value of 8% means one can be 85% confident that the true PY3 energy savings of the Small C&I Equipment program was between 28,173 MWh/yr and 33,073 MWh/yr. Each of the Met-Ed non-residential programs exceeded the requirement of 15% precision at the 85% confidence level for energy set forth in the Audit Plan.

The low energy and demand realization rates shown in Table 7-6 for the Small C&I Equipment and Remaining Government/Non-Profit Programs were due in large part to the verified savings estimates for the CFL measure category. CFLs were responsible for about 75% of the gross reported energy savings in the Small C&I Equipment Program and approximately 50% of the gross reported energy savings of the Remaining Government/Non-Profit Program, thus the CFL measure category evaluation had a large impact on the gross verified savings for these Programs.

In PY3, a large number of conservation kits that included CFL bulbs were mailed to Met-Ed customers. The FirstEnergy Program Evaluator used a combination of site visits and phone interviews to determine the in-service rates of the CFLs. Lighting loggers were also deployed in building types that did not have EFLH values in the 2011 TRM. A sample size of 104 was achieved for the CFL measure category between the Small C&I Equipment Program and the Remaining Government/Non-Profit Program.

The realization rate for the CFL measure category was 70% for energy and 44% for demand. The low realization rate was due to an in-service rate lower than expected because many bulbs were actually installed in the residential settings. The fact that the surveys which determined the in-service rate were conducted in October for kits mailed in May also likely contributed to the low realization rate. If more time had elapsed between the mailing of the kits and the surveys, a greater number of bulbs may have been installed. Residential hours-of-use (HOU) assumptions in the 2011 TRM were substantially lower than most commercial building types. The lower in-service rate reduced the Programs' realization rates. The metered hours-of-use values were also about 15% lower than the assumed value used in the reported savings figures. The SWE believes that the low realization rate for the CFL measure category is an important finding that can be used to inform program design and TRM protocols. The SWE found the M&V approach used by the FirstEnergy Program Evaluator to be thorough and rigorous. Although the findings led to a verified savings estimate lower than anticipated, the SWE believes the methodology produced an accurate estimate of the true impact of the Programs.

A total of 70 site inspections were conducted by the program evaluator as part of the PY3 evaluation of Met-Ed's non-residential programs. Prior to the site inspection, each project received a desk review to gather key equipment parameters. For custom measures, a site-specific M&V plan was developed for each sampled site. Metering equipment was deployed at 15 of the 70 sites. A variety of M&V approaches were used to develop verified savings estimates including simple verification and TRM calculations, IPMVP Option A (Partially Measured Retrofit Isolation) and IPMVP Option C (Whole Facility Billing Analysis). The SWE reviewed the approaches used for each measure category and found them to be reasonable given the type of equipment installed.

The FirstEnergy Program Evaluator submitted spreadsheets to the SWE which documented the calculation of the realization and error ratios for each measure category. The error ratio is the key variance metric for programs that use stratified ratio estimation, and is used to satisfy the Cv assumption for future sample designs. The SWE reviewed each calculation worksheet and confirmed that the verified savings estimates and associated precision levels were calculated correctly. Lighting projects were the least variable measure category in PY3 because reported savings values are calculated using a version of protocols in the 2011 TRM Appendix C (Lighting Inventory Tool), and are consequently very accurate. The highest variability was observed in the prescriptive measure category which included mostly HVAC projects. The SWE recommends that Met-Ed review the assumptions used to generate reported savings estimates for these projects in PY4 to stabilize the relationship between the reported and verified savings estimates.

7.3.2.2 Net Impact Evaluation

Net-to-Gross (NTG) analyses are conducted as part of an impact evaluation to determine what proportion of evaluated savings is attributable to the program. That is, a NTG ratio (NTGR) represents the percentage of savings that would not have occurred in the absence of the program. To calculate a NTGR for a given program, evaluators will typically assess the level of free ridership (FR) and spillover (SO) among program participants. Free ridership is an assessment of how likely a program participant would have implemented a program measure regardless of the program incentive or existence of the program. Spillover is an assessment of additional energy saving actions taken by a participant or non-participant that were a result of the program. The NTGR is calculated using the following formula:

$$NTGR = 1 - FR + SO$$

The NTG approach taken by the FirstEnergy Program Evaluator followed an industry-standard approach. Both residential and non-residential programs were evaluated through customer self-reports and structured interviews with key decision-makers.

Results from the NTG evaluation are presented in Table 7-7. Additional information on Met-Ed's NTG methodology is provided in Appendix B.4. The SWE's evaluation of the NTG methodology is provided in Section 7.4.5.

Table 7-7: Met-Ed NTG Results

Program	Total Surveys	Free Ridership	Spillover	NTG Ratio
Residential Home Energy Audits and Outreach Program	144	24.8%	12.7%	87.9%
Residential Appliance Turn-In Program	201	38.5%	NA[1]	61.5%
Residential Energy Efficiency HVAC Program	113	41.0%	0.3%	57.7%
Residential Energy Efficient Products Program	126	56.5%	7.0%	50.5%
Commercial/Industrial Equipment Program	70	43.4	8.9%	65.5%

1 NA indicates that program not structured to induce spillover, and any anticipated spillover would be minimal.

7.4 Statewide Evaluator Audit Activities and Findings

7.4.1 Residential Program Audit Summary

7.4.1.1 Residential Lighting

Residential lighting is included in Met-Ed's EE Products Program. The SWE reviewed the data tracked in the FirstEnergy's database and tracking system to verify that FirstEnergy was using the appropriate savings values and algorithms from the 2011 TRM. The SWE also selected a sample of 10 bulbs for the review of baseline assumptions to ensure the CFL wattages fell within the ranges specified in the TRM. Lastly, the SWE team selected five retail invoices per quarter from Met-Ed's buy-down program to review and verify that the bulb counts were accurately tracked in the Met-Ed database and tracking system. The SWE found that Met-Ed used the correct values and algorithms, and the correct baseline assumptions, from the 2011 TRM. Additionally, no issues were identified in the review of invoices from PY3.

7.4.1.2 Appliance Turn-In Program

The SWE requested samples of Met-Ed's JACO[53] work orders and corresponding database entries for each quarter. The SWE then checked the database entries for these participants and verified them against the individual database entries from JACO for each customer. For each participant, the SWE verified that number and type of appliances removed was consistent across both databases. The SWE also verified that the savings value used for each sampled participant reflected the characteristics of the recycled appliance. The SWE observed that all participant data was consistent in both Met-Ed and JACO's databases. Met-Ed used the updated values for energy savings of replaced and retired refrigerators from the 2011 TRM in the calculation of net savings.

7.4.1.3 Energy Efficient (EE) Products Program

The SWE requested samples of Met-Ed's customer rebate applications and corresponding database entries for each quarter. The SWE then checked these participants' rebate applications (including copies of receipts for purchased equipment) against the Met-Ed database. The SWE found that all participants sampled had active Met-Ed accounts and all measures that were rebated were on the approved list. Met-Ed used the correct deemed savings from the 2011 TRM. The SWE found no quality control errors In the PY3 samples. In the latter part of PY2, the SWE informed Met-Ed that the SWE would start choosing the sample from Met-Ed's residential database. This gave the SWE a higher level of confidence in the random sample audited in PY3.

7.4.1.4 New Construction Program

The SWE finds from its desktop audit that no adjustments to *ex post* savings reported in Met-Ed's PY3 Annual Report for its (residential) New Construction Program are required. However, the SWE has some general observations and recommendations for future program years based on the PY3 audit.

The FirstEnergy Program Evaluator has found that the TRM algorithms for calculating energy savings from lighting and appliances are difficult to use because not all of the information required to use the algorithms is readily available. The FirstEnergy Program Evaluator's home inspections are typically performed during the late construction phase when key components such as insulation, window make and model, and whole-house air infiltration properties are easy to identify and verify but lamps and appliances may not be fully installed.[54] The FirstEnergy Program Evaluator also has found that the REM/Rate™ files do not include enough information that could be extracted for use in the TRM algorithms for lighting and appliances. For example, the files do not include a home's exact lighting fixture count, but rather an overall percentage of fixtures that are CFLs. Because the TRM algorithm for lighting is on a per-bulb basis, the lighting savings cannot be estimated using only the data available in REM/Rate™. For appliances, the FirstEnergy Program Evaluator used homeowner and builder surveys to collect information on the appliances installed required for the TRM algorithms, and for lighting, the Evaluator estimated energy savings based on assumptions used in the SWE Residential Baseline Study.

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53 JACO is the vendor for all EDCs' appliance recycling programs.
54 Met-Ed PY3 Annual Report, p. 60.

The SWE recommends discussions with the FirstEnergy Program Evaluator and new construction program CSP to explore improving process and accuracy for estimating and reporting energy and demand savings from lighting and appliances using the TRM algorithms instead of output from REM/Rate™. One improvement, for example, could be to have the certified Home Energy Rating System (HERS) rater record information required as inputs to the TRM algorithms for lighting and appliances (e.g. fixture counts, refrigerator configuration). Participant and builder surveys could then be used to supplement and check the recorded HERS rater information, rather than the surveys being the main source of information for the input to the TRM's algorithms for calculating energy and demand savings from lighting and appliances installations.

The SWE also recommends discussion with the FirstEnergy Program Evaluator and Program CSP to explore the feasibility of the CSP reporting the *ex ante* demand savings for each home calculated using the TRM algorithms rather than based on output from REM/Rate™. This would improve on the current process, which requires a significant adjustment to the sampled homes' demand impacts and extrapolating that adjustment to the entire Program.

The SWE further recommends a review of the TRM's demand savings algorithms for residential new construction, in light of the high demand realization rate for the New Construction Program. The algorithms appear to take a non-conservative approach in the application of the over-sizing factor for the baseline home, which results in an over-estimated baseline demand and thus over-estimated demand savings. The review should include consideration of the demand savings calculations used by REM/Rate™ and should result in a reduction of the over-estimated demand savings produced by the TRM.

7.4.2 **Low-Income Programs Audit Summary**

Met-Ed's Act 129 WARM Program is an extension of LIURP and supports an increase in the number of income-eligible homes receiving comprehensive measures such as appliances, high efficiency lighting and weatherization. The evaluation approach for this program is a statistical billing analysis based on job type.[55]

Met-Ed's WARM Extra Measures program had active participation in PY3. This program provides to WARM Program participants additional electricity-saving measures, including CFLs, LED night lights, furnace whistles and smart power strips. The PY3 energy savings for the WARM Extra Measures program were calculated based on 2011 TRM algorithms.

In prior program years, the SWE conducted site inspections of Met-Ed WARM Program (including WARM Extra Measures) installations. During PY3, Met Ed deployed a third party contractor to perform the site inspections. The SWE worked with Met-Ed to develop a site inspections checklist to ensure that the site

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[55] The three job types used by Met-Ed are as follows: electric heat jobs involve weatherization and provide measures with a value of at least $250 to reduce space heating energy usage for electrically heated homes; electric water heat jobs that provide measures with a value of at least $25 to reduce water heating energy usage for homes that have electric water heaters, and electric base load jobs, which may include refrigerator/freezer replacement and lighting retrofits.

inspectors were adequately assessing all measure installations and to provide confidence in the results.[56]

The SWE reviewed 40 site inspection reports from Act 129 WARM Program installations in PY3. Audit forms, inspection reports, and invoices were reviewed to confirm that job types were assigned correctly in the Met-Ed database extracts. All job types were assigned correctly. In addition, the SWE reviewed the site inspector notes to determine whether all measures were being installed and if there was follow-up if work was found to be incomplete. The SWE commends Met-Ed's follow-up on incomplete measure installations. There were several instances where jobs were not "passed" until contractors returned to complete all work, customer complaints were addressed, and other issues resolved. Met-Ed's site inspection process appears to be working effectively to promote quality installations. For WARM Extra Measures inspection reports reviewed, the SWE determined if measures were installed and that invoiced measures were properly reported in the database extracts. The SWE found isolated instances of measures not installed, which confirmed the in-service rates used by Met Ed's Program Evaluator through surveys.[57] The SWE found an inconsistency between Met-Ed's energy savings analysis and Met Ed's PY3 annual report. The report states that in-service rates from the 2011 TRM were used to calculate savings for WARM Extra Measures CFLs and furnace whistles. The SWE confirmed with Met-Ed that the measure savings were calculated using in-service rates determined through primary data gathering (e.g. surveys) and that the verified savings listed in Met Ed's annual report were correct.

The SWE reviewed the program evaluator's WARM Plus billing analysis results for any inconsistencies, improper assumptions, and statistical accuracy and precision. No issues were found. It should be noted that, while three job types are defined for the WARM Plus program, results were presented in Met-Ed's annual report for space heat and base load jobs. The number of water heat jobs was insufficient to provide statistically viable results, and therefore the water heat and base load jobs were combined for the billing analysis.

In addition to site inspection reports, the SWE reviewed quarterly data extracts to verify participant data, measure calculations, and reported program data. Any inconsistencies were reviewed with Met-Ed. Most inconsistencies were the result of adjustments to TRM in-service rates based on evaluation findings. Annual verified energy and demand impacts were confirmed to be consistent with the participant counts and verified per-job and per-measure savings.

Finally, the SWE verified that Met-Ed was in compliance with the requirement that the number of energy conservation measures offered to low-income households is proportionate to those households' share of the total energy usage in Met-Ed's service territory. Met-Ed offered seven types of measures to the low-income sector in PY3, which is 17.1%of the total number of measures offered across all sectors.

[56] The checklist subsequently supported development of the SWE's guidance memorandum for performing site inspections for the EDCs' low-income programs.

[57] In the case of LED night lights, the SWE found a 100% in-service rate, compared to the 68% in-service rate used by the FirstEnergy Program Evaluator. However, the SWE's sample was not statistically significant and therefore the SWE defers to the FirstEnergy Program Evaluator's in-service rate.

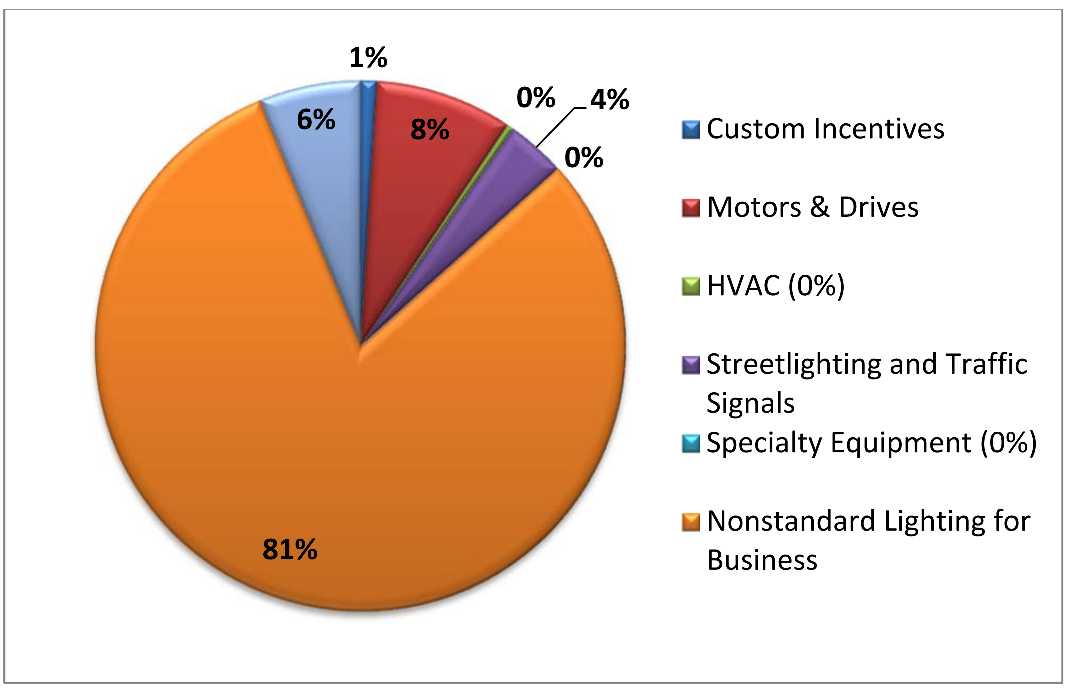
The SWE reviewed Met-Ed's measures list to confirm that the company is in compliance with its Act 129 requirement for proportion of measures offered, which is 7.84%.[58]

7.4.3 Non-Residential Program Audit Summary

The SWE reviewed evaluator verification work, and conducted a quarterly audit of the program tracking data for Met-Ed's non-residential programs and found no major issues. Based on this review, the SWE supports the verified results presented in Met-Ed's PY3 Annual Report. Met-Ed programs are generally based on sectors, with each distinct customer segment in the non-residential customer base being assigned to a program. The FirstEnergy Program Evaluator uses a different set of program definitions from the ones used for reporting that are based on equipment type. The different program definitions created some confusion early in PY3 as to which program a project belonged. In PY3Q3, Met-Ed began mapping each completed project to the reporting category in its quarterly data request response to the SWE. The SWE recommends Met-Ed use the tracking data format that was used in PY3Q3 and PY3Q4 when submitting quarterly tracking data to the SWE in PY4.

Over 90% of the energy savings in PY3 in Met-Ed's non-residential portfolio came from lighting measures. Figure 7-1 shows the distribution of non-residential energy savings by equipment. Non-standard lighting rebates were the leading contributor of reported savings. Additional detail on the SWE review of Met-Ed non-residential tracking data can be found in Appendix G.4.

Figure 7-1: Met-Ed PY3 Non-Residential Energy Savings by Equipment Type



58 It is noted that Met-Ed stated that its Act 129 proportion of measures target is 8.8%, which is incorrect. The target it set at 7.84% for Phase I of Act 129.

The SWE also conducted a project file review on a sample on non-residential energy efficiency projects in PY3. The purpose of the project file reviews is to verify that the reported savings estimates stored in the program tracking data are accurate and calculated in accordance with the TRM. Project files are requested in Section 3b of the SWE Quarterly Data Request. Typical supporting documents include:

- Application forms, approval forms, installation confirmation;
- Equipment specifications, invoices for the purchase and installation of efficient equipment; and
- Savings calculation worksheets.

Of the 56 project files uploaded by Met-Ed to the SWE SharePoint in PY3 for desk reviews, 27 were drawn from the impact evaluation sample. In PY4, the SWE plans to, in coordination with the FirstEnergy Program Evaluator, review project files for projects that are not part of the evaluation sample so that a greater number of projects are reviewed and to avoid redundancy between the SWE and the FirstEnergy Program Evaluator.

While verified savings are well supported, the SWE project file review noted opportunity for improved consistency between the savings values called out in project files and the savings values that were ultimately recorded in the program tracking database. In many cases, the scope of the projects appeared to change after the initial application was completed but the supporting documents did not always make clear what the changes were. Some projects were also lacking invoices for the efficient equipment. Invoices are a critical component of the project files because they support the installed quantity of a measure used in the savings calculation. It should be noted that most projects included invoices and detailed TRM-based (e.g. Appendix C style) calculations.

Most projects within the sub 50kW range correctly specified the appropriate hours of operation from the 2011 TRM. The on-site inspections conducted by SWE and by Met-Ed's Program Evaluator found general consistency between the claimed and installed measures and quantities. The SWE noted a small number of projects using savings calculations worksheets that were not based on the deemed values in the 2011 TRM. It appears that the TRM values were ultimately used in the calculation of the reported savings values stored in the program tracking data. However, multiple intermediary or seemingly final versions of project savings calculators had discrepancies with the tracking data. The SWE recommends that Met-Ed incorporate TRM assumptions and algorithms earlier in the implementation process by requiring use of the TRM Appendix C (Lighting Inventory Tool) and Appendix D (Motor and Variable Frequency Drive Inventory Tool) during the rebate application process. Including fewer intermediary savings calculation worksheets, or clearly labeling the final calculation worksheet used to calculate *ex ante* impacts, would make the FirstEnergy project files more transparent and auditable. Appendix G.4 contains additional detail about the SWE's project file review for the FirstEnergy companies.

Lastly, the SWE performed eight ride-along inspections and one independent site inspection of the FirstEnergy companies' PY3 non-residential projects. The programs and evaluator are the same for all FirstEnergy companies. Therefore, since the primary goal of the inspection process is to ensure that the impacts reported by the EDC evaluator are in compliance with statewide standards, the SWE treats the FirstEnergy companies as a single entity for site inspection purposes. An overview of the site inspection process and common findings is provided in Section 3.1.3.1 and FirstEnergy-specific project findings and resolutions are provided in Appendix G.4.

7.4.4 Demand Response Audit Summary

There was no audit work completed on Demand Response programs as these programs had not yet been implemented in PY3.

7.4.5 Net-to-Gross and Process Evaluation Audit Summary

The SWE's review of the net-to-gross (NTG) analyses and process evaluations for Met-Ed's energy efficiency programs in general focused on the level of rigor employed for programs evaluation, the level of transparency provided regarding the evaluation methodology and the level of consistency in methodology, and reporting practices for each evaluated program. Findings and recommendations from this review are presented in this section.

7.4.5.1 Net-to-Gross

The SWE team requested and the FirstEnergy Program Evaluator provide memoranda detailing net-to-gross (NTG) methodologies because no or insufficient information was included in the Met-Ed PY3 Annual Report.

As described in Section 3.8, the SWE defined three levels of rigor for the NTG analysis – Basic, Standard, and Enhanced. The SWE recommended a Basic rigor be used for the analysis of each of the FirstEnergy companies' programs, with the exception of two programs – the Energy Efficiency (EE) Products Program, for which a Standard level of rigor was recommended, and the low-income program (WARM Program), for which no study was recommended.

The FirstEnergy Program Evaluator conducted NTG analyses for eight of the 11 programs (or sub-programs) recommended for analysis by the SWE. The FirstEnergy Program Evaluator did not conduct a NTG analysis for the Residential Behavioral Modification and Education Program or the Residential Multiple Family Program because no participation was recorded in PY3. No NTG research was conducted for the Governmental/Non-Profit Street Lighting Program, likely because participation was very low in PY3. The FirstEnergy Program Evaluator conducted a Basic level of rigor (self-reporting surveys) for the Energy Efficiency (EE) Products Program instead of a Standard level of rigor. There is no indication of plans to perform billing analysis, or market analysis, or market-based studies given work performed in the Potential Studies.

Although the NTG methodology and program design were the same across the FirstEnergy companies, the NTG ratio for the Small and Large C&I Equipment Programs, the Non-Profit Program, and the Remaining Government/Non-Profit Program for Met-Ed was 65.5%, compared to 84.2% and 87.9% for Penelec and Penn Power, respectively. The SWE recommends further research to determine if there is a significant difference between these EDCs that could account for this variance or if the difference is due to project-related sample characteristics specific to PY3. The FirstEnergy Program Evaluator conducted 70 interviews for Met-Ed, fewer than other EDCs due to a smaller population which could cause the results (particularly at the equipment level) to be heavily influenced by a single respondent. For program planning, the SWE recommends that FirstEnergy companies' average NTG ratio of 80% be used unless it is determined that there are inherent differences between service territories.

Finally, the NTG surveys with Met-Ed customers installing motors and drives found a 100% free ridership rate. The population and sample size was small (3) and NTG ratio for Motors and Drives was higher for Penelec. Due to the small population and sample for motors and drives, the SWE recommends Met-Ed combine results with other FirstEnergy EDCs that offer the same program to assess NTG in the future. Combining results across EDCs is not typically encouraged, but the SWE feels in this case the additional sample size would provide FirstEnergy with a more statistically valid assessment of the Motors and Drives program across its operating companies.

The NTG summaries for each program for which NTG research was performed were straightforward and easy to understand. For the Residential New Construction Program, FirstEnergy reported, "Per the 2012 TRC Order, EDCs are required to use NTG for program planning purposes. NTG ratios are not applied to gross savings for compliance purposes. The FirstEnergy Program Evaluator completed NTG program research which was used to inform program design for Phase II of Act 129." There is no explanation for what the "NTG program research" consisted of or what is planned. In addition, there is no clear explanation for why Basic level of rigor was applied to the EE Products Program instead of the recommended Standard level of rigor.

The spillover methodologies in the supplemental NTG memos were found to be straightforward and general descriptions for how spillover was calculated was described, but there were no examples of survey instruments or excerpts from the sources used for some programs to quantify spillover savings. While all requested information was provided in PY3 in the form of supplemental memos, the SWE recommends that more specific information relative to treatment of NTG methodology and results be included in future annual reports.

7.4.5.2 Process Evaluation

The process evaluation conducted by the FirstEnergy Program Evaluator for Met-Ed's programs was reviewed in the same manner as the NTG analysis. Findings and recommendations from the SWE's review are presented below.

No pre-determined level of rigor was described nor recommended by the SWE for process evaluations as was the case for the NTG analysis. Process evaluation findings were available for three programs – the Residential Home Energy Audits, Energy Efficiency HVAC Program and the Small and Large C&I Equipment Programs. Findings encompassed multiple areas but, at a minimum, included customer satisfaction and market actor feedback. Process evaluation activities were well documented, even in the cases for which there are no results to report.

The FirstEnergy Program Evaluator reported the process evaluation activities in a transparent way. The processes and methodology were explained well. A few programs, including the HVAC Program, did not give specific numbers for how many people were surveyed across all process evaluation data-gathering processes. In the future, it is recommended that these numbers are reported for all programs for which surveys were administered.

The approaches taken across the FirstEnergy programs were fairly consistent. The purpose of the surveys and interviews were similar throughout, though the types of interviewees varied. Some programs included interviews with program participants and program nonparticipants, while others included program staff, trade allies and other market actors.

7.5 Statewide Evaluator Final Recommendations

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

1. Engage in discussions with the FirstEnergy Program Evaluator and Met-Ed's New Construction Program CSP to (a) explore process improvements for reporting appliance and lighting savings for homes in the Program, and (b) explore the feasibility of reporting *ex ante* savings in line with TRM requirements instead of as direct outputs of REM/Rate™. Review the demand savings algorithms in the TRM for the New Construction Program.
2. Update the WARM Plus *ex ante* savings assumptions with the most recent billing analysis results by job type to mitigate disparities between reported and verified savings.
3. Met-Ed updated its low-income Act 129 proportion of measures target based on the most recent low-income sector and EDC consumption data. The target it set at 7.84% for Phase I of Act 129 and should not be updated annually using consumption data.
4. A number of findings and recommendations were presented by the FirstEnergy Program Evaluator based on the PY3 process evaluation. The SWE recommends that Met-Ed consider incorporating the recommended actions in PY4 and in Phase II of Act 129.
5. Work to eliminate waiting lists for non-residential programs. A waiting list hurts program satisfaction and discourages customers from implementing energy efficient measures. The SWE understands that this recommendation may be difficult to implement given the sector-level budget constraints of Act 129.
6. The SWE recommends that Met-Ed explore the feasibility of performing avoided cost calculations at the measure level so that measure-specific load shapes, effective useful life and participant cost values can be applied.
7. The SWE recommends Met-Ed review the assumptions used to generate reported savings estimates for commercial HVAC projects in PY4 to stabilize the relationship between the reported and verified savings estimates.
8. The PY3 evaluation found that the *ex ante* savings assumptions for CFL kits in the non-residential sectors were overly optimistic leading to low realization rates. The *ex ante* savings assumptions such as installation rate and hours-of-use (HOU) should be lowered in PY4 to reflect the results of the PY3 evaluation.
9. The SWE recommends Met-Ed follow the format used in PY3Q3 and PY3Q4 when submitting tracking data from non-residential programs to the SWE.
10. The SWE requests that Met-Ed supply project files for projects that are not part of the evaluation sample in PY4 so that a greater number of projects are reviewed, and to avoid redundancy between the SWE and the FirstEnergy Program Evaluator.
11. The SWE recommends that Met-Ed incorporate TRM assumptions and algorithms earlier in the implementation process by requiring use of the TRM Appendix C (Lighting Inventory Tool) and Appendix D (Motor and Variable Frequency Drive Inventory Tool) during the rebate application

process. The SWE confirmed that TRM values are ultimately used to calculate *ex ante* impacts so this recommendation is designed simply to make project documentation more transparent and auditable. Special attention should also be paid to lighting projects with a connected load greater than 50 kW and for the "Other" building type where applicants are allowed to specify their own HOU.

12. The PY3 net impact evaluation found that the NTG ratio for non-residential programs was significantly lower in Met-Ed service territory than in Penelec or Penn Power service territories. Additional research is needed to determine if a significant difference between these service territories exists that should be addressed in future program designs. The SWE recommends that Met-Ed include NTG methodology and findings in future annual reports.
13. Met-Ed's non-residential savings come primarily from lighting projects. The SWE recommends Met-Ed pursue cost-effective savings from other C&I equipment types in PY4.

7.6 Statewide Evaluator Best Practice Analysis

In PY3, the FirstEnergy Program Evaluator completed a thorough and rigorous evaluation of the lighting kits distributed to commercial customers. The survey sent to these customers identified that some bulbs distributed for C&I use ended up in residential homes. This was an important finding as the HOU for residential bulbs are less than the HOU of bulbs installed in a commercial building. Therefore the gross verified savings for the program were affected. Additionally, the FirstEnergy Program Evaluator used light loggers to verify the HOU of the CFL bulbs from the kits installed in the commercial buildings. Performing rigorous evaluation work in order to determine accurate savings is a best practice cited in Appendix D.

8 Pennsylvania Electric Company

This section summarizes Pennsylvania Electric Company (Penelec) performance in PY3, as well as the cumulative energy savings and demand reductions achieved by Penelec's Act 129 EE&C programs through the end of PY3. This section presents the evaluation activity completed by both ADM (the current FirstEnergy Program Evaluator) and the SWE in the calculation of the cost-effectiveness, and the measurement and verification (M&V), of Penelec's EE&C programs. This section also provides the SWE's recommendations for Penelec's programs going forward.

8.1 Summary of Energy and Demand Reductions

Table 8-1 highlights Penelec's cumulative reported gross impact and verified gross impact since the EE&C programs' inception through the end of PY3.

Table 8-1: Summary of Penelec CPITD Impacts

	CPITD Reported Gross Impact[f]	CPITD Verified Gross Impact[h]	Savings Achieved as % of 2013 Targets[i]
Total Energy Savings (MWh/yr)	334,582	309,977	71.8%
Total Demand Reduction (MW)	49	38	35.2%
TRC Benefits ($1,000) [a]	Not Applicable[g]	$94,931	Not Applicable
TRC Costs ($1,000) [b]	Not Applicable[g]	$39,257	Not Applicable
TRC Benefit-Cost Ratio[c]	Not Applicable[g]	2.42	Not Applicable
CO_2 Emissions Reduction (Tons) [d][e]	271,0111	251,081	Not Applicable

NOTES:
[a] 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. 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 TRC Order.
[d] 8.1x10-4 metric tons of CO_2 per kWh (EPC's eGRID2007 Version 1.1, RFCE Region annual non-baseload CO_2 output emissions rate, year 2005 data). This is included in this report per the approved SWE work plan.
[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] Defined as the gross energy savings that were reported during the period since date of program implementation through the current reporting period (i.e., reporting period of this report). CPITD = Cumulative Program Inception To-Date.
[g] TRC Benefits and Costs are calculated only for verified savings, which reflect actual program results.
[h] Defined as the energy savings that have been verified by the FirstEnergy Program Evaluator and audited by the SWE, and since the date of program implementation through the end of PY3.
[i] Savings achieved based on CPITD Verified Gross Impact.

As shown, Penelec has achieved 71.8 % of its Act 129 2013 energy savings target and 35.2% of its Act 129 demand savings at the end of PY3. The TRC Benefit-Cost Ratio (or TRC Ratio) of 2.42 indicates Penelec's EE&C programs are cost-effective on an aggregate (portfolio) basis.

Table 8-2 contains a listing of Penelec's EE&C programs that reported participation and had energy and/or demand savings that were evaluated in PY3, and programs that are yet to be implemented or had no reported savings in PY3.

Table 8-2: Penelec EE&C Programs[59]

Programs Reporting PY3 Gross Savings:
4. Home Energy Audits and Outreach
5. Appliance Turn-In
6. EE HVAC
7. EE Products
8. New Construction
9. WARM Programs
10. Small C&I Equipment
11. Large C&I Equipment
12. Street Lighting
13. Non-Profit
14. Remaining Government/Non-Profit
Programs to be Implemented or with No Reported PY3 Savings:
15. Behavioral Modification and Education
16. PJM Demand Response
17. Multiple Family
18. Direct Load Control
19. Commercial Industrial Demand Response

Penelec has reported PY3 gross energy and/or demand savings for 12 programs. Table 8.3 below provides a breakdown of the contribution of each program's verified gross energy savings and verified gross demand savings towards the CPITD portfolio savings. As shown, the Energy Efficient (EE) Products Program accounts for 26% of the total CPITD verified gross energy savings for Penelec's portfolio. This Program also represents approximately 52% of the savings from Penelec's residential energy efficiency programs. The EE Products Program includes a residential lighting component buy-down component and rebates for appliances. The Small C&I Equipment and Large C&I Equipment Programs also account for a large percentage (together 36%) of Penelec's portfolio verified gross energy savings.

[59] Program names are as presented in EDC annual report, Figure 1-5.

Table 8-3: Summary of Penelec EE&C Program Impacts on Gross Reported Portfolio Savings – Through PY3

Program	CPITD Verified Gross MWh/yr Savings	Percent of Portfolio CPITD Verified Gross MWh/yr Savings	CPITD Verified Gross MW Reductions	Percent of Portfolio CPITD Verified Gross MW Reductions
EE Products	80,411	26%	4.4	12%
Home Energy Audits and Outreach	38,714	12%	1.9	5%
Appliance Turn-In	25,955	8%	4.3	11%
Multiple Family	5,142	2%	0.2	1%
EE HVAC	3,074	1%	1.3	3%
New Construction	866	0%	0.3	1%
WARM Programs	6,051	2%	0.8	2%
Small C&I Equipment	59,509	19%	10.7	28%
Large C&I Equipment	54,047	17%	7.4	19%
Remaining Government/Non-Profit	33,685	11%	6.6	17%
Street Lighting	1,354	0%	0.0	0%
Non-Profit	1,201	0%	0.2	1%
TOTAL PORTFOLIO	**309,977**	**100%**	**38.2**	**100%**

Programs to be implemented or with no reported PY3 savings are not shown. See Table 8-2.

8.2 Total Resource Cost Test

Table 8-4 provides a breakdown of the contribution of each EE&C program's Program Year-to-Date (PYTD) verified gross energy savings and demand reductions as well as the TRC Ratios.

Table 8-4: Summary of Penelec EE&C Program Impacts on TRC Ratios

Program	PY3 Verified MWh/yr Savings	PY3 Verified MW Reductions	TRC Ratio
EE Products	40,920	2.11	4.49
Home Energy Audits and Outreach	12,875	0.63	3.12
Appliance Turn-In	10,575	1.66	5.31
EE HVAC	1,912	0.75	1.12
New Construction	709	0.26	1.52
WARM Programs	1,357	0.32	0.95
Small C&I Equipment	23,410	4.03	3.73
Large C&I Equipment	16,486	2.38	3.66
Remaining Government/Non-Profit	16,195	3.79	1.91
Non-Profit	867	0.18	3.49
Street Lighting	410	0.00	1.65
TOTAL PORTFOLIO	**125,716**	**16.11**	**2.42**

Programs to be implemented or with no reported PY3 savings are not shown. See Table 8-2.

Ten of the 11 programs are found to be cost-effective by the TRC Ratio. (i.e., the Ratio exceeds 1). The only programs that generated savings in PY3 but that are not found to be cost-effective are the WARM Programs (Penelec's Low-Income Program.)

An important finding is that the programs with the largest amount of savings in the residential and C&I sectors generally have high TRC Ratios. This means that not only are they performing well in terms of generating savings, they are also cost-effective programs.

8.2.1 Assumption and Inputs

TRC Model calculations are handled independently for Met-Ed, Penelec and Penn Power, but each EDC uses the same FirstEnergy TRC model. FirstEnergy uses a TRC Model discount rate of 7.92% to discount program benefits and costs. This rate is used to compare the Net Present Value (NPV) of program benefits that will occur later in a measure's lifetime to the upfront costs of installation and implementation. A line loss factor of 11% is used for all programs.

In the residential sector, measure lifetime was reported on a measure-by-measure basis and is consistent with the 2011 TRM. In the non-residential sector, effective measure life was applied to the FirstEnergy TRC model calculations at the program level rather than at the measure level. In order to determine the measure life for a program, a weighted average of the effective lives of the program measures was calculated and rounded to the nearest year, and this integer value was used in the avoided supply and avoided capacity benefits calculations. The measures rebated for non-residential programs include lighting, motors and variable frequency drives (VFDs). In addition to these measures, CFL lighting was installed as part of the Small C&I Equipment and Remaining Government/Non-Profit Programs. Non-residential CFLs were assigned an effective measure life of 3.7 years (compared to 6.4 years for residential CFLs) in FirstEnergy's TRC model because bulbs in these sectors will see more annual hours of use than in the residential sector, which will shorten their effective measure life. The sources used for measure lives mainly include 2011 TRM and DSMore Michigan database.

Incremental costs were also assigned at the measure level in the residential sector and program level in the non-residential sectors in the FirstEnergy TRC model. Penelec's EE&C Plan and the DEER were the sources of incremental costs for individual measures. These incremental measure costs were multiplied by the weight of that measure in the program. Measure weighting within a program was a function of the quantity and savings from that measure within a given rebate type.

The energy and demand impacts used in the FirstEnergy TRC model analysis were drawn 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.

8.2.2 Avoided Cost of Energy

The FirstEnergy TRC model assigns a value ($/kWh) to the avoided cost of energy for each year from 2012 through 2026 for each sector – residential, small commercial and large commercial – as well as for each sector in specific seasons. The unit impacts are multiplied 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 FirstEnergy model assigns a flat annual figure ($/kW) to the cost of adding generation capacity. A single value is used for the avoided cost of capacity for all programs and sectors. The forecasted avoided cost of capacity figures are the same for Met-Ed and Penelec. The figures used for Penn Power are slightly higher than those used for Met-Ed and Penelec. This value is multiplied by the *ex post* demand savings for each combination of program and sector to determine the benefits incurred by the applicable FirstEnergy company from not having to expand capacity.

8.2.4 Conclusions and Recommendations

The SWE recommends that FirstEnergy explore the feasibility of performing avoided cost calculations in the non-residential sectors at the measure level so a measure-specific effective life can be imposed. The SWE also recommends that FirstEnergy more clearly show how the measure life at the program level was determined and specify the measures lives used for all measures in the TRC model. This would also allow the measure-specific incremental costs in the non-residential sectors to be used and would provide insight into the relative performance of measures within a program. FirstEnergy should also explore the benefits, costs and ability to more effectively incorporate load shapes into the TRC model, and address the fact that some measures save energy during periods when it is more valuable than others. It should be noted that the time-dependent value of avoided electric service is reflected in FirstEnergy's current TRC calculator. This is achieved through usage of four different avoided cost structures for each rate class, corresponding to measures that provide year-round savings (e.g., lighting), primarily winter savings (e.g., LED holiday lights), primarily summer savings (e.g., AC), or peak summer savings (e.g., demand response).

8.3 Status of Evaluation Activities

8.3.1 Status of EM&V Plans

Per the guidelines outlined in the Audit Plan,[60] the SWE has reviewed EM&V plans submitted by the EDCs to verify that the plans comply with the TRM and TRC Orders and meet the minimum evaluation requirements set forth in the Audit Plan. The Audit Plan provides an outline for the evaluation framework expectations and guidelines necessary to address the following research objectives:

- determine realization rates for gross savings;
- determine net to gross (NTG) ratios;
- determine method for calculating savings; and
- Set acceptable levels of rigor, precision and bias for measurement and verification (M&V) activities.

No changes were made to the EM&V plans for Penelec's energy efficiency programs in PY3. In March, 2012, the Company submitted EM&V plans for two Demand Response programs that would be active during the summer of 2012. The Direct Load Control and Commercial and Industrial (C&I) Demand Response Programs were designed to produce temporary demand reductions during the top 100 hours of the summer.

Evaluation of the Direct Load Control Program uses hourly metered data from a sample of 300 homes (150 from Penelec service territory and 150 from Penn Power service territory). The FirstEnergy Program Evaluator opted to oversample to ensure that precision requirements are met even if the observed variation is greater than expected. The EM&V plan also called for switch operability to be assessed using a separate sample of customers, which the SWE feels is the most appropriate methodology. Once hourly load data are collected, the FirstEnergy Program Evaluator will use regression analysis to estimate the average load reductions during the summer 2012 events. The SWE believes that regression analysis produces the most accurate estimates of load reduction for a Direct Load Control program and approved the plan on May 17, 2012.

The EM&V plan for Penelec's C&I Demand Response Program calls for verified savings estimates to be developed for a census of program participants. Depending on the load profile of the participant's site,

[60] See Statewide Evaluator Team, *Audit Plan and Evaluation Framework for Pennsylvania Energy Efficiency and Conservation Programs,* November 4, 2011.

one of three potential models will be selected to estimate the baseline consumption, or how much energy the site would have consumed if it had not participated in the curtailment event:

1. Weather Sensitive Adjustment Model;
2. Customer Baseline Load; or
3. Symmetric Additive Adjustment (SAA).

The SWE agrees with FirstEnergy's approach of choosing from several possible baseline calculation methodologies because of the variation in customer load profiles in the C&I sector. However, the SWE feels it is important for the baseline methodology be chosen which provides the most accurate results, not necessarily the largest load reduction.

8.3.2 M&V Activities and Findings

The following section provides a summary of the Measurement and Verification (M&V) activities conducted by the FirstEnergy Program Evaluator based on details provided in Penelec's PY3 Annual Report as well as information gathered from SWE data requests and audits.

8.3.2.1 Gross Impact Evaluation

Table 8-5 provides a summary of M&V based on activities conducted by the FirstEnergy Program Evaluator based on details provided in Penelec's PY3 Annual Report, and on information obtained from SWE data requests and audits.

Table 8-5: Penelec Energy Efficiency Programs – Realization Rates for Energy and Demand

Program	Realization Rate-Energy Savings	Realization Rate-Demand Savings
EE Products	99%	90%
Home Energy Audits and Outreach	90%	55%
Appliance Turn-In	73%	71%
EE HVAC	87%	79%
New Construction	71%	143%
WARM Programs	69%	81%
Small C&I Equipment	83%	76%
Large C&I Equipment	90%	63%
Remaining Government/Non-Profit	90%	51%
Non-Profit	135%	162%
Street Lighting	97%	NA[1]
TOTAL PORTFOLIO	**89%**	**67%**

1 Street lighting occurs at night and thus no peak demand reduction will be realized.
2 Programs to be implemented or with no reported PY3 savings are not shown. See Table 8-2.

The realization rate is a factor that compares the gross savings reported by the EDC to the verified savings determined by the EM&V contractor through M&V activities. The calculation for a realization rate is as follows.

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

Depending on the program, realization rates are calculated either based on a sample of program participants and then applied to all participants or the realization rate is calculated on a census of all program participants and then applied to all participants. A realization rate of 100% indicates that the FirstEnergy Program Evaluator was able to verify all reported savings (this is the case with the energy savings of Met-Ed's EE Products Program and Street Lighting Program). A realization rate of less than 100% indicates that the gross savings were overestimated and a realization rate of over 100% indicates that gross savings were underestimated.

Realization rates for energy savings from Penelec's programs range from 69% (WARM Program) to 135% (Non-Profit Program). Penelec's realization rates for program demand reductions range from 51% (Remaining Government/Non-Profit Program) to 162% (Non-Profit).

8.3.2.1.1 Appliance Turn-In Program

The low realization rate for the Appliance Turn-In Program is a reflection of a TRM update that took place in PY3 and reduced the per-unit savings for this Program. Because Penelec estimated savings for this Program using PY2 TRM protocols, the gross savings had to be adjusted to reflect this update.

8.3.2.1.2 Residential New Construction

The energy savings realization rate of 71% for Penelec's Residential New Construction Program resulted from a combination of two factors. The first factor is that an overstatement of energy savings from ground-source heat pumps (GSHPs) frequently occurred in REM/Rate™ due to an over-estimated baseline usage.

The second factor is that an adjustment was needed to make the reported *ex ante* savings consistent with TRM protocols. Per the 2011 TRM, energy savings from lighting and appliances in the residential new construction program are a function of the TRM algorithms. The *ex ante* savings reported by Penelec were based on the direct output from REM/Rate™ rather than calculated from the TRM algorithms, and thus were adjusted. The adjustment is specific to each home audited and can be either an increase or a decrease in the energy savings compared to the output from REM/Rate™. Factors affecting the magnitude and direction of the adjustment include the level of efficiency of the appliances installed, the percentage of efficient lighting installed, and home size.

The demand savings realization rate of 143% for the Residential New Construction Program resulted from an adjustment to the *ex ante* demand savings reported by Penelec to achieve consistency with the requirements of the 2011 TRM. Per the TRM, demand savings should be calculated using the algorithms contained in the TRM and should not be direct outputs of REM/Rate™. The *ex ante* savings reported by Penelec were based on the direct output from REM/Rate™, and thus were adjusted. In all homes audited by the SWE, the TRM algorithms produced greater demand savings estimates than REM/Rate™, which resulted in a realization rate significantly greater than 100%.

8.3.2.1.3 Home Energy Audits and Outreach Program

Overall realization rates were generally over 90% for energy savings. The low realization rate for demand savings for the Home Energy Audits and Outreach Program was primarily the result of the EDCs factoring in the effect of furnace whistles in their demand reduction calculations even though the 2011 TRM does not recognize demand reductions attributed to furnace whistles. A secondary source of variance is due to the findings of a participant web-survey conducted by the FirstEnergy Program Evaluator. The survey found a wide variance in savings due to the corresponding variance in installation rates. The survey indicated that customers did not install the same proportion of measures included in the energy conservation kit that were assumed by Penelec and therefore the savings generated by each measure varied from tracking estimates.

8.3.2.1.4 WARM Programs

The reported savings for the WARM Program were based on 2008 LIURP data by job type. The reason LIURP data was used is because the Program is evaluated using a billing analysis, which requires at least 12 months of pre- and post-installation billing data. The WARM program, which has been offered for over 20 years through LIURP, is essentially identical to the WARM Program offered through Act 129 and is also evaluated using statistical billing analysis. Therefore, in September 2010 the SWE approved a custom measure protocol to use recent LIURP billing analysis results to report the energy savings until WARM Program results were available. At the conclusion of PY3, the FirstEnergy Program Evaluator conducted an independent billing analysis of 2010 Program participants to calculate verified energy savings for PY3. The results of the analysis were smaller baseline energy usage and per-job savings as compared to the 2008 LIURP data that was used for the report savings, which led to the low realization rate. The SWE recommends that Met-Ed update the participant tracking database with the most recent billing analysis results to mitigate realization rate anomalies.

8.3.2.1.5 Non-Residential Programs

Penelec defines and reports impacts from non-residential programs by sectors. In PY3, energy and demand savings were reported for the Small C&I Equipment, Large C&I Equipment, Street Lighting, Non-Profit and Remaining Government/Non-Profit Programs. Completed projects within each program were further segmented by equipment type to create homogenous groups for evaluation. These equipment types, or measure categories, were the basis of the sample design. M&V approach, sampling assumptions and level of rigor of the evaluation were a function of the savings contribution and relative uncertainty associated with the measure category.

The sample design assumptions were based on the results of the PY2 evaluation. The required sample sizes for prescriptive measure categories, which tend to have homogenous realization rates among sampled projects, were calculated using a coefficient of variation (Cv) of 0.5. Sample sizes for custom measure categories were calculated using a coefficient of variation of 1.0 because verified savings estimates for these measures were found to show high variance in PY2. The SWE commends Penelec for using a high Cv assumption for these measure categories because the larger required sample size ensures that the confidence and precision levels established in the Audit Plan will be met.

Each program in the Penelec non-residential portfolio was evaluated using stratified ratio estimation. This means a separate realization rate was calculated for each measure category within a program based on the observed ratio of the evaluators verified savings estimates to the reported savings estimates. The realization rate for the measure category was applied to all projects in that measure category for the year to calculate the gross verified savings estimate for the measure category.

Table 8-6 shows the energy and demand savings realization rates for each of the non-residential programs in Penelec's portfolio for PY3.

Table 8-6: Penelec Realization Rates and Relative Precision Values – Non-Residential Programs

Program	Energy Savings Realization Rate	Relative Precision (Energy)	Demand Savings Realization Rate	Relative Precision (Demand)
Small C&I Equipment	83%	12%	76%	15%
Large C&I Equipment	90%	12%	63%	16%
Street Lighting	97%	14%	NA[1]	NA
Non-Profit	135%	8%	162%	12%
Remaining Government/Non-Profit	90%	8%	51%	12%

1 Street lighting occurs at night and thus no peak demand reduction will be realized.

The relative precision values in Table 8-6 are presented at the 85% confidence level and can be used to assess uncertainty associated with the realization rate due to sampling error. For example, the gross verified energy savings estimate for the Large C&I Equipment program in PY3 was 16,486 MWh/yr after applying the realization rate of 90%. The relative precision value of 12% means one can be 85% confident that the true PY3 energy savings of the Large C&I Equipment program was between 14,508 MWh/yr and 18,464 MWh/yr. Each of the Penelec non-residential programs exceeded the requirement of 15% precision at the 85% confidence level for energy set forth in the Audit Plan.

The relative precision of the peak demand reduction estimate for the Large C&I Equipment program was 16%. The SWE recommends Penelec investigate sources of variance in the reported and verified savings estimates for demand in the custom and prescriptive measure categories in PY4 to ensure that the 15% precision requirement will be met for both energy and demand.

The high energy and demand realization rates shown in 8-6 for the Non-Profit program was due in large part to the verified savings estimates for the Standard Lighting for Business (SLB) measure category. Five of the 11 total projects in the measure category were evaluated in PY3; one of the largest evaluated projects had a verified energy savings estimate almost four times the reported savings estimate. As a result, the ratio of verified savings to reported savings for the entire program was significantly greater than 1.0. This shows the effect a single project with unexpected results can have on program savings for programs which have small populations and evaluation sample sizes. The SLB measure category showed variable results for other programs in the Penelec non-residential portfolio, but was responsible for a much smaller share of the program savings. The SWE recommends Penelec continue to assume a coefficient of variation (Cv) of 1.0 for SLB projects in PY4.

A total of 80 site inspections were conducted by the FirstEnergy Program Evaluator as part of the PY3 evaluation of Met-Ed's non-residential programs. Prior to the site inspection, each project received a desk review to gather key equipment parameters. For custom measures, a site-specific M&V plan was developed for each sampled site. Metering equipment was deployed at 19 of the 80 sites. A variety of M&V approaches were used to develop verified savings estimates including simple verification and TRM calculations, IPMVP Option A (Partially Measured Retrofit Isolation) and IPMVP Option C (Whole Facility Billing Analysis). The SWE reviewed the approaches used for each measure category and found them to be reasonable given the type of equipment installed.

The FirstEnergy Program Evaluator submitted spreadsheets to the SWE, which documented the calculation of the realization and error ratios for each measure category. The error ratio is the key variance metric for programs that use stratified ratio estimation, and is used to satisfy the Cv assumption for future sample designs. The SWE reviewed each calculation worksheet and confirmed that the verified savings estimates and associated precision levels were calculated correctly. Lighting projects were the least variable measure category in PY3 because reported savings values are calculated using a version of protocols in the 2011 TRM Appendix C (Lighting Inventory Tool), and are consequently very accurate. The highest variability was observed in the prescriptive measure category which included mostly HVAC projects. The SWE recommends that Met-Ed review the assumptions used to generate reported savings estimates for these projects in PY4 to stabilize the relationship between the reported and verified savings estimates.

8.3.2.2 Net Impact Evaluation

Net-to-Gross (NTG) analyses are conducted as part of an impact evaluation to determine what proportion of evaluated savings is attributable to the program. That is, a NTG ratio (NTGR) represents the percentage of savings that would not have occurred in the absence of the program. To calculate a NTGR for a given program, evaluators will typically assess the level of free ridership (FR) and spillover (SO) among program participants. Free ridership is an assessment of how likely a program participant would have implemented a program measure regardless of the program incentive or existence of the program. Spillover is an assessment of additional energy saving actions taken by a participant or non-participant that were a result of the program. The NTGR is calculated using the following formula:

$$NTGR = 1 - FR + SO$$

The NTG approach taken by the FirstEnergy Program Evaluator followed an industry-standard approach. Both residential and non-residential programs were evaluated through customer self-reports and structured interviews with key decision-makers.

Results from the NTG evaluation are presented in Table 8-7. Additional information on Penelec's NTG methodology is provided in B.4. The SWE's evaluation of the NTG methodology for the FirstEnergy legacy companies (Met-Ed, Penelec and Penn Power) is provided in Section 7.4.5.1.

Table 8-7: Penelec NTG Results

Program	Total Surveys	Free Ridership	Spillover	NTG Ratio
Residential Home Energy Audits and Outreach Program	106	39.6%	23.2%	83.6%
Residential Appliance Turn-In Program	204	35.6%	NA[1]	64.4%
Residential Energy Efficiency HVAC Program	106	41.0%	0.4%	59.4%
Residential Energy Efficient Products Program	140	55.6%	8.4%	52.8%
Residential New Construction Program	N/A	N/A	N/A	N/A
Commercial/Industrial Equipment Program	217	31.2%	15.4%	84.2%

1 NA indicates that program not structured to induce spillover, and any anticipated spillover would be minimal.

8.4 Statewide Evaluator Audit Activities and Findings

8.4.1 Residential Program Audit Summary

8.4.1.1 Residential Lighting

Residential lighting is included in Penelec's Residential Energy Efficient Products Program. The SWE reviewed the data tracked in the FirstEnergy's database and tracking system to verify that FirstEnergy was using the appropriate savings values and algorithms from the 2011 TRM. The SWE also selected a sample of 10 bulbs for the review of baseline assumptions to ensure the CFL wattages fell within the ranges specified in the TRM. Lastly, the SWE team selected five retail invoices per quarter from Penelec's buy-down program to review and verify that the bulb counts were accurately tracked in the Penelec database and tracking system. The SWE found that Penelec used the correct values and algorithms, and the correct baseline assumptions, from the 2011 TRM. Additionally, no issues were identified in the review of invoices from PY3.

8.4.1.2 Appliance Turn-In Program

The SWE requested samples of Penelec's JACO[61] work orders and corresponding database entries for each quarter. The SWE then checked the database entries for these participants and verified them against the individual database entries from JACO for each customer. For each participant, the SWE

61 JACO is the vendor for all EDCs' appliance recycling programs.

verified that number and type of appliances removed was consistent across both databases. The SWE also verified that the savings value used for each sampled participant reflected the characteristics of the recycled appliance. The SWE observed that all participant data was consistent in both Penelec and JACO's databases. Penelec used the updated values for energy savings of replaced and retired refrigerators from the 2011 TRM in the calculation of net savings.

8.4.1.3 Energy Efficient Products Program

In order to audit Penelec's Energy Efficient Products Program for PY3, the SWE requested samples of Penelec's customer rebate applications and corresponding database entries for each quarter. The SWE then checked these participants' rebate applications (including copies of receipts for purchased equipment) against the Penelec database. The SWE found that all participants sampled had active Penelec accounts and all measures that were rebated were on the approved list. Additionally, Penelec is using the correct deemed savings from the 2011 TRM. In the samples from PY3 the SWE found no quality control errors. Starting in the later part of PY2 the SWE informed Penelec that the SWE would be choosing the sample from Penelec's residential database. This gave the SWE a higher level of confidence in the random sample audited in PY3.

8.4.1.4 New Construction Program

The SWE finds from its desktop audit that no adjustments to *ex post* savings reported in Penelec's PY3 Annual Report for its (residential) New Construction Program are required. However, the SWE has some general observations and recommendations for future program years based on the PY3 audit.

The FirstEnergy Program Evaluator has found that the TRM algorithms for calculating energy savings from lighting and appliances are difficult to use because not all of the information required to use the algorithms is readily available. The FirstEnergy Program Evaluator's home inspections are typically performed during the late construction phase when key components such as insulation, window make and model, and whole-house air infiltration properties are easy to identify and verify but lamps and appliances may not be fully installed.[62] The FirstEnergy Program Evaluator also has found that the REM/Rate™ files do not include enough information that could be extracted for use in the TRM algorithms for lighting and appliances. For example, the files do not include a home's exact lighting fixture count, but rather an overall percentage of fixtures that are CFLs. Because the TRM algorithm for lighting is on a per-bulb basis, the lighting savings cannot be estimated using only the data available in REM/Rate™. For appliances, the FirstEnergy Program Evaluator used homeowner and builder surveys to collect information on the appliances installed required for the TRM algorithms, and for lighting, the Evaluator estimated energy savings based on assumptions used in the SWE Residential Baseline Study.

The SWE recommends discussions with the FirstEnergy Program Evaluator and new construction program CSP to explore improving process and accuracy for estimating and reporting energy and demand savings from lighting and appliances using the TRM algorithms instead of output from REM/Rate™. One improvement, for example, could be to have the certified Home Energy Rating System

[62] Penelec PY3 Annual Report, p. 59.

(HERS) rater record information required as inputs to the TRM algorithms for lighting and appliances (e.g. fixture counts, refrigerator configuration). Participant and builder surveys could then be used to supplement and check the recorded HERS rater information, rather than the surveys being the main source of information for the input to the TRM's algorithms for calculating energy and demand savings from lighting and appliances installations.

The SWE also recommends discussion with the FirstEnergy Program Evaluator and Program CSP to explore the feasibility of the CSP reporting the *ex ante* demand savings for each home calculated using the TRM algorithms rather than based on output from REM/Rate™. This would improve on the current process, which requires a significant adjustment to the sampled homes' demand impacts and extrapolating that adjustment to the entire Program.

The SWE further recommends a review of the TRM's demand savings algorithms for residential new construction, in light of the high demand realization rate for the New Construction Program. The algorithms appear to take a non-conservative approach in the application of the over-sizing factor for the baseline home, which results in an over-estimated baseline demand and thus over-estimated demand savings. The review should include consideration of the demand savings calculations used by REM/Rate™ and should result in a reduction of the over-estimated demand savings produced by the TRM.

8.4.2 Low-Income Program Audit Summary

Penelec's Act 129 WARM Program is an extension of LIURP and supports an increase in the number of income-eligible homes receiving comprehensive measures such as appliances, high efficiency lighting and weatherization. The evaluation approach for this program is a statistical billing analysis based on job type.[63]

Penelec's WARM Extra Measures program had active participation in PY3. This program provides to WARM Program participants additional electricity-saving measures, including CFLs, LED night lights, furnace whistles and smart power strips. The PY3 energy savings for the WARM Extra Measures program were calculated based on 2011 TRM algorithms.

Previously, the SWE conducted site inspections of Penelec WARM Program (including WARM Extra Measures) installations. During PY3, Penelec deployed a third party contractor to perform the site inspections. The SWE worked with Penelec to develop a site inspections checklist to ensure that the site

[63] The three job types used by Penelec are as follows: electric heat jobs involve weatherization and provide measures with a value of at least $250 to reduce space heating energy usage for electrically heated homes; electric water heat jobs that provide measures with a value of at least $25 to reduce water heating energy usage for homes that have electric water heaters, and electric base load jobs, which may include refrigerator/freezer replacement and lighting retrofits.

inspectors were adequately assessing all measure installations and to provide confidence in the results.[64]

The SWE reviewed 40 site inspection reports from Act 129 WARM Program installations in PY3. Audit forms, inspection reports, and invoices were reviewed to confirm that job types were assigned correctly in the Penelec database extracts. All job types were assigned correctly. In addition, the SWE reviewed the site inspector notes to determine whether all measures were being installed and if there was follow-up if work was found to be incomplete. The SWE commends Penelec's follow-up on incomplete measure installations. There were several instances where jobs were not "passed" until contractors returned to complete all work, customer complaints were addressed, and other issues resolved. Penelec's site inspection process appears to be working effectively to promote quality installations. For WARM Extra Measures inspection reports reviewed, the SWE determined if measures were installed and that invoiced measures were properly reported in the database extracts. The SWE found isolated instances of measures not installed, which generally confirmed the in-service rates used by Penelec's program evaluator through surveys.[65] The SWE found an inconsistency between Penelec's energy savings analysis and the Penelec's PY3 annual report. The report states that in-service rates from the 2011 TRM were used to calculate savings for WARM Extra Measures CFLs and furnace whistles. The SWE confirmed with Penelec that the measure savings were calculated using in-service rates determined through primary data gathering (e.g., surveys) and that the verified savings listed in Penelec's annual report were correct.

The SWE reviewed the program evaluator's WARM Programs billing analysis results for any inconsistencies, improper assumptions, and statistical accuracy and precision. No issues were found. It should be noted that, while three job types are defined for the WARM Plus program, results were presented in the Penelec's annual report for space heat and base load jobs. The number of water heat jobs was insufficient to provide statistically viable results, and therefore the water heat and base load jobs were combined for the billing analysis.

In addition to site inspection reports, the SWE reviewed quarterly data extracts to verify participant data, measure calculations, and reported program data. Any inconsistencies were reviewed with Penelec. Most inconsistencies were the result of adjustments to TRM in-service rates based on evaluation findings. Annual verified energy and demand impacts were confirmed to be consistent with the participant counts and verified per-job and per-measure savings.

Finally, the SWE verified that Penelec was in compliance with the requirement that the number of energy conservation measures offered to low-income households is proportionate to those households' share of the total energy usage in Penelec's service territory. Penelec offered seven types of measures to the low-income sector in PY3, which is 17.1% of the total number of measures offered across all

[64] The checklist subsequently supported development of the SWE's guidance memorandum for performing site inspections for the EDCs' low-income programs.

[65] In the case of LED night lights, the SWE found a 100% in-service rate, compared to the 81% in-service rate used by the FirstEnergy Program Evaluator. However, the SWE's sample was not statistically significant and therefore the SWE defers to the FirstEnergy Program Evaluator's in-service rate.

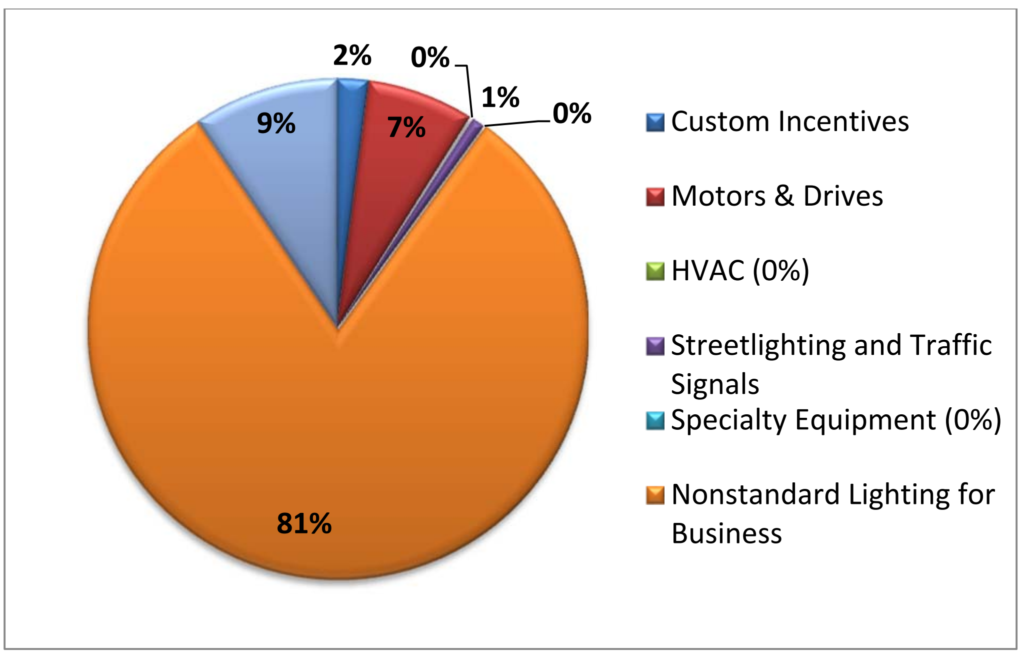
sectors. The SWE reviewed Penelec's measures list to confirm that the company is in compliance with its Act 129 requirement for proportion of measures offered, which is 9.51%.[66]

8.4.3 Non-Residential Program Audit Summary

The SWE reviewed evaluator verification work, and conducted a quarterly audit of the program tracking data for Penelec's non-residential programs and found no major issues. Based on this review, the SWE supports the verified results presented in Penelec's PY3 Annual Report. The Penelec programs are generally based on sectors, with each distinct customer segment in the non-residential customer base being assigned to a program. The FirstEnergy Program Evaluator uses a different set of program definitions from the ones used for reporting that are based on equipment type. The different program definitions created some confusion early in PY3 as to which program a project belonged. In PY3Q3, Penelec began mapping each completed project to the reporting category in its quarterly data request response to the SWE. The SWE recommends Penelec use the tracking data format that was used in PY3Q3 and PY3Q4 when submitting quarterly tracking data to the SWE in PY4.

Approximately 90% of the energy savings in PY3 in Penelec's non-residential portfolio came from lighting measures. Figure 8-1 shows the distribution of non-residential energy savings by equipment. Non-standard lighting rebates were the leading contributor of reported savings. Additional detail on the SWE review of Penelec non-residential tracking data can be found in Appendix G.5.

Figure 8-1: Penelec PY3 Non-Residential Energy Savings by Equipment Type



[66] It is noted that Penelec stated that its Act 129 proportion of measures target is 10.2 percent, which is incorrect. The target it set at 9.51% for Phase I of Act 129.

The SWE also conducted a project file review on a sample on non-residential energy efficiency projects in PY3. The purpose of the project file reviews is to verify that the reported savings estimates stored in the program tracking data are accurate and calculated in accordance with the TRM. Project files are requested in Section 3b of the SWE Quarterly Data Request. Typical supporting documents include:

- Application forms, approval forms, installation confirmation;
- Equipment specifications, invoices for the purchase and installation of efficient equipment; and
- Savings calculation worksheets.

Twenty-eight of the 73 project files uploaded by Penelec to the SWE SharePoint in PY3 for desk reviews were drawn from the impact evaluation sample. The SWE proposes in PY4, in coordination with the FirstEnergy Program Evaluator, to review project files for projects that are not part of the evaluation sample so that a greater number of projects are reviewed and to avoid redundancy between the SWE and the FirstEnergy Program Evaluator.

While verified savings are well supported, the SWE project file review noted opportunity for improved consistency between the savings values called out in project files and the savings values that were ultimately recorded in the program tracking database. In many cases, the scope of the projects appeared to change after the initial application was completed but the supporting documents did not always make clear what the changes were. Some projects were also lacking invoices for the efficient equipment. Invoices are a critical component of the project files because they support the installed quantity of a measure used in the savings calculation. It should be noted that most projects included invoices and detailed TRM-based (e.g., Appendix C-style) calculations.

Most projects within the sub 50kW range correctly specified the appropriate hours of operation from the 2011 TRM. The on-site inspections conducted by SWE and by Penelec's evaluator found general consistency between the claimed and installed measures and quantities. The SWE noted a small number of projects using savings calculations worksheets that were not based on the deemed values in the 2011 TRM. It appears that the TRM values were ultimately used in the calculation of the reported savings values stored in the program tracking data. However, multiple intermediary or seemingly final versions of project savings calculators had discrepancies with the tracking data. The SWE recommends that Penelec incorporate TRM assumptions and algorithms earlier in the implementation process by requiring use of the TRM Appendix C (Lighting Inventory Tool) and Appendix D (Motor and Variable Frequency Drive Inventory Tool) during the rebate application process. Including fewer intermediary savings calculation worksheets, or clearly labeling the final calculation worksheet used to calculate *ex ante* impacts, would make the FirstEnergy project files more transparent and auditable. Appendix G.4 contains additional detail about the SWE's project file review for the FirstEnergy companies.

Lastly, the SWE performed eight ride-along inspections and one independent site inspection of the FirstEnergy companies' PY3 non-residential projects. The programs and evaluator are the same for all FirstEnergy companies. Therefore, since the primary goal of the inspection process is to ensure that the impacts reported by the EDC evaluator are in compliance with statewide standards, the SWE treats the FirstEnergy companies as a single entity for site inspection purposes. An overview of the site inspection process and common findings is provided in Section 3.1.3.1 and FirstEnergy-specific project findings and resolutions are provided in Appendix G.4.

8.4.4 Demand Response Audit Summary

There was no audit work completed on Demand Response programs as these programs had not yet been implemented in PY3.

8.4.5 Net-to-Gross and Process Evaluation Audit Summary

The SWE audit of FirstEnergy's net-to-gross and process evaluations is presented in Section 7.4.5.

8.5 Statewide Evaluator Final Recommendations

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

1. Engage in discussions with the FirstEnergy Program Evaluator and Penelec's New Construction Program CSP to (a) explore process improvements for reporting appliance and lighting savings for homes in the Program, and (b) explore the feasibility of reporting *ex ante* savings in line with TRM requirements instead of as direct outputs of REM/Rate.™ Review the demand savings algorithms in the TRM for the Program.
2. Update the WARM Plus *ex ante* savings assumptions with the most recent billing analysis results by job type to mitigate disparities between reported and verified savings.
3. Penelec updated its low-income Act 129 proportion of measures target based on the most recent low-income sector and EDC consumption data. The target it set at 9.51% for Phase I of Act 129 and should not be updated annually using consumption data.
4. A number of findings and recommendations were presented by the FirstEnergy Program Evaluator based on the PY3 process evaluation. The SWE recommends that Penelec consider incorporating the recommended actions in PY4 and in Phase II of Act 129.
5. Work to eliminate waiting lists for non-residential programs. A waiting list hurts program satisfaction and discourages customers from implementing energy efficient measures. The SWE understands that this recommendation may be difficult to implement given the sector-level budget constraints of Act 129.
6. The SWE recommends that Penelec explore the feasibility of performing avoided cost calculations at the measure level so that measure-specific load shapes, effective useful life and participant cost values can be applied.
7. The SWE recommends Penelec review the assumptions used to generate reported savings estimates for commercial HVAC projects in PY4 to stabilize the relationship between the reported and verified savings estimates.
8. The SWE recommends Penelec continue to use a coefficient of variation assumption of 1.0 for Standard Lighting for Business rebates. The PY3 evaluation found high variability in savings values for these projects so continuing a conservative sampling approach is warranted.
9. The PY3 evaluation found that the *ex ante* savings assumptions for CFL kits in the non-residential sectors were overly optimistic leading to low realization rates. The *ex ante* savings assumptions such as installation rate and hours-of-use (HOU) should be lowered in PY4 to reflect the results of the PY3 evaluation.

10. The SWE recommends Penelec follow the format used in PY3Q3 and PY3Q4 when submitting tracking data from non-residential programs to the SWE.
11. The SWE proposes in PY4, in coordination with the FirstEnergy Program Evaluator, to review project files for projects that are not part of the evaluation sample so that a greater number of projects are reviewed, and to avoid redundancy between the SWE and the FirstEnergy Program Evaluator.
12. The SWE recommends that Penelec incorporate TRM assumptions and algorithms earlier in the implementation process by requiring use of the TRM Appendix C (Lighting Inventory Tool) and Appendix D (Motor and Variable Frequency Drive Inventory Tool) during the rebate application process. The SWE confirmed that TRM values are ultimately used to calculate *ex ante* impacts so this recommendation is designed simply to make project documentation more transparent and auditable. Special attention should also be paid to lighting projects with a connected load greater than 50kW and for the "Other" building type where applicants are allowed to specify their own hours of use.
13. The PY3 net impact evaluation found that the NTG ratio for non-residential programs was significantly lower in Met-Ed service territory than in Penelec or Penn Power service territories. Additional research is needed to determine if a significant difference between these service territories exists that should be addressed in future program designs. The SWE recommends that Penelec include NTG methodology and findings in future annual reports.
14. Penelec's non-residential savings come primarily from lighting projects. The SWE recommends Penelec pursue cost effective savings from other C&I equipment types in PY4.

8.6 Statewide Evaluator Best Practice Analysis

In PY3, the FirstEnergy Program Evaluator completed a thorough and rigorous evaluation of the lighting kits distributed to commercial customers. The survey sent to these customers identified that some bulbs distributed for C&I use ended up in residential homes. This was an important finding as the Hours of Use (HOU) for residential bulbs are less than the HOU of bulbs installed in a commercial building. Therefore the gross verified savings for the program were affected. Additionally, the FirstEnergy Program Evaluator used light loggers to verify the HOU of the CFL bulbs from the kits installed in the commercial buildings. Performing rigorous evaluation work in order to determine accurate savings is a best practice cited in Appendix D.

9 Pennsylvania Power Company

This section summarizes Pennsylvania Power Company's (Penn Power) performance in PY3, as well as the cumulative energy savings and demand reductions achieved by Penn Power's Act 129 EE&C programs through the end of PY3. This section presents the evaluation activity completed by both ADM (the current FirstEnergy Program Evaluator) and the SWE in the calculation of the cost-effectiveness, and the measurement and verification (M&V), of Penn Power's EE&C programs. This section also provides the SWE's recommendations for Penn Power's programs going forward.

9.1 Summary of Energy and Demand Reductions

Table 9-1 highlights Penn Power's cumulative reported gross impact and verified gross impact since the EE&C programs' inception through the end of PY3.

Table 9-1: Summary of Penn Power CPITD Impacts

	CPITD Reported Gross Impact[f]	CPITD Verified Gross Impact[h]	Savings Achieved as % of 2013 Targets[i]
Total Energy Savings (MWh/yr)	115,559	107,812	75.3%
Total Demand Reduction (MW)	15	13	29.5%
TRC Benefits ($1,000) [a]	Not Applicable[g]	$26,199	Not Applicable
TRC Costs ($1,000) [b]	Not Applicable[g]	$8,319	Not Applicable
TRC Benefit-Cost Ratio[c]	Not Applicable[g]	3.15	Not Applicable
CO_2 Emissions Reduction (Tons) [d][e]	93,603	87,238	Not Applicable

NOTES:

[a] 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. 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 TRC Order.
[d] 8.1x10-4 metric tons of CO_2 per kWh (EPC's eGRID2007 Version 1.1, RFCE Region annual non-baseload CO_2 output emissions rate, year 2005 data). This is included in this report per the approved SWE work plan.
[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] Defined as the gross energy savings that were reported during the period since date of program implementation through the current reporting period (i.e., reporting period of this report). CPITD = Cumulative Program Inception To-Date.
[g] TRC Benefits and Costs are calculated only for verified savings, which reflect actual program results.
[h] Defined as the energy savings that have been verified by the FirstEnergy Program Evaluator and audited by the SWE, and since the date of program implementation through the end of PY3.
[i] Savings achieved based on CPITD Verified Gross Impact.

As shown, Penn Power has achieved 75.3% of its Act 129 2013 energy savings target and 29.5% of its Act 129 demand savings at the end of PY3. The TRC Benefit-Cost Ratio (or TRC Ratio) of 3.15 indicates Penn Power's EE&C programs are cost-effective on an aggregate (portfolio) basis.

Table 9-2 contains a listing of Penn Power's EE&C programs that reported participation and had energy and/or demand savings that were evaluated in PY3, and programs that are yet to be implemented or had no reported savings in PY3.

Table 9-2: Penn Power EE&C Programs[67]

Programs Reporting PY3 Gross Savings:
4. Home Energy Audits and Outreach
5. Appliance Turn-In
6. EE HVAC
7. EE Products
8. New Construction
9. WARM Programs
10. Small C&I Equipment
11. Large C&I Equipment
12. Remaining Government/Non-Profit
Programs to be Implemented or with No Reported PY3 Savings:
13. Demand Reduction
14. Behavioral Modification and Education
15. PJM Demand Response
16. Multiple Family
17. Street Lighting
18. Non-Profit
19. Direct Load Control
20. Commercial and Industrial (C&I) Demand Response Programs

Penn Power has reported PY3 gross energy and/or demand savings for 12 programs. Table 9-3 below provides a breakdown of the contribution of each program's verified gross energy savings and verified gross demand savings towards the CPITD portfolio savings. As shown, the Energy Efficient (EE) Products Program accounts for 33% of the total CPITD verified gross energy savings for Penn Power's portfolio. This Program also represents approximately 62% of the savings from Penn Power's residential energy efficiency programs. The EE Products Program includes a residential lighting component buy-down component and rebates for appliances. The Small C&I Equipment and Large C&I Equipment Programs also account for a large percentage (together 35%) of Penn Power's portfolio verified gross energy savings.

[67] Program names are as presented in EDC annual report, Figure 1-5.

Table 9-3: Summary of Penn Power EE&C Program Impacts on Gross Reported Portfolio Savings – Through PY3

Program	CPITD Verified Gross MWh/yr Savings	Percent of Portfolio CPITD Verified Gross MWh/yr Savings	CPITD Verified Gross MW Reductions	Percent of Portfolio CPITD Verified Gross MW Reductions
EE Products	35,876	33%	1.9	15%
Small C&I Equipment	22,897	21%	3.8	29%
Large C&I Equipment	14,578	14%	1.8	14%
Remaining Government/Non-Profit	10,510	10%	2.3	18%
Home Energy Audits and Outreach	10,270	10%	0.5	4%
Appliance Turn-In	7,115	7%	1.1	9%
WARM Programs	2,271	2%	0.2	2%
EE HVAC	1,864	2%	0.7	5%
New Construction	1,127	1%	0.5	4%
Multiple Family	1,021	1%	0.0	0%
Street Lighting	246	0%	NA[1]	NA
Non-Profit	37	0%	0.0	0%
TOTAL PORTFOLIO	**107,812**	**100%**	**12.9**	**100%**

1 Streetlighting occurs at night and thus no peak demand reduction will be realized.

2 Programs to be implemented or with no reported PY3 savings are not shown. See Table 9-2.

9.2 Total Resource Cost Test

Table 9-4 provides a breakdown of the contribution of each EE&C program's Program Year-to-Date (PYTD) verified gross energy savings and demand reductions as well as the TRC Ratios.

Table 9-4: Summary of Penn Power EE&C Program Impacts on TRC Ratios

Program:	PY3 Verified MWh/yr Savings	PY3 Verified MW Reductions	TRC Ratio
EE Products	16,649	0.84	5.02
Small C&I Equipment	12,035	2.09	4.62
Home Energy Audits and Outreach	3,513	0.18	3.16
Remaining Government/Non-Profit	3,062	1.10	3.79
Appliance Turn-In	2,995	0.44	5.42
EE HVAC	973	0.44	1.18
New Construction	908	0.38	3.99
Large C&I Equipment	883	0.11	2.25
WARM Programs	163	0.08	0.73
TOTAL PORTFOLIO	41,182	5.66	3.15

1 Programs to be implemented or with no reported PY3 savings are not shown. See Table 9-2.

Eight of the nine programs are found to be cost-effective by the TRC Ratio. (i.e., the Ratio exceeds 1). The only program that generated savings in PY3 but that is not found to be cost-effective is the WARM Program (Penn Power's Low-Income Program.)

An important finding is that the programs with the largest amount of savings in the residential and C&I sectors generally have high TRC Ratios. This means that not only are they performing well in terms of generating savings, they are also cost-effective programs.

9.2.1 Assumption and Inputs

The FirstEnergy TRC model is discussed in Section 7.2.

9.2.2 Avoided Cost of Energy

The FirstEnergy TRC model assigns a value ($/kWh) to the avoided cost of energy for each year from 2012 through 2026 for each sector – residential, small commercial and large commercial – as well as for each sector in specific seasons. The unit impacts are multiplied by the most appropriate avoided cost stream to determine the per-unit avoided energy costs for that program.

9.2.3 Avoided Cost of Capacity

The FirstEnergy model assigns a flat annual figure ($/kW) to the cost of adding generation capacity. A single value is used for the avoided cost of capacity for all programs and sectors. The forecasted avoided cost of capacity figures are the same for Met-Ed and Penelec. The figures used for Penn Power are slightly higher than those used for Met-Ed and Penelec. This value is multiplied by the *ex post* demand savings for each combination of program and sector to determine the benefits incurred by the applicable FirstEnergy company from not having to expand capacity.

9.2.4 Conclusions and Recommendations

The SWE recommends that FirstEnergy explore the feasibility of performing avoided cost calculations in the non-residential sectors at the measure level so a measure-specific effective life can be imposed. The SWE also recommends that FirstEnergy more clearly show how the measure life at the program level was determined and specify the measures lives used for all measures in the TRC model. This would also allow the measure-specific incremental costs in the non-residential sectors to be used and would provide insight into the relative performance of measures within a program. FirstEnergy should also explore the benefits, costs and ability to more effectively incorporate load shapes into the TRC model, and address the fact that some measures save energy during periods when it is more valuable than others. It should be noted that the time-dependent value of avoided electric service is reflected in FirstEnergy's current TRC calculator. This is achieved through usage of four different avoided cost structures for each rate class, corresponding to measures that provide year-round savings (e.g., lighting), primarily winter savings (e.g., LED holiday lights), primarily summer savings (e.g., AC), or peak summer savings (e.g., demand response).

The SWE would additionally like to point out that the Penn Power Residential New Construction program TRC[68] is significantly higher than the TRCs for Met-Ed's[69] and Penelec's[70] identical Residential New Construction Programs due to a negative PY3 "Administration" cost and a CPITD Administration cost of $19,000, compared to $466,000 for Penelec and $1,111,000 for Met-Ed. FirstEnergy described this negative cost as an adjustment to the fixed management cost allocation between the three legacy PA operating companies.

9.3 Status of Evaluation Activities

9.3.1 Status of EM&V Plans

Per the guidelines outlined in the Audit Plan,[71] the SWE has reviewed EM&V plans submitted by the EDCs to verify that the plans comply with the TRM and TRC Orders and meet the minimum evaluation requirements set forth in the Audit Plan. The Audit Plan provides an outline for the evaluation framework expectations and guidelines necessary to address the following research objectives:

68 3.99 Annual PY3 TRC, 2.33 CPITD TRC.
69 1.33 Annual PY3 TRC, 1.03 CPITD TRC.
70 1.52 Annual PY3 TRC, 1.03 CPITD TRC.
71 See Statewide Evaluator Team, *Audit Plan and Evaluation Framework for Pennsylvania Energy Efficiency and Conservation Programs,* November 4, 2011.

- determine realization rates for gross savings;
- determine net to gross (NTG) ratios;
- determine method for calculating savings; and,
- set acceptable levels of rigor, precision and bias for measurement and verification (M&V) activities.

No changes were made to the EM&V plans for Penn Power's energy efficiency programs in PY3. In March, 2012, the Company submitted EM&V plans for two Demand Response programs that would be active during the summer of 2012. The Direct Load Control and C&I Demand Response Programs were designed to produce temporary demand reductions during the top 100 hours of the summer.

Evaluation of the Direct Load Control Program uses hourly metered data from a sample of 300 homes (150 from Penelec service territory and 150 from Penn Power service territory). The FirstEnergy Program Evaluator opted to oversample to ensure that precision requirements are met even if the observed variation is greater than expected. The EM&V plan also called for switch operability to be assessed using a separate sample of customers, which the SWE feels is the most appropriate methodology. Once hourly load data are collected, the FirstEnergy Program Evaluator will use regression analysis to estimate the average load reductions during the summer 2012 events. The SWE believes that regression analysis produces the most accurate estimates of load reduction for a Direct Load Control program and approved the plan on May 17, 2012.

The EM&V plan for Penn Power's C&I Demand Response Program calls for verified savings estimates to be developed for a census of program participants. Depending on the load profile of the participant's site, one of three potential models will be selected to estimate the baseline consumption, or how much energy the site would have consumed if it had not participated in the curtailment event:

1. Weather Sensitive Adjustment Model;
2. Customer Baseline Load; or
3. Symmetric Additive Adjustment (SAA).

The SWE agrees with FirstEnergy's approach of choosing from several possible baseline calculation methodologies because of the variation in customer load profiles in the C&I sector. However, the SWE feels it is important for the baseline methodology be chosen which provides the most accurate results, not necessarily the largest load reduction.

9.3.2 M&V Activities and Findings

The following section provides a summary of the Measurement and Verification (M&V) activities conducted by the FirstEnergy Program Evaluator based on details provided in Penn Power's PY3 Annual Report as well as information gathered from SWE data requests and audits.

9.3.2.1 Gross Impact Evaluation

Table 9-5 provides a summary of M&V based on activities conducted by the FirstEnergy Program Evaluator based on details provided in Penn Power's PY3 Annual Report, and on information obtained from SWE data requests and audits.

Table 9-5: Penn Power Energy Efficiency Programs – Realization Rates for Energy and Demand

Program:	Realization Rate-Energy Savings	Realization Rate-Demand Savings
EE Products	100%	93%
Home Energy Audits and Outreach	95%	60%
Appliance Turn-In	79%	76%
EE HVAC	88%	77%
New Construction	101%	181%
WARM Programs	45%	131%
Small C&I Equipment	76%	59%
Large C&I Equipment	139%	110%
Remaining Government/Non-Profit	88%	71%
TOTAL PORTFOLIO	**88%**	**73%**

1 **Programs to be implemented or with no reported PY3 savings are not shown. See Table 9-2.**

The realization rate is a factor that compares the gross savings reported by the EDC to the verified savings determined by the EM&V contractor through M&V activities. The calculation for a realization rate is as follows.

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

Depending on the program, realization rates are calculated either based on a sample of program participants and then applied to all participants or the realization rate is calculated on a census of all program participants and then applied to all participants. A realization rate of 100% indicates that the FirstEnergy Program Evaluator was able to verify all reported savings (this is the case with the energy savings of Penn Power's EE Products Program and Street Lighting Program). A realization rate of less than 100% indicates that the gross savings were an over-estimate and a realization rate of over 100% indicates that gross savings were an under-estimate.

Realization rates for energy savings from Penn Power's programs range from 45% (WARM Program) to 139% (Large C&I Equipment Program). Penn Power's realization rates for program demand reductions range from 59% (Small C&I Equipment Program) to 181% (New Construction Program.)

9.3.2.1.1 Appliance Turn-In Program

The low realization rate for the Appliance Turn-In Program is a reflection of a TRM update that took place in PY3 and reduced the per-unit savings for this Program. Because Penn Power estimated savings for this Program using PY2 TRM protocols, the gross savings had to be adjusted to reflect this update.

9.3.2.1.2 Residential New Construction Program

The energy realization rate for Penn Power's residential New Construction Program resulted from an adjustment that was needed to make the reported *ex ante* savings consistent with TRM protocols. Per the TRM, energy savings from lighting and appliances in the residential new construction program are a function of TRM algorithms. The *ex ante* savings reported by Penn Power were based on the direct output from REM/Rate™ rather than calculated from the TRM algorithms and thus were adjusted. The adjustment is specific to each home audited and can be either an increase or a decrease in the energy savings compared to the output from REM/Rate™. Factors affecting the magnitude and direction of the adjustment included the level of efficiency of the appliances installed, the percentage of efficient lighting installed, and home size.

The demand realization rate of 181% for Penn Power's residential new construction program results from an adjustment to the *ex ante* demand savings reported by Penn Power to achieve consistency with the requirements of the TRM. Per the TRM, demand savings should be calculated using the algorithms contained in the TRM and should not be direct outputs of REM/Rate™. The *ex ante* savings reported by Penn Power were based on the direct output from REM/Rate™ and thus were adjusted. In all homes audited by the SWE, the TRM algorithms produced greater demand savings estimates than REM/Rate™, which resulted in a realization rate significantly greater than 100%.

9.3.2.1.3 Home Energy Audits and Outreach Program

Overall realization rates were generally over 90% for energy savings. The low realization rate for demand savings for the Home Energy Audits and Outreach Program was primarily the result of the EDCs factoring in the effect of furnace whistles in their demand reduction calculations even though the 2011 TRM does not recognize demand reductions attributed to furnace whistles. A secondary source of variance is due to the findings of a participant web-survey conducted by the FirstEnergy Program Evaluator. The survey found a wide variance in savings due to the corresponding variance in installation rates. The survey indicated that customers did not install the same proportion of measures included in the energy conservation kit that were assumed by Penn Power and therefore the savings generated by each measure varied from tracking estimates.

9.3.2.1.4 WARM Program

The reported savings for the WARM Program were based on 2008 LIURP data by job type. The reason LIURP data was used is because the Program is evaluated using a billing analysis, which requires at least 12 months of pre- and post-installation billing data. The WARM program, which has been offered for over 20 years through LIURP, is essentially identical to the WARM Program offered through Act 129 and is also evaluated using statistical billing analysis. Therefore, in September 2010 the SWE approved a custom measure protocol to use recent LIURP billing analysis results to report the energy savings until WARM Program results were available. At the conclusion of PY3, the FirstEnergy Program Evaluator conducted an independent billing analysis of 2010 Program participants to calculate verified energy savings for PY3. The results of the analysis were smaller baseline energy usage and per-job savings as compared to the 2008 LIURP data that was used for the report savings, which led to the low realization rate. The SWE recommends that Penn Power update the participant tracking database with the most recent billing analysis results to mitigate realization rate anomalies.

The WARM Program's demand impact realization rate was high due to a change in the evaluation approach. Because LIURP billing analysis results do not provide enough information to develop coincident peak demand savings, the reported demand impact was based on a conservative kWh to kW conversion factor. The verified demand impact was based on modeling results using program inputs and average historical dry bulb temperature for the 100 hours of highest peak summer demand. The realization rate was thus a result of the conservative approach to calculating the reported savings.

9.3.2.1.5 Non-Residential Programs

Penn Power defines and reports impacts from non-residential programs by sectors. In PY3, energy and demand savings were reported for the Small C&I Equipment, Large C&I Equipment, Street Lighting, Non-Profit and Remaining Government/Non-Profit Programs. Completed projects within each program were further segmented by equipment type to create homogenous groups for evaluation. These equipment types, or measure categories, were the basis of the sample design. M&V approach, sampling assumptions and level of rigor of the evaluation were a function of the savings contribution and relative uncertainty associated with the measure category.

The sample design assumptions were based on the results of the PY2 evaluation. The required sample sizes for prescriptive measure categories, which tend to have homogenous realization rates among sampled projects, were calculated using a coefficient of variation (Cv) of 0.5. Sample sizes for custom measure categories were calculated using a coefficient of variation of 1.0 because verified savings estimates for these measures were found to show high variance in PY2. The SWE commends Penn Power for using a high Cv assumption for these measure categories because the larger required sample size ensures that the confidence and precision levels established in the Audit Plan will be met.

Each program in the Penn Power non-residential portfolio was evaluated using stratified ratio estimation. This means a separate realization rate was calculated for each measure category within a program based on the observed ratio of the evaluators verified savings estimates to the reported savings estimates. The realization rate for the measure category was applied to all projects in that measure category for the year to calculate the gross verified savings estimate for the measure category.

Table 9-6 shows the energy and demand savings realization rates for each of the non-residential programs in Penn Power's portfolio for PY3.

Table 9-6: Penn Power Realization Rates and Relative Precision Values

Program	Energy Savings Realization Rate	Relative Precision (Energy)	Demand Savings Realization Rate	Relative Precision (Demand)
Small C&I Equipment	76%	8%	59%	13%
Large C&I Equipment	139%	3%	110%	4%
Remaining Government/Non-Profit	88%	12%	71%	11%

The relative precision values in Table 9-6 are presented at the 85% confidence level and can be used to assess uncertainty associated with the realization rate due to sampling error. For example, the gross verified energy savings estimate for the Remaining Government/Non-Profit Program in PY3 was 3,495 MWh/yr. The relative precision value of 8% means that one can be 85% confident that the true PY3 energy savings of the Remaining Government/Non-Profit Program was between 3,215 MWh/yr and 3,775 MWh/yr. Each of the Penn Power non-residential programs exceeded the requirement of 15% precision at the 85% confidence level for energy set forth in the Audit Plan.

The low energy and demand realization rates shown in Table 9-6 for the Small C&I Equipment and Remaining Government/Non-Profit Programs were due in large part to the verified savings estimates for the CFL measure category. CFLs were responsible for over 80 percent of the gross reported energy savings in the Small C&I Equipment Program and approximately 40percent of the gross reported energy savings of the Remaining Government/Non-Profit Program, thus the CFL measure category evaluation had a large impact on the gross verified savings for these Programs.

In PY3, a large number of conservation kits that included CFL bulbs were mailed to Penn Power customers. The FirstEnergy Program Evaluator used a combination of site visits and phone interviews to determine the in-service rates of the CFLs. Lighting loggers were also deployed in building types that did not have EFLH values in the 2011 TRM. A sample size of 98 was achieved for the CFL measure category between the Small C&I Equipment Program and the Remaining Government/Non-Profit Program. The realization rate for the CFL measure category was 72 percent for energy for both programs.

The realization rate for demand was 51 percent for the Small C&I Equipment Program and 56% for the Remaining Government/Non-Profit Program. The low realization rates were due to an in-service rate much lower than expected because many bulbs were actually installed in the residential settings. Residential hours-of-use assumptions in the 2011 TRM were substantially lower than most commercial building types, which had an adverse impact on the programs' realization rates. The metered hours-of-use values were also about 15 percent lower than the assumed value used in the reported savings figures. The SWE believes that the low realization rate for the CFL measure category is an important finding that can be used to inform program design and highlights the need for a Pennsylvania lighting hours-of-use (HOU) study in Phase II of Act 129. The SWE found the M&V approach used by the FirstEnergy Program Evaluator to be thorough and rigorous. Although the findings led to a verified savings estimate lower than anticipated, the SWE believes the methodology produced an accurate estimate of the true impact of the program.

A total of 33 site inspections were conducted by the FirstEnergy Program Evaluator as part of the PY3 evaluation of Penn Power's non-residential programs. Prior to the site inspection, each project received a desk review to gather key equipment parameters. For custom measures, a site-specific M&V plan was developed for each sampled site. Metering equipment was deployed at 14 of the 33 sites. A variety of M&V approaches were used to develop verified savings estimates including simple verification and TRM calculations, IPMVP Option A (Partially Measured Retrofit Isolation) and IPMVP Option D (eQuest Whole Building Simulation). The SWE reviewed the approaches used for each measure category and found them to be reasonable given the type of equipment installed.

The FirstEnergy Program Evaluator submitted spreadsheets to the SWE which documented the calculation of the realization and error ratios for each measure category. The error ratio is the key variance metric for programs that use stratified ratio estimation, and is used to satisfy the Cv assumption for future sample designs. The SWE reviewed each calculation worksheet and confirmed that the verified savings estimates and associated precision levels were calculated correctly. Lighting projects were the least variable measure category in PY3 because reported savings values are calculated using a version of protocols in the 2011 TRM Appendix C (Lighting Inventory Tool), and are consequently very accurate. The highest variability was observed in the prescriptive measure category which included mostly HVAC projects. The SWE recommends that Penn Power review the assumptions used to generate reported savings estimates for these projects in PY4 to stabilize the relationship between the reported and verified savings estimates.

9.3.2.2 Net Impact Evaluation

Net-to-Gross (NTG) analyses are conducted as part of an impact evaluation to determine what proportion of evaluated savings is attributable to the program. That is, a NTG ratio (NTGR) represents the percentage of savings that would not have occurred in the absence of the program. To calculate a NTGR for a given program, evaluators will typically assess the level of free ridership (FR) and spillover (SO) among program participants. Free ridership is an assessment of how likely a program participant would have implemented a program measure regardless of the program incentive or existence of the program. Spillover is an assessment of additional energy saving actions taken by a participant or non-participant that were a result of the program. The NTGR is calculated using the following formula:

$$NTGR = 1 - FR + SO$$

The NTG approach taken by the FirstEnergy Program Evaluator followed an industry-standard approach. Both residential and non-residential programs were evaluated through customer self-reports and structured interviews with key decision-makers.

Results from the NTG evaluation are presented in Table 9-7. Additional information on Penn Power's NTG methodology is provided in Appendix B.4. The SWE's evaluation of the NTG methodology is provided in Section 7.4.5.1.

Table 9-7: Penn Power NTG Results

Program	Total Surveys	Free Ridership	Spillover	NTG Ratio
Residential Home Energy Audits and Outreach Program	66	22.5%	14.3%	91.9%
Residential Appliance Turn-In Program	155	38.3%	NA[1]	61.7%
Residential Energy Efficiency HVAC Program	88	35.8%	0.5	64.7%
Residential Energy Efficient Products Program	143	69.2%	11.9%	42.7%
Commercial/Industrial Equipment Program	26	12.5%	0.4%	87.9%

1 NA indicates that program not structured to induce spillover, and any anticipated spillover would be minimal.

9.4 Statewide Evaluator Audit Activities and Findings

9.4.1 Residential Program Audit Summary

9.4.1.1 Residential Lighting Program

Residential lighting is included in Penn Power's Residential Energy Efficient Products Program. The SWE reviewed the data tracked in the FirstEnergy's database and tracking system to verify that FirstEnergy was using the appropriate savings values and algorithms from the 2011 TRM. The SWE also selected a sample of 10 bulbs for the review of baseline assumptions to ensure the CFL wattages fell within the ranges specified in the TRM. Lastly, the SWE team selected five retail invoices per quarter from Penn Power's buy-down program to review and verify that the bulb counts were accurately tracked in the Penn Power database and tracking system. The SWE found that Penn Power used the correct values and algorithms, and the correct baseline assumptions, from the 2011 TRM. Additionally, no issues were identified in the review of invoices from PY3.

9.4.1.2 Appliance Turn-In Program

The SWE requested samples of Penn Power's JACO[72] work orders and corresponding database entries for each quarter. The SWE then checked the database entries for these participants and verified them against the individual database entries from JACO for each customer. For each participant, the SWE verified that number and type of appliances removed was consistent across both databases. The SWE

[72] JACO is the vendor for all EDCs' appliance recycling programs.

also verified that the savings value used for each sampled participant reflected the characteristics of the recycled appliance. The SWE observed that all participant data was consistent in both Penn Power and JACO's databases. Penn Power used the updated values for energy savings of replaced and retired refrigerators from the 2011 TRM in the calculation of net savings.

9.4.1.3 Energy Efficient (EE) Products Program

The SWE requested samples of Penn Power's customer rebate applications and corresponding database entries for each quarter. The SWE then checked these participants' rebate applications (including copies of receipts for purchased equipment) against the Penn Power database. The SWE found that all participants sampled had active Met Ed accounts and all measures that were rebated were on the approved list. Penn Power used the correct deemed savings from the 2011 TRM. The SWE found no quality control errors In the PY3 samples. In the latter part of PY2, the SWE informed Penn Power that the SWE would start choosing the sample from Penn Power's residential database. This gave the SWE a higher level of confidence in the random sample audited in PY3.

9.4.1.4 New Construction Program

The SWE finds from its desktop audit that a slight correction to the energy realization rate from Penn Power's PY3 Annual Report is required to correct a typographical error in the evaluation calculations performed by the FirstEnergy Program Evaluator. This typographical error occurred in the lighting and appliances savings adjustment performed by the Evaluator, and when corrected, changes the program realization rate from 101% to 99%, with a negligible effect on the total portfolio realization rate. Therefore, the SWE does not recommend any changes to the reported savings. Additionally, the SWE has some general observations and recommendations for future program years based on the PY3 audit.

The FirstEnergy Program Evaluator has found that the TRM algorithms for calculating energy savings from lighting and appliances are difficult to use because not all of the information required to use the algorithms is readily available. The FirstEnergy Program Evaluator's home inspections are typically performed during the late construction phase when key components such as insulation, window make and model, and whole-house air infiltration properties are easy to identify and verify but lamps and appliances may not be fully installed.[73] The FirstEnergy Program Evaluator also has found that the REM/Rate™ files do not include enough information that could be extracted for use in the TRM algorithms for lighting and appliances. For example, the files do not include a home's exact lighting fixture count, but rather an overall percentage of fixtures that are CFLs. Because the TRM algorithm for lighting is on a per-bulb basis, the lighting savings cannot be estimated using only the data available in REM/Rate™. For appliances, the FirstEnergy Program Evaluator used homeowner and builder surveys to collect information on the appliances installed required for the TRM algorithms, and for lighting, the Evaluator estimated energy savings based on assumptions used in the SWE Residential Baseline Study.

The SWE recommends discussions with the FirstEnergy Program Evaluator and new construction program CSP to explore improving process and accuracy for estimating and reporting energy and

[73] Penn Power PY3 Annual Report, p. 60.

demand savings from lighting and appliances using the TRM algorithms instead of output from REM/Rate.™ One improvement, for example, could be to have the certified Home Energy Rating System (HERS) rater record information required as inputs to the TRM algorithms for lighting and appliances (e.g. fixture counts, refrigerator configuration). Participant and builder surveys could then be used to supplement and check the recorded HERS rater information, rather than the surveys being the main source of information for the input to the TRM's algorithms for calculating energy and demand savings from lighting and appliances installations.

The SWE also recommends discussion with the FirstEnergy Program Evaluator and Program CSP to explore the feasibility of the CSP reporting the *ex ante* demand savings for each home calculated using the TRM algorithms rather than based on output from REM/Rate.™ This would improve on the current process, which requires a significant adjustment to the sampled homes' demand impacts and extrapolating that adjustment to the entire Program.

The SWE further recommends a review of the TRM's demand savings algorithms for residential new construction, in light of the high demand realization rate for the New Construction Program. The algorithms appear to take a non-conservative approach in the application of the over-sizing factor for the baseline home, which results in an over-estimated baseline demand and thus over-estimated demand savings. The review should include consideration of the demand savings calculations used by REM/Rate™ and should result in a reduction of the over-estimated demand savings produced by the TRM.

9.4.2 **Low-Income Program Audit Summary**

Penn Power's Act 129 WARM Program is an extension of LIURP and supports an increase in the number of income-eligible homes receiving comprehensive measures such as appliances, high efficiency lighting and weatherization. The evaluation approach for this program is a statistical billing analysis based on job type.[74]

Penn Power's WARM Extra Measures program had active participation in PY3. This program provides to WARM Program participants additional electricity-saving measures, including CFLs, LED night lights, furnace whistles and smart power strips. The PY3 energy savings for the WARM Extra Measures program were calculated based on 2011 TRM algorithms.

In prior program years, the SWE conducted site inspections of Penn Power WARM Program (including WARM Extra Measures) installations. During PY3, Penn Power deployed a third party contractor to perform the site inspections. The SWE worked with Penn Power to develop a site inspections checklist to

[74] The three job types used by Penn Power are as follows: electric heat jobs involve weatherization and provide measures with a value of at least $250 to reduce space heating energy usage for electrically heated homes; electric water heat jobs that provide measures with a value of at least $25 to reduce water heating energy usage for homes that have electric water heaters, and electric base load jobs, which may include refrigerator/freezer replacement and lighting retrofits.

ensure that the site inspectors were adequately assessing all measure installations and to provide confidence in the results.[75]

The SWE reviewed 34 site inspection reports from Act 129 WARM Program installations in PY3. Audit forms, inspection reports, and invoices were reviewed to confirm that job types were assigned correctly in the Penn Power database extracts. All job types were assigned correctly. In addition, the SWE reviewed the site inspector notes to determine whether all measures were being installed and if there was follow-up if work was found to be incomplete. The SWE commends Penn Power's follow-up on incomplete measure installations. There were several instances where jobs were not "passed" until contractors returned to complete all work, customer complaints were addressed, and other issues resolved. Penn Power's site inspection process appears to be working effectively to promote quality installations. For WARM Extra Measures inspection reports reviewed, the SWE determined if measures were installed and that invoiced measures were properly reported in the database extracts. The SWE found isolated instances of measures not installed, which generally confirmed the in-service rates used by Penn Power's program evaluator through surveys. The SWE found an inconsistency between Penn Power's energy savings analysis and Penn Power's PY3 annual report. The report states that in-service rates from the 2011 TRM were used to calculate savings for WARM Extra Measures CFLs and furnace whistles. The SWE confirmed with Penn Power that the measure savings were calculated using in-service rates determined through primary data gathering (e.g., surveys) and that the verified savings listed in Penn Power's annual report were correct.

The SWE reviewed the program evaluator's WARM Plus billing analysis results for any inconsistencies, improper assumptions, and statistical accuracy and precision. No issues were found. It should be noted that, while three job types are defined for the WARM Plus program, results were presented in the Penn Power's annual report for space heat and base load jobs. The number of water heat jobs was insufficient to provide statistically viable results, and therefore the water heat and base load jobs were combined for the billing analysis.

In addition to site inspection reports, the SWE reviewed quarterly data extracts to verify participant data, measure calculations, and reported program data. Any inconsistencies were reviewed with Penn Power. Most inconsistencies were the result of adjustments to TRM in-service rates based on evaluation findings. Annual verified energy and demand impacts were confirmed to be consistent with the participant counts and verified per-job and per-measure savings.

Finally, the SWE verified that Penn Power was in compliance with the requirement that the number of energy conservation measures offered to low-income households is proportionate to those households' share of the total energy usage in Penn Power's service territory. Penn Power offered seven types of measures to the low-income sector in PY3, which is 17.1% of the total number of measures offered

[75] The checklist subsequently supported development of the SWE's guidance memorandum for performing site inspections for the EDCs' low-income programs.

across all sectors. The SWE reviewed Penn Power's measures list to confirm that the company is in compliance with its Act 129 requirement for proportion of measures offered, which is 8.16%. [76]

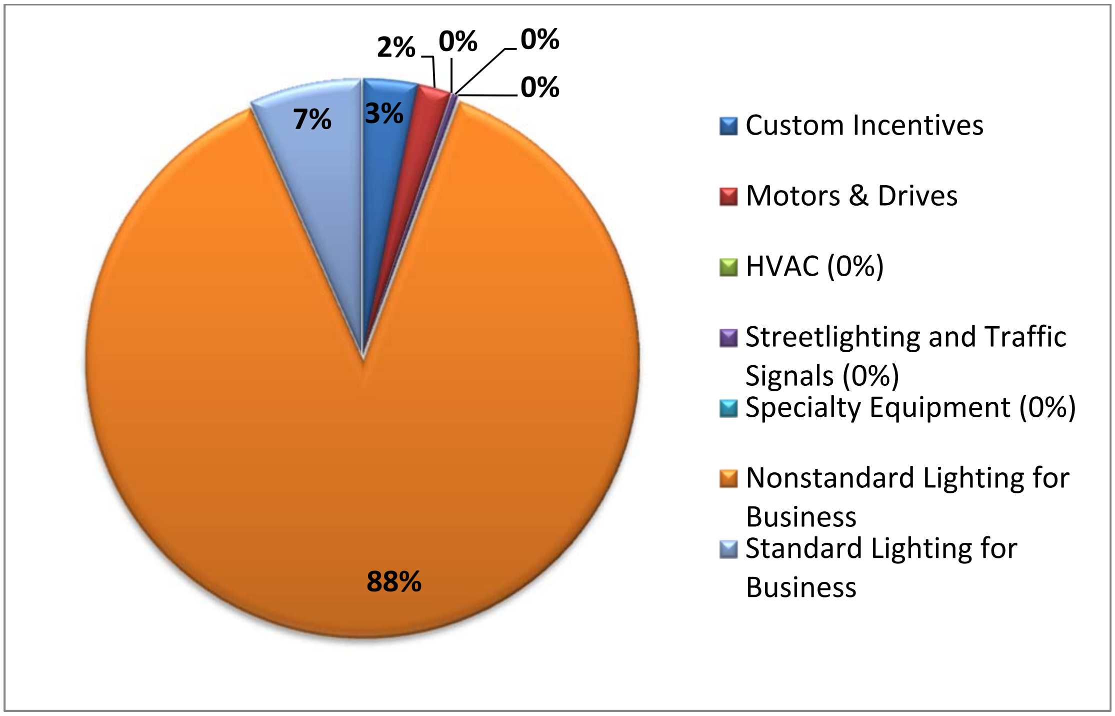
9.4.3 Non-Residential Program Audit Summary

The SWE reviewed evaluator verification work, and conducted a quarterly audit of the program tracking data for Penn Power's non-residential programs and found no major issues. Based on this review, the SWE supports the verified results presented in Penn Power's PY3 Annual Report. The Penn Power programs are generally based on sectors, with each distinct customer segment in the non-residential customer base being assigned to a program. The FirstEnergy Program Evaluator uses a different set of program definitions from the ones used for reporting that are based on equipment type. The different program definitions created some confusion early in PY3 as to which program a project belonged. In PY3Q3, Penn Power began mapping each completed project to the reporting category in its quarterly data request response to the SWE. The SWE recommends Penn Power use the tracking data format that was used in PY3Q3 and PY3Q4 when submitting quarterly tracking data to the SWE in PY4.

[76] It is noted that Penn Power stated that its Act 129 proportion of measures target is 10.6%, which is incorrect. The target it set at 8.16% for Phase I of Act 129 and should not be updated annually using consumption data.

Over 90% of the energy savings in PY3 in Penn Power's non-residential portfolio came from lighting measures. Figure 9-1 shows the distribution of non-residential energy savings by equipment. Non-standard lighting rebates were the leading contributor of reported savings. Additional detail on the SWE review of Penn Power non-residential tracking data can be found in Appendix G.6.

Figure 9-1: Penn Power PY3 Non-Residential Energy Savings by Equipment Type



The SWE also conducted a project file review on a sample on non-residential energy efficiency projects in PY3. The purpose of the project file reviews is to verify that the reported savings estimates stored in the program tracking data are accurate and calculated in accordance with the TRM. Project files are requested in Section 3b of the SWE Quarterly Data Request. Typical supporting documents include:

- Application forms, approval forms, installation confirmation;
- Equipment specifications, invoices for the purchase and installation of efficient equipment; and
- Savings calculation worksheets.

Of the 25 project files uploaded by Penn Power to the SWE SharePoint in PY3 for desk reviews, 11 were drawn from the impact evaluation sample. The SWE proposes in PY4, in coordination with the FirstEnergy Program Evaluator, to review project files for projects that are not part of the evaluation sample so that a greater number of projects are reviewed and to avoid redundancy between the SWE and the FirstEnergy Program Evaluator.

While verified savings are well supported, the SWE project file review noted opportunity for improved consistency between the savings values called out in project files and the savings values that were ultimately recorded in the program tracking database. In many cases, the scope of the projects appeared to change after the initial application was completed but the supporting documents did not always make clear what the changes were. Some projects were also lacking invoices for the efficient equipment. Invoices are a critical component of the project files because they support the installed quantity of a measure used in the savings calculation. It should be noted that most projects included invoices and detailed TRM-based (e.g., Appendix C-style) calculations.

Most projects within the sub 50kW range correctly specified the appropriate hours of operation from the 2011 TRM. The on-site inspections conducted by SWE and by Penn Power's evaluator found general consistency between the claimed and installed measures and quantities. The SWE noted a small number of projects using savings calculations worksheets that were not based on the deemed values in the 2011 TRM. It appears that the TRM values were ultimately used in the calculation of the reported savings values stored in the program tracking data. However, multiple intermediary or seemingly final versions of project savings calculators had discrepancies with the tracking data. The SWE recommends that Penn Power incorporate TRM assumptions and algorithms earlier in the implementation process by requiring use of the TRM Appendix C (Lighting Inventory Tool) and Appendix D (Motor and Variable Frequency Drive Inventory Tool) during the rebate application process. Including fewer intermediary savings calculation worksheets, or clearly labeling the final calculation worksheet used to calculate *ex ante* impacts, would make the FirstEnergy project files more transparent and auditable. Appendix G.4 contains additional detail about the SWE's project file review for the FirstEnergy companies.

Lastly, the SWE performed 8 ride-along inspections and 1 independent site inspection of the FirstEnergy companies' PY3 non-residential projects. The programs and evaluator are the same for all FirstEnergy companies. Therefore, since the primary goal of the inspection process is to ensure that the impacts reported by the EDC evaluator are in compliance with statewide standards, the SWE treats the FirstEnergy companies as a single entity for site inspection purposes. An overview of the site inspection process and common findings is provided in Section 3.1.3.1 and FirstEnergy-specific project findings and resolutions are provided in Appendix G.4.

9.4.4 Demand Response Audit Summary

There was no audit work completed on Demand Response programs as these programs had not yet been implemented in PY3.

9.4.5 Net-to-Gross and Process Evaluation Audit Summary

The SWE audit of FirstEnergy's Net-to-Gross and Process evaluations is presented in Section 7.4.5.

9.5 Statewide Evaluator Final Recommendations

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

1. Engage in discussions with the FirstEnergy Program Evaluator residential new construction program implementer to (1) explore process improvements for reporting appliance and lighting savings for homes in the residential new construction program; and (2) explore the feasibility of reporting *ex ante* savings in line with TRM requirements instead of as direct outputs of REM/Rate.™ Review of the residential new construction demand savings algorithm in the TRM.

2. The SWE recommends that Penn Power update the WARM Plus *ex ante* savings assumptions with the most recent billing analysis results by job type to mitigate disparities between reported and verified savings.
3. Penn Power updated its low-income Act 129 proportion of measures target based on the most recent low-income sector and EDC consumption data. The target it set 8.16% for Phase I of Act 129 and should not be updated annually using consumption data.
4. A number of findings and recommendations were presented by the FirstEnergy Program Evaluator based on the PY3 process evaluation. The SWE recommends that Penn Power consider incorporating the recommended actions in PY4 and in Phase II of Act 129.
5. Work to eliminate waiting lists for non-residential programs. A waiting list hurts program satisfaction and discourages customers from implementing energy efficient measures. The SWE understands that this recommendation may be difficult to implement given the sector-level budget constraints of Act 129.
6. The SWE recommends that Penn Power explore the feasibility of performing avoided cost calculations at the measure level so that measure-specific load shapes, effective useful life and participant cost values can be applied.
7. The SWE recommends Penn Power review the assumptions used to generate reported savings estimates for commercial HVAC projects in PY4 to stabilize the relationship between the reported and verified savings estimates.
8. The SWE recommends Penn Power continue to use a coefficient of variation assumption of 1.0 for Standard Lighting for Business rebates. The PY3 evaluation found high variability in savings values for these projects so continuing a conservative sampling approach is warranted.
9. The PY3 evaluation found that the *ex ante* savings assumptions for CFL kits in the non-residential sectors were overly optimistic leading to low realization rates. The *ex ante* savings assumptions such as installation rate and hours-of-use should be lowered in PY4 to reflect the results of the PY3 evaluation.
10. The SWE recommends Penn Power follow the format used in PY3Q3 and PY3Q4 when submitting tracking data from non-residential programs to the SWE.
11. The SWE proposes in PY4, in coordination with the FirstEnergy Program Evaluator, to review project files for projects that are not part of the evaluation sample so that a greater number of projects are reviewed and to avoid redundancy between the SWE and the FirstEnergy Program Evaluator.
12. The SWE recommends that Penn Power incorporate TRM assumptions and algorithms earlier in the implementation process by requiring use of the TRM Appendix C (Lighting Inventory Tool) and Appendix D (Motor and Variable Frequency Drive Inventory Tool) during the rebate application process. The SWE confirmed that TRM values are ultimately used to calculate *ex ante* impacts so this recommendation is designed simply to make project documentation more transparent and auditable. Special attention should also be paid to lighting projects with a connected load greater than 50 kW and for the “Other” building type where applicants are allowed to specify their own hours of use.

13. The PY3 net impact evaluation found that the NTG ratio for non-residential programs was significantly lower in Met-Ed service territory than in Penelec or Penn Power service territories. Additional research is needed to determine if a significant difference between these service territories exists that should be addressed in future program designs.
14. The SWE recommends Penn Power include net-to-gross methodology and findings in future annual reports.
15. Penn Power's non-residential savings come primarily from lighting projects. The SWE recommends Penn Power pursue cost effective savings from other Commercial and Industrial equipment types in PY4.

9.6 Statewide Evaluator Best Practice Analysis

In PY3, the FirstEnergy Program Evaluator completed a thorough and rigorous evaluation of the lighting kits distributed to commercial customers. The survey sent to these customers identified that some bulbs distributed for C&I use ended up in residential homes. This was an important finding as the Hours of Use (HOU) for residential bulbs are less than the HOU of bulbs installed in a commercial building. Therefore the gross verified savings for the program were affected. Additionally, the FirstEnergy Program Evaluator used light loggers to verify the HOU of the CFL bulbs from the kits installed in the commercial buildings. Performing rigorous evaluation work in order to determine accurate savings is a best practice cited in Appendix D.

10 West Penn Power Company

This section summarizes West Penn Power Company's (West Penn Power) performance in PY3, as well as the cumulative energy savings and demand reductions achieved by West Penn Power's Act 129 EE&C programs through the end of PY3. This section presents the evaluation activity completed by both ADM and Tetra Tech (the current West Penn Power Program Evaluators) and the SWE in the calculation of the cost-effectiveness, and the measurement and verification (M&V), of West Penn Power's EE&C programs. This section also provides the SWE's recommendations for West Penn Power's programs going forward.

10.1 Summary of Energy and Demand Reductions

Table 10-7-1 highlights West Penn Power's cumulative reported gross impact and verified gross impact since the EE&C programs' inception through the end of PY3.

Table 10-1: Summary of West Penn Power CPITD Impacts

	CPITD Reported Gross Impact[f]	CPITD Verified Gross Impact[h]	Savings Achieved as % of 2013 Targets[i]
Total Energy Savings (MWh/yr)	395,944	394,239	62.8%
Total Demand Reduction (MW)	56	47	29.9%
TRC Benefits ($1,000) [a]	Not Applicable[g]	$128,781	Not Applicable
TRC Costs ($1,000) [b]	Not Applicable[g]	$53,068	Not Applicable
TRC Benefit-Cost Ratio[c]	Not Applicable[g]	2.43	Not Applicable
CO_2 Emissions Reduction (Tons) [d][e]	320,715	319,334	Not Applicable

NOTES:

[a] 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. 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 TRC Order.

[d] 8.1x10-4 metric tons of CO_2 per kWh (EPC's eGRID2007 Version 1.1, RFCE Region annual non-baseload CO_2 output emissions rate, year 2005 data). This is included in this report per the approved SWE work plan.

[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] Defined as the gross energy savings that were reported during the period since date of program implementation through the current reporting period (i.e., reporting period of this report). CPITD = Cumulative Program Inception To-Date.

[g] TRC Benefits and Costs are calculated only for verified savings, which reflect actual program results.

[h] Defined as the energy savings that have been verified by the West Penn Power Program Evaluators and audited by the SWE, and since the date of program implementation through the end of PY3.

[i] Savings achieved based on CPITD Verified Gross Impact.

As shown, West Penn Power has achieved 62.8% of its Act 129 2013 energy savings target and 29.9% of its Act 129 demand savings at the end of PY3. The TRC Benefit-Cost Ratio (or TRC Ratio) of 2.43 indicates West Penn Power's EE&C programs are cost-effective on an aggregate (portfolio) basis.

Table 10-2 contains a listing of West Penn Power's EE&C programs that reported participation and had energy and/or demand savings that were evaluated in PY3, and programs that are yet to be implemented or had no reported savings in PY3.

Table 10-2: West Penn Power EE&C Programs[77]

Programs Reporting PY3 Gross Savings:
• Residential Appliance Turn-In Program • Residential Energy Efficient Products Program • Residential Energy Efficient HVAC Equipment Program • Residential Home Performance Program • Limited Income Energy Efficiency Program (LIEEP) • Joint Utility Usage Management Program • Commercial & Industrial Equipment Program - Small • Commercial & Industrial Equipment Program - Large • Governmental and Institutional Program
Programs to be Implemented or with No Reported PY3 Savings:
• Critical Peak Rebate (CPR) Rate • Time of Use (TOU) with Critical Peak Pricing (CPR) Rate • Customer Load Response Program • Customer Resources Demand Response Program • Distributed Generation Program • Conservation Voltage Reduction (CVR) Program

West Penn Power has reported PY3 gross energy and/or demand savings for nine programs. Table 10-3 below provides a breakdown of the contribution of each program's verified gross energy savings and verified gross demand savings towards the CPITD portfolio savings. As shown, the Residential Home Performance Program accounts for 29% of the total CPITD verified gross energy savings for West Penn Power's portfolio and represents approximately 59% of the savings from residential energy efficiency programs. In the C&I sector, the largest energy and demand savings comes from the Governmental and Institutional Program and the Commercial & Industrial Equipment Program - Small. These two programs together account for 41% of the total portfolio verified gross energy savings and over 85% of the energy savings from C&I energy efficiency programs. These two Programs also account for 58% of the verified gross demand savings of the total portfolio.

[77] Program names are as presented in EDC annual report, Figure 1-5.

Table 10-3: Summary of West Penn Power EE&C Program Impacts on Gross Reported Portfolio Savings

Program	CPITD Verified Gross MWh/yr Savings	Percent of Portfolio CPITD Verified Gross MWh/yr Savings	CPITD Verified Gross MW Reductions	Percent of Portfolio CPITD Verified Gross MW Reductions
Residential Home Performance Program	115,151	29%	5.3	11%
Governmental and Institutional Program	82,223	21%	13.1	28%
Commercial & Industrial Equipment Program - Small	77,682	20%	14.3	30%
Residential Energy Efficient Products Program	67,703	17%	5.7	12%
Commercial & Industrial Equipment Program - Large	25,632	7%	4.4	9%
Limited Income Energy Efficiency Program (LIEEP)	13,241	3%	2.0	4%
Residential Appliance Turn-In Program	7,785	2%	1.5	3%
Residential Energy Efficient HVAC Equipment Program	3,479	1%	1.1	2%
Joint Utility Usage Management Program	1,342	0%	0.1	0%
TOTAL PORTFOLIO	**394,239**	**100%**	**47.4**	**100%**

1 Programs to be implemented or with no reported PY3 savings are not shown. See Table 10-2.

10.2 Total Resource Cost Test

Table 10-4 provides a breakdown of the contribution of each EE&C program's Program Year-to-Date (PYTD) verified gross energy savings and demand reductions as well as the TRC Ratios.

Table 10-4: Summary of West Penn Power EE&C Program Impacts on TRC Ratios

Program	PY3 Verified MWh/yr Savings	PY3 Verified MW Reductions	TRC Ratio
Residential Home Performance Program	104,703	4.80	4.13
Governmental and Institutional Program	70,306	9.70	2.07
Commercial & Industrial Equipment Program – Small	65,621	12.10	3.14
Residential Energy Efficient Products Program	26,767	2.10	2.56
Commercial & Industrial Equipment Program – Large	20,636	3.60	2.31
Limited Income Energy Efficiency Program (LIEEP)	6,494	1.10	0.50
Residential Appliance Turn-In Program	4,612	0.80	1.95
Residential Energy Efficient HVAC Equipment Program	1,378	0.30	1.46
Joint Utility Usage Management Program	1,266	0.10	1.03
TOTAL PORTFOLIO	**301,783**	**34.50**	**2.43**

1 **Programs to be implemented or with no reported PY3 savings are not shown. See Table 10-2.**

Eight out of the 9 programs are found to be cost-effective by the TRC Ratio. (i.e., the Ratio exceeds 1). The only program that generated savings in PY3 that is not to be found cost-effective is the Limited Income Energy Efficiency Program (LIEEP)**.**

An important finding is that the programs with the largest amount of savings in the residential and C&I sectors generally have high TRC Ratios. This means that not only are they performing well in terms of generating savings, they are also cost-effective programs.

10.2.1 Assumption and Inputs

The look and functionality of the West Penn Power TRC model is similar to the FirstEnergy model that was used to calculate cost-effectiveness ratios for Penn Power, Penelec and Met-Ed, with several notable differences. West Penn Power uses a weighted average cost of capital, or discount rate, of 9.034% to discount program benefits and costs. This rate is used to compare the Net Present Value (NPV) of program benefits that will occur later in a measure's lifetime to the upfront costs of installation and implementation. A high discount rate will lead to lower TRC ratios. West Penn Power uses the largest discount rate used by any of the EDCs in PY3 TRC model calculations. A line loss factor of 11% is used for all programs.

A separate TRC workbook was submitted to the SWE for each of West Penn Power's programs. Each workbook laid out the key inputs used in the TRC calculation in a transparent fashion. These inputs included the number of units installed, the average energy and demand impacts, realization rate, incremental cost and effective lifetime for each measure in that program. Measure costs and benefits were calculated at a measure level and then aggregated along with program administrative costs to return the TRC ratio for the program.

The effective measure lives used in the West Penn Power TRC model were consistent with Appendix A of the 2011 TRM with the exception of CFL replacement. CFL measures in the equipment program for the C&I Equipment Program – Small and the Government and Institutional Program were assigned an effective measure life of 3 years in the West Penn Power TRC model. The SWE feels that the underlying assumption is that CFL bulbs in these sectors will see more annual hours of use than in the residential sector and this will shorten the effective measure life. Incremental costs were also applied at the measure level in the West Penn Power TRC model. West Penn Power cost modeling was used to estimate incremental participant costs for residential measures. The DEER and actual project invoice research were the primary sources of incremental cost values for non-residential measures.

The energy and demand impacts used in the West Penn Power TRC model analysis were drawn from the program tracking database, which used TRM-specified values and equations to assign *ex ante* annual savings values to completed measures. The TRC analysis is based on *ex post* verified savings, so program impacts are adjusted by an applicable realization rate. Separate realization rates were applied to energy and demand impacts.

10.2.2 Avoided Cost of Energy

The West Penn Power TRC model assigns a value ($/kWh) to the avoided cost of energy for each year from 2011 through 2025 for each sector – residential, small commercial and large commercial – as well as for each sector in specific seasons. The unit impacts are multiplied by the most appropriate avoided cost stream to determine the per-unit avoided energy costs for that program. Avoided energy costs are highest for residential programs and lowest for large C&I programs. Measures in the government and non-profit sector use the same avoided energy costs as small C&I measures, which are slightly higher than the estimates for large C&I.

10.2.3 Avoided Cost of Capacity

The West Penn Power TRC model assigns a flat annual figure ($/kW) to the cost of adding generation capacity. A single value is used for the avoided cost of capacity for all programs and sectors. The forecasted avoided costs of capacity figures are very low for the 2012 and 2013. In 2012, the value used is $6.01 per kW and in 2013 the value used in $10.12 per kW. These values are consistent with the low capacity prices in PJM for the Western market region for these years. This is approximately $70 lower than the values used in the FirstEnergy TRC model in 2012 and almost $90 lower than the FirstEnergy values for 2013. These low values reduce the financial benefits attributed to demand savings in the West Penn Power TRC model.

10.2.4 Conclusions and Recommendations

The SWE anticipates that West Penn Power will use the FirstEnergy TRC model in PY4 after programs have transitioned to the FirstEnergy TRC model. The SWE recommends that FirstEnergy explore the feasibility of performing avoided cost calculations in the non-residential sectors at the measure level so a measure-specific effective useful life can be imposed. The SWE also recommends that FirstEnergy clearly show how the measure life at the program level in the non-residential sectors were determined and specify the measures lives used for all measures in the TRC model. This would also allow the measure-specific incremental costs to be used and would provide insight into the relative performance of measures within a program. FirstEnergy should also explore the ability to more effectively incorporate load shapes into the TRC model and address the fact that some measures save energy during periods when it is more valuable than others. For example, HVAC measures save energy during peak summer hours when energy prices are elevated, while streetlights save energy at night when energy prices are relatively low. The current FirstEnergy TRC model does not account for this on-peak/off-peak discrepancy in the avoided cost stream.

10.3 Status of Evaluation Activities

10.3.1 Status of EM&V Plans

Per the guidelines outlined in the Audit Plan,[78] the SWE has reviewed EM&V plans submitted by the EDCs to verify that the plans comply with the TRM and TRC Orders and meet the minimum evaluation requirements set forth in the Audit Plan. The Audit Plan provides an outline for the evaluation framework expectations and guidelines necessary to address the following research objectives:

- determine realization rates for gross savings;
- determine net to gross (NTG) ratios;
- determine method for calculating savings; and
- Set acceptable levels of rigor, precision and bias for measurement and verification (M&V) activities.

As West Penn Power transitioned to a FirstEnergy operating company in PY3, many of the evaluation activities began to assume the structure and approach used in the evaluation of the Penn Power, Met-Ed and Penelec energy efficiency programs. While the SWE did not receive a revised EM&V plan for West Penn Power documenting this transition, the intent was confirmed during several teleconferences. On April 18, 2012 the FirstEnergy Program Evaluator submitted evaluation plans for two demand response programs that would be active during the summer of 2012 and were not offered by the other FirstEnergy companies. It was noted in the plan that the evaluation of West Penn Power's Customer Load Response Program would be evaluated using the same protocols established for the legacy FirstEnergy companies. The Time of Use Program (TOU Program) and the Critical Peak Rebate (CPR) Program (CPR Program) were designed to incent customers to reduce load during the top 100 hours of 2012 using a variable pricing tariff.

The TOU Program was not implemented. The CPR Program is offered to residential customers and its impacts will be quantified through a statistical billing analysis. The SWE submitted questions to the West

[78] See Statewide Evaluator Team, *Audit Plan and Evaluation Framework for Pennsylvania Energy Efficiency and Conservation Programs,* November 4, 2011.

Penn Power Program Evaluators on several points that were not clear in the EM&V plans and received satisfactory responses. The SWE approved the plans on May 17, 2012.

10.3.2 M&V Activities and Findings

The following section provides a summary of the Measurement and Verification (M&V) activities conducted by the West Penn Power Program Evaluators based on details provided in West Penn Power's PY3 Annual Report as well as information gathered from SWE data requests and audits.

10.3.2.1 Gross Impact Evaluation

Table 10-5 provides a summary of M&V based on activities conducted by the West Penn Power Program Evaluators based on details provided in West Penn Power's PY3 Annual Report, and on information obtained from SWE data requests and audits.

Table 10-5: West Penn Power Energy Efficiency Programs – Realization Rates for Energy and Demand

Program	Realization Rate-Energy Savings	Realization Rate-Demand Savings
Residential Home Performance Program	99%	99%
Residential Energy Efficient Products Program	96%	93%
Residential Appliance Turn-In Program	74%	77%
Residential Energy Efficient HVAC Equipment Program	122%	70%
Limited Income Energy Efficiency Program (LIEEP)	80%	80%
Joint Utility Usage Management Program	93%	93%
Governmental and Institutional Program	101%	95%
Commercial & Industrial Equipment Program - Small	111%	69%
Commercial & Industrial Equipment Program - Large	103%	105%
TOTAL PORTFOLIO	**101%**	**84%**

1 Programs to be implemented or with no reported PY3 savings are not shown. See Table 10-2.

The realization rate is a factor that compares the gross savings reported by the EDC to the verified savings determined by the EM&V contractor through M&V activities. The calculation for a realization rate is as follows.

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

Depending on the program, realization rates are calculated either based on a sample of program participants and then applied to all participants or the realization rate is calculated on a census of all program participants and then applied to all participants. A realization rate of 100% indicates that the program evaluator was able to verify all reported savings. A realization rate of less than 100% indicates that the gross savings were an over-estimate and a realization rate of over 100% indicates that gross savings were an under-estimate.

Realization rates for energy savings from West Penn Power's programs range from 74% (Residential Appliance Turn-In Program) to 122% (Residential Energy Efficient HVAC Equipment Program). West Penn Power's realization rates for program demand reductions range from 69% (Commercial & Industrial Equipment Program - Small) to 105% (Commercial & Industrial Equipment Program – Large).

10.3.2.1.1 Residential Appliance Turn-In Program

The realization rate for the Residential Appliance Turn-In Program is a reflection of a TRM update that took place in PY3 and reduced the per-unit savings for this program. Because West Penn Power estimated savings for this program using PY2 TRM protocols, the gross savings had to be adjusted to reflect this update.

10.3.2.1.2 Residential Energy Efficient HVAC Equipment Program

The realization rate for the Residential Energy Efficient HVAC Equipment Program is the result of a desk review that found the reported energy savings to be underestimated. Savings were recalculated using the baseline efficiencies and savings calculation protocols stipulated in the 2011 TRM.

10.3.2.1.3 Limited Income Energy Efficiency Program (LIEEP)

The lower than expected energy and demand realization rates for the Limited Income Energy Efficiency Program (LIEEP) are primarily a result of a 58% realization rate for low flow showerheads and 41% for faucet aerators. West Penn Power evaluation verified fewer installed water heating measures than was reported in the program data. Additionally, a significant portion of the participants reported a non-electric water heating fuel. These findings are consistent with prior SWE site visit findings and recommendations. West Penn Power has made changes to program tracking to itemize measures as opposed to assuming a whole kit is installed, and also took steps to check to ensure water heating measures are not being distributed to non-electric water heating customers.

10.3.2.1.4 Non-Residential Programs

West Penn Power adopted the FirstEnergy non-residential program model in PY3, which defines and reports impacts from non-residential programs by sector. In PY3, energy and demand savings were reported for the C&I Equipment - Small, C&I Equipment - Large, and Government and Institutional Programs. Completed projects within each program are further segmented by equipment type to create homogenous groups for evaluation. These equipment types, or measure categories, are the basis of the sample design and the M&V approach. Sampling assumptions and level of rigor of the evaluation are a function of the savings contribution and relative uncertainty associated with the measure category. Measures implemented under the previous West Penn Power program design were placed in separate strata from projects implemented under the FirstEnergy program design to account for any possible differences in *ex ante* savings assumptions or reporting trends. This proved to be a worthwhile strategy as reported savings from projects implemented before the change tended to be more closely aligned with verified savings estimates for lighting retrofits.

The sample design assumptions were based on the results of the PY2 evaluation. Legacy West Penn Power strata used the results of the West Penn Power PY2 evaluation and FirstEnergy strata used the PY2 evaluation results observed in the Met-Ed, Penelec and Penn Power service territories. The required sample sizes for prescriptive measure categories, which tend to have homogenous realization rates among sampled projects, were calculated using a coefficient of variation (Cv) of 0.4. Sample sizes for custom measure categories were calculated using a Cv of 1.6 because verified savings estimates for these measures were found to show high variance in PY2. The SWE commends West Penn Power for using a high Cv assumption for these measure categories because the larger required sample size ensures that the confidence and precision levels established in the Audit Plan will be met.

Each program in the West Penn Power non-residential portfolio was evaluated using stratified ratio estimation. This means a separate realization rate is calculated for each measure category within a program based on the observed ratio of the evaluators verified savings estimates to the reported savings estimates. The realization rate for the measure category is applied to all projects in that measure category for the year to calculate the gross verified savings estimate for the measure category.

Table 10-6: West Penn Power Realization Rates and Relative Precision Values shows the overall energy and demand realization rates for each of the non-residential programs in West Penn Power's portfolio that reported savings for PY3.

Table 10-6: West Penn Power Realization Rates and Relative Precision Values

Program	Energy Savings Realization Rate	Relative Precision (Energy)	Demand Savings Realization Rate	Relative Precision (Demand)
C&I Equipment – Small	111%	8%	69%	11%
C&I Equipment – Large	103%	13%	105%	13%
Government and Institutional	101%	4%	95%	8%

The relative precision values in Table 10-6 are presented at the 85% confidence level and can be used to assess uncertainty associated with the realization rate due to sampling error. For example, the gross verified energy savings estimate for the Government and Institutional Program in PY3 was 69,463 MWh/yr. The relative precision value of 4% means that one can be 85% confident that the true PY3 energy savings of the Government and Institutional Program was between 66,684 MWh/yr and 72,242 MWh/yr.

Each of the West Penn Power non-residential programs exceeded the requirement of 15% precision at the 85% confidence level for energy set forth in the Audit Plan for both energy and demand. The SWE found the high energy realization rate for the C&I Equipment – Small Program shown Table 10-6: West Penn Power Realization Rates and Relative Precision Values noteworthy. Like the other FirstEnergy companies, a large number of conservation kits that included CFL bulbs were mailed to West Penn Power customers in an attempt to gather cost effective savings. CFL kits were responsible for approximately 65% of the energy savings in the C&I Equipment – Small Program in PY3. Each of the legacy FirstEnergy EDCs reported an energy realization rate well below 1.0 for these measure categories because of a low in-service rate and metered hours-of-use values below the values assumed in the reported savings calculations. The West Penn Power CFL measure category was evaluated using the same approach as the legacy FirstEnergy companies. The difference between West Penn Power and the legacy FirstEnergy companies is that West Penn Power used more conservative assumptions (installation rate and hours of use) in the calculation of reported energy savings from CFL kits. As a result, the energy realization rate for the West Penn Power CFL measure category was above 1.0 and the gross verified energy savings for program as a whole was greater than the gross reported energy savings. The SWE recommends that FirstEnergy incorporate the evaluated results from PY4 across all four EDCs into the *ex ante* savings assumptions if CFL kits are going to be distributed.

A total of 53 site inspections were conducted by the West Penn Power Program Evaluators as part of the PY3 evaluation of West Penn Power's non-residential programs. Prior to the site inspection, each project received a desk review to gather key equipment parameters. For custom measures, a site-specific M&V plan was developed for each sampled site. Metering equipment was deployed at 12 of the 53 sites. A variety of M&V approaches were used to develop verified savings estimates including simple verification and TRM calculations: IPMVP Option A (Partially Measured Retrofit Isolation); and IMPVP Option C (Whole Facility Billing Analysis). A number of project analyses made use of metered data gathered on the baseline equipment gathered by the program implementer. The SWE reviewed the approaches used for each measure category and found them to be reasonable given the type of equipment installed.

The FirstEnergy Program Evaluator submitted spreadsheets to the SWE documenting the calculation of the realization and error ratios for each measure category. The error ratio is the key variance metric for programs which use stratified ratio estimation and is used to satisfy the Cv assumption for future sample designs. The SWE reviewed each calculation worksheet and confirmed that the verified savings estimates and associated precision levels were calculated correctly. Lighting projects were the least variable measure category in PY3 because reported savings values are calculated using a version of the protocol in TRM Appendix C (Lighting Inventory Tool), and are consequently very accurate. The highest variability was observed in the prescriptive measure category, which included mostly HVAC projects. The SWE recommends that West Penn Power review the assumptions used to generate reported savings estimates for these projects in PY4 to stabilize the relationship between the reported and verified savings estimates.

10.3.2.2 Net Impact Evaluation

Given the mid-year transition of West Penn Power programs to FirstEnergy's model, West Penn Power's specific net-to-gross (NTG) research was not conducted. The West Penn Power Program Evaluators plan to complete net-to-gross research on West Penn Power program participants starting in February 2013 and the research will be based on six months of PY4 participants. These results will be available in time to inform the final plans for Phase II of Act 129. The NTG data acquisition will be based on participant self-report surveys and will follow a similar approach as that used for the FirstEnergy legacy companies.

10.4 Statewide Evaluator Audit Activities and Findings

10.4.1 Residential Program Audit Summary

10.4.1.1 Residential Lighting

Residential lighting is included in West Penn Power's Residential Energy Efficient Products Program. The SWE reviewed the data tracked in the West Penn Power's database and tracking system to verify that West Penn Power was using the appropriate savings values and algorithms from the 2011 TRM. The SWE also selected a sample of 10 bulbs for the review of baseline assumptions to ensure the CFL wattages fell within the ranges specified in the TRM. Lastly, the SWE team selected 5 retail invoices per quarter from West Penn Power's buy-down program to review and verify that the bulb counts were accurately tracked in the Met-Ed database and tracking system. The SWE found that West Penn Power used the correct values and algorithms, and the correct baseline assumptions, from the 2011 TRM. Additionally, no issues were identified in the review of invoices from PY3.

10.4.1.2 Residential Appliance Turn-In Program

The SWE requested samples of West Penn Power's JACO[79] work orders and corresponding database entries for each quarter. The SWE then checked the database entries for these participants and verified them against the individual database entries from JACO for each customer. For each participant, the SWE verified that number and type of appliances removed was consistent across both databases. The SWE also verified that the savings value used for each sampled participant reflected the characteristics of the recycled appliance. The SWE observed that all participant data was consistent in both the West Penn Power and JACO's databases. West Penn Power used the updated values for energy savings of replaced and retired refrigerators from the 2011 TRM in the calculation of net savings.

10.4.1.3 Residential Energy Efficient Products Program

The SWE requested samples of West Penn Power's customer rebate applications and corresponding database entries for each quarter. The SWE then checked these participants' rebate applications (including copies of receipts for purchased equipment) against the West Penn Power database. The SWE found that all participants sampled had active West Penn Power accounts and all measures that were rebated were on the approved list. West Penn Power used the correct deemed savings from the 2011 TRM. The SWE found no quality control errors In the PY3 samples. In the latter part of PY2, the SWE informed West Penn Power that the SWE would start choosing the sample from West Penn Power s residential database. This gave the SWE a higher level of confidence in the random sample audited in PY3.

10.4.1.4 New Construction

West Penn Power did not have an active new construction program in PY3.

[79] JACO is the vendor for all EDCs' appliance recycling programs.

10.4.2 Low-Income Programs Audit Summary

West Penn Power's Limited Income Energy Efficiency Program (LIEEP) and Joint Utility Usage Management Program (JUUMP) are an expansion of the existing Low-Income Usage Reduction Program (LIURP) offered outside Act 129. In prior program years, the SWE conducted site visits to determine whether measures were being installed and reported correctly. For PY3, West Penn Power advised it had commissioned a third-party contractor to perform site inspections of low-income installations. After reviewing the initial set of site inspection reports, the SWE worked with West Penn Power to develop a site inspection checklist to be used by third-party inspectors in order to ensure that inspectors were adequately assessing all measure installations and to provide confidence in the results.[80]

For PY3, the SWE reviewed 40 low-income site inspection reports. The SWE compared the invoices and survey results to the program tracking database extract. The SWE's findings support the participant survey results reported in West Penn Power's PY3 Annual Report, that in-service rates for water heating measures are low. In addition to reviewing the site inspection reports, the SWE compared quarterly program database extracts, verified per-unit energy and demand savings, and in-service rates to the verified program savings for LIEEP and JUUMP, respectively.

The SWE verified that West Penn Power was in compliance with the Act 129 requirement for the number of energy conservation measures offered to low-income households West Penn Power offered 10 types of measures to the low-income sector in PY3, which is 23.81% of the total number of measures offered across all sectors,[81] compared to its Act 129 compliance target of 8.50%.

10.4.3 Non-Residential Program Audit Summary

During the second half of PY3, West Penn Power transitioned to using FirstEnergy's CSP. The transition did not cause any issues with the quarterly program tracking data submitted to the SWE. A portion of the PY3Q3 data extract and the entire PY3Q4 program tracking data extract was submitted to the SWE consistent with the format used by the legacy FirstEnergy companies. In its PY3 Annual Report, West Penn Power reported impacts using the legacy FirstEnergy companies' program definitions, which separate non-residential impacts by sector into small C&I, large C&I and remaining Government/Non-Profit programs.[82] The SWE was able to map projects completed in Q1 and Q2 to the proper program based on the 'customer segment' field and only minor variations were observed between the program tracking data and the gross reported energy and demand impacts for PY3.

Figure 10-1 shows the distribution of the PY3 energy and demand by across West Penn Power's portfolio. Free CFL kits were the leading contributor of savings in the Small C&I program and a single combined heat and power project produced the majority of savings for the Government and

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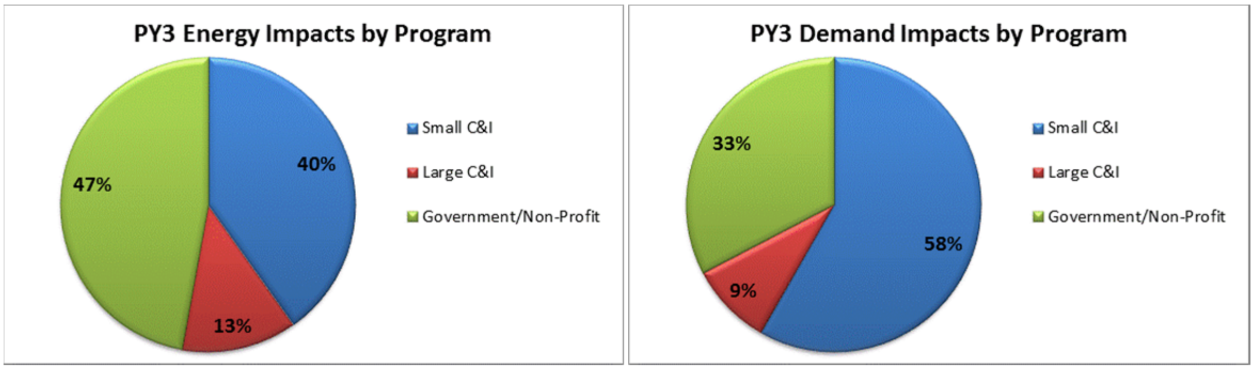
80 The SWE Subsequently issued a guidance memorandum all EDCs that explained the SWE's expectations of data to be collected should an EDC choose to have a third-party contractor conduct the low-income program site inspections.

81 The SWE notes that West Penn Power stated that the proportion of measures target is 8.8 percent, which is incorrect. The target it set at 8.5% for Phase I of Act 129.

82 The legacy FirstEnergy companies' specific non-residential EE&C programs are identified and discussed in Sections 7, 8 and 9 of this Annual Report.

Institutional Program. Additional detail on the SWE audit of non-residential program tracking data can be found in Appendix G.7.

Figure 10-1: Non-Residential Impacts by Program – West Penn Power PY3



The SWE also performed desk audits of project files from a sample of PY3 non-residential projects which were submitted as part of the SWE Quarterly Data Request. Project file reviews are designed to audit the accuracy of the savings values stored in the West Penn tracking system and to confirm that calculations were performed in accordance with the 2011 TRM. The uploaded project files included project level savings calculation workbooks, specification sheets for equipment installed, invoices, customer incentive agreements and post-inspection forms. The transition to the FirstEnergy program design had a negative impact on the quality of project documentation for West Penn Power. Projects implemented by West Penn Power typically included all of the requested documentation and were well organized and transparent. The SWE observed the following issues in the project files uploaded after West Penn transitioned to the FirstEnergy program model.

1. Project file folders included a number of documents which were not requested in the quarterly data request such as tax forms and email correspondence.
2. There were often multiple versions of a savings calculation workbook or application with no indication which file was the most current.
3. The kWh and kW savings in the savings calculation worksheets differed from the values that were ultimately stored in the program tracking data. The SWE recommends that West Penn Power encourage program implementers to use the TRM Appendix C (Lighting Inventory Tool) and Appendix D (Motor and Variable Frequency Drive Inventory Tool) when calculating savings from lighting, motor and VFD project.

Lastly, the SWE performed 8 ride-along inspections and 1 independent site inspection of the FirstEnergy companies' PY3 non-residential projects. The evaluator is the same for all FirstEnergy companies. Therefore, since the primary goal of the inspection process is to ensure that the impacts reported by the EDC evaluator are in compliance with statewide standards, the SWE treats the FirstEnergy companies as a single entity for site inspection purposes. An overview of the site inspection process and common findings is provided in section 3.1.3.1 and West Penn Power-specific project findings and resolutions are provided in Appendix G.4.

10.4.4 Demand Response Audit Summary

There was no audit work completed on Demand Response programs as these programs had not yet been implemented in PY3.

10.4.5 Net-to-Gross and Process Evaluation Audit Summary

10.4.5.1 Net-to-Gross (NTG)

Given the mid-year transition of West Penn Power programs to FirstEnergy's model, West Penn Power-specific NTG research was not conducted, and there was no NTG study suggested for West Penn Power programs by the SWE. Therefore, a review was not conducted.

10.4.5.2 Process Evaluation

The process evaluation conducted by the West Penn Power Program Evaluators for West Penn Power's programs was reviewed by the SWE for the level of rigor and the level of transparency, and for the level of consistency used in the methodology and reporting practices for the evaluated programs. Findings and recommendations from this review are presented below.

The level rigor performed for West Penn Power programs was on the basic scale. For most of the programs for which a process evaluation was conducted, online, self-reported participant surveys were used to collect data and feedback. Participant phone numbers were available for the Joint Utility Usage Management Program (JUUMP) so the West Penn Program Evaluators were able to conduct telephone interviews instead of online surveys. For future studies, a more rigorous methodology is suggested for any program which is not meeting savings goals. The West Penn Power Program Evaluators should conduct surveys with other market actors as well as conduct reviews of studies of similar programs in other jurisdictions.

The West Penn Power Program Evaluators provided a good amount of information regarding the process evaluation methodology used across West Penn Power programs. The methodology was explained in detail and the number of surveys administered was provided for most programs. For future reports, a full or partial example of the surveys used by the evaluation contractor would provide a higher level of transparency.

10.5 Statewide Evaluator Final Recommendations

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

1. A number of findings and recommendations were presented by the West Penn Power Program Evaluators based on the PY3 process evaluation. The SWE recommends that West Penn Power consider incorporating the recommended actions in PY4 and in Phase II of Act 129.
2. West Penn Power should continue to work to ensure that water heating measures are not distributed to LIEEP participants that have non-electric water heating.
3. West Penn Power updated its low-income Act 129 proportion of measures target based on the most recent low-income sector and EDC consumption data. The target it set 8.5% for Phase I of Act 129 and should not be updated annually using consumption data.
4. The SWE recommends that West Penn Power explore the feasibility of performing avoided cost calculations at the measure level so that measure-specific effective useful life and participant cost values can be applied.
5. Unlike the legacy FirstEnergy companies, the reported savings assumptions used for non-residential CFL kits in West Penn Power's service territory were found to be too conservative based on the PY3 evaluation. The SWE recommends that FirstEnergy incorporate the results of the PY3 evaluation efforts into the *ex ante* savings assumptions for all four operating companies (Met-Ed, Penelec, Penn Power and West Penn Power).
6. Net-to-gross (NTG) research should be conducted in West Penn Power service territory in PY4 to calculate NTG ratios for programs now that the FirstEnergy program model has been adopted by West Penn Power.
7. The SWE observed a decrease in the quality of the project documentation for non-residential projects in West Penn Power service territory following the transition to the FirstEnergy program model. The SWE recommends West Penn Power review the suggestions provided to the legacy FirstEnergy companies and incorporate some of the practices that were in place prior to the transition.
8. The SWE found that a number of Non-Residential project files submitted by First Energy to the SWE contained several iterations of savings calculations. Because the files were not clearly labeled, there were instances where the SWE had difficulty tracking the reported and verified savings and inadvertently audited the wrong savings calculations. The SWE recommends that First Energy clearly label final reported and verified savings calculations.

10.6 Statewide Evaluator Best Practice Analysis

A best practice for adaptation to "Changes in Technologies and Market Conditions" is to be willing to experiment with new program approaches that have proven successful elsewhere. West Penn Power has developed Critical Peak Rebate (CPR) riders that have been shown to decrease customer usage of electricity during peak energy periods. West Penn Power is currently using a CPR rider in its service territory and has over 23,000 enrolled participants. Customers receive a credit on their bill for reducing load during West Penn Power's critical peak periods. Innovative rate design, such as critical peak rebates, gives customers opportunities to respond to price signals supporting efficient system operations.

11 Summary

The following provides a summary of the findings, best practices and recommendations from the SWE for PY3.

11.1 Findings

The SWE, the PUC TUS Staff, the EDCs and the EDC program evaluators have worked hard to develop a solid foundation for the evaluation, measurement and verification (EM&V) of the Act 129 EE&C programs. The SWE notes that improvements continue to be made to the SWE audit processes and appreciates the support and responsiveness of the Pennsylvania Energy Association, the EDCs and their EM&V contractors.

The SWE believes the following are the most important findings from PY3:

1. The TRC benefit/cost ratio for Programs Years 1 to 3 is 2.97 to 1.

2. The net present value savings of the EDCs programs to date (through the end of PY#) is $1.3 billion.

3. Through the end of PY3, the EDC should reach 80% of the Phase 1 savings target for MWH savings, and 40% of the Phase 1 MW savings goal

11.2 Summary of Best Practices

The SWE Team reviewed several existing energy efficiency Best Practices studies and summarized key findings of those studies in Appendix D of this report. These existing studies provide considerable ideas on Best Practices for energy efficiency programs in order to make them as efficient and effective as possible. The lessons learned from years of program implementation across the US provide a roadmap for the continuous improvement of the Act 129 programs operated by Pennsylvania's EDCs. Listed below are a few examples of best practices already being implemented by Pennsylvania EDCs.

Duquesne developed strong working relationships with many retailers in PY3. Specifically, during PY3, Duquesne worked with the program's Upstream Lighting CSP and with retailers to promote residential rebates in their stores. These events took place at large retailers, such as Lowes and Sam's club, on a monthly basis. These events used lots of program signage and information sheets, along with special pricing. For PY4, Duquesne and its CSP, ECOVA, have targeted promotions in 58 major appliance stores in the Pittsburgh area to display program signage on or next to qualifying appliances.

Knowing its target audience gives PECO the opportunity to cross-sell other residential energy efficiency products to their customers who participate in the Smart Appliance Recycling Program. PECO recognizes that the Program may be a customer's first experience with PECO's energy efficiency programs. As such, PECO should direct its Program CSP to provide information to customers about PECO's other residential EE&C programs when picking up the appliances.

PPL's Direct Discount delivery channel was used to successfully increase participation in lighting projects for the small C&I sector in PY3. This focus on a particular customer class is found in the best practice of "efficiently delivering integrated programs to all end-users regardless of their size." See Appendix D. PPL's focus on the small C&I sector allows customers in that sector to participate in and take advantage of energy efficiency opportunities.

11.3 Recommendations

Based on the findings from the SWE audit activities conducted in PY3, the SWE makes the following recommendations to the PA PUC relating to the Act 129 energy efficiency and demand response programs:

1. The SWE finds that the seven Pennsylvania EDCs (that are subject to the electricity savings requirements of Act 129) are making steady progress towards meeting the Phase 1 savings targets listed in Act 129.

2. The SWE finds that the overall Total Resource Cost Test benefit/cost ratio for the period covering the first three program years is 2.97 to 1. The net present value savings to Pennsylvania ratepayers is approximately $1.3 billion.

3. It was found for several EDCs that Effective Full Load Hour (EFLH) values for measures in the commercial sector in the supporting project documentation submitted to the SWE were different than EFLH values in the 2011 TRM. The SWE recommends that the EDCs incorporate TRM assumptions and algorithms earlier in the implementation process by requiring use of the TRM Appendix C (Lighting Inventory Tool) and TRM Appendix D (Motor and Variable Frequency Drive Inventory Tool) during the rebate application process.

4. It was discovered in the review process that non-residential programs for PECO and the FirstEnergy companies have waiting lists for customers wishing to implement energy efficient measures. It is recommended that work be initiated to reduce these waiting lists, and thus increase the number of non-residential energy efficiency measures installed. The Commission may want to consider granting EDCs additional flexibility to reallocate budget between sectors to prevent this type of lost opportunity.

5. It is recommended that net-to-gross (NTG) analysis be conducted or modified for several of the programs reviewed. Specifically, the Duquesne Upstream Lighting program, the PECO Smart Lighting Discounts and PPL's Residential Lighting program should be updated in Phase II of Act 129 so that they meet the Enhanced level of rigor as defined in the SWE Net-to-Gross Study Methods paper.

6. It is recommended that the FirstEnergy companies explore the feasibility of more clearly presenting avoided cost calculations at the measure level so that measure-specific effective useful life and participant cost values can be applied.

7. The SWE Team plans to follow up with the Pennsylvania EDCs to determine the final disposition of all process evaluation recommendations made to EDCs by their evaluation contractors. The SWE team recommends that it prepare a report to the PA PUC staff that presents the final

disposition of all of these recommendations (made by the EDC evaluation teams) by April 1, 2013.

8. The SWE team recommends that it work with the PUC staff and the EDCs to review the best practices listed in the appendices of the SWE PY3 Annual Report to see if any of these best practices should be implemented in the EDC programs in Pennsylvania.

Appendix A Evaluation Overview

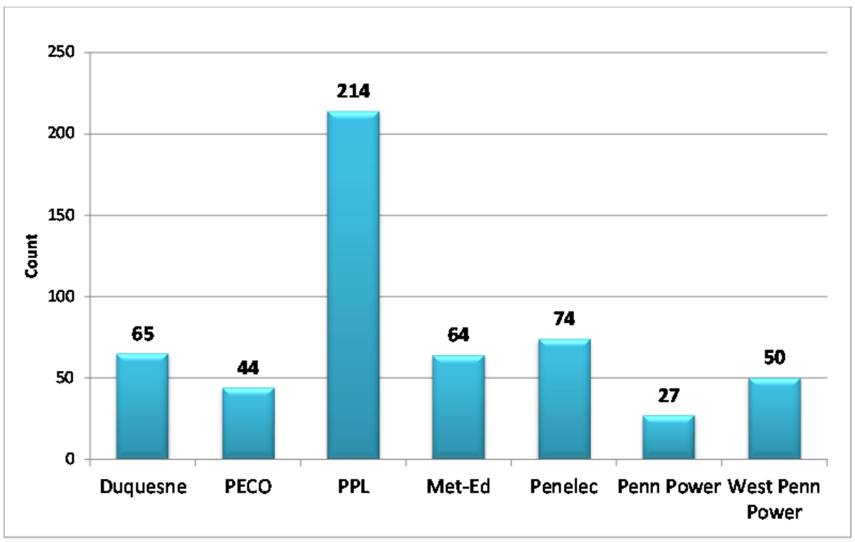
Appendix A presents concepts and terms used in the SWE's audits of EDC sampling and evaluation activities for non-residential programs.

Each efficiency measure that is implemented as part of an EDC's EE&C plan is assigned a reported (*ex ante*) savings (or impact) value for energy and demand savings. These savings values are usually generated by the conservation service provider (CSP), which implements the specific EE&C program and associated efficiency measures. Determination of the savings values should be based on TRM protocols. The sum of the savings reported (through program tracking databases and systems) by the EDC and/or its CSP is the gross reported savings for the EE&C program. However, compliance with Act 129 energy and demand savings targets is based on gross verified savings estimates. In order to develop gross verified savings estimates for a program, an EDC's energy, measurement and verification (EM&V) contractor (also termed the EDC program evaluator) selects a sample of projects from the program population for more rigorous measurement and verification activities than used in preparing reported savings estimates. A sample is used because it is not feasible or cost-effective to evaluate all of the efficiency measures implemented (one or more such measures implemented at a customer site is termed a project).

The EDC program evaluator is responsible for developing an independent estimate of the savings achieved by each project in the evaluation sample. The methodology and level of rigor used to develop these estimates depends on the measure implemented and the relative contribution of the project to EE&C program savings. For non-residential programs, evaluation approaches range from a simple phone call to the site contact, confirming the installation of the efficient equipment, to metering the electric load of the baseline equipment and efficient equipment for several months. For large non-residential projects, the SWE recommends a site inspection to verify equipment installation and gather key parameters about the equipment operating characteristics.

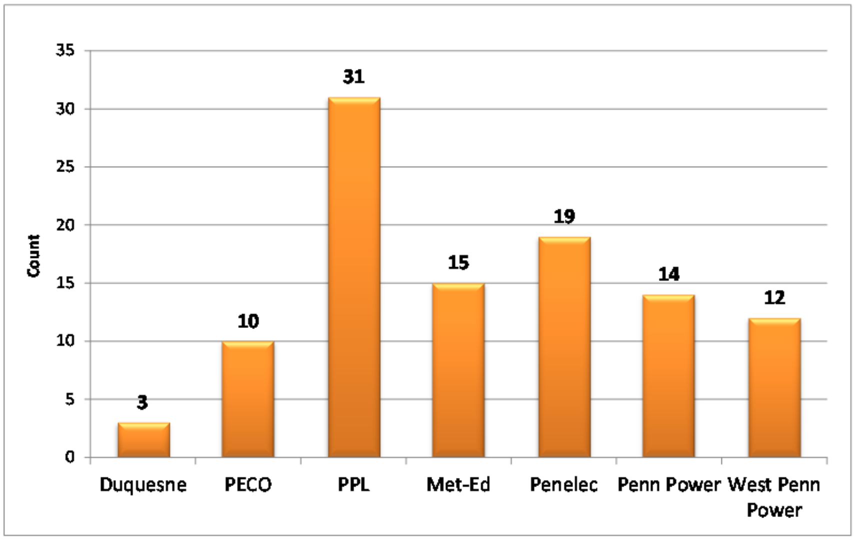
Figure A-1 shows the number of site inspections conducted by each EDC program evaluator during PY3 for estimating verified gross savings achieved in the EDCs' non-residential EE&C programs.

Figure A-1: Count of PY3 Non-Residential Site Inspections by EDC



The 2011 TRM suggests logging[83] for lighting projects with a connected load savings of 50 kW or higher. The SWE recommends that EDC program evaluators deploy logging equipment when there is considerable uncertainty associated with the operating characteristics of lighting, motor and VFD equipment, and thus TRM estimates may not produce reliable savings estimates. Figure A-2 shows the number of non-residential projects where end-use metering was deployed by each EDC program the customer/evaluator to capture key operating characteristics for use in the verified savings estimates for the project.

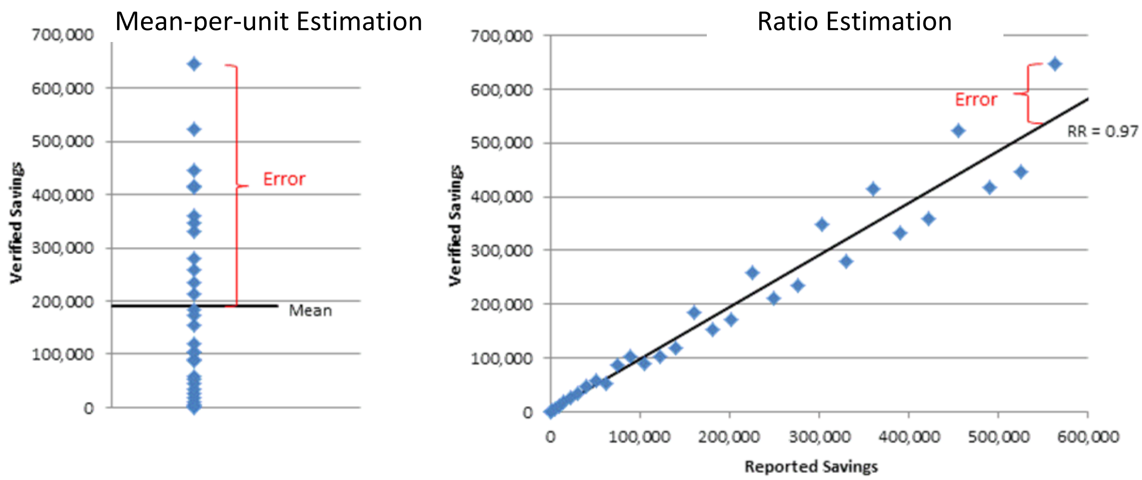
Figure A-2: Count of Non-Residential Projects with Metering Equipment Deployed in PY3 Evaluation



83 Installation of metering equipment to measure a key parameter such lighting levels, run time or power consumption.

Non-residential programs are typically evaluated for savings estimates by use of ratio estimation,[84] because the sizes of the savings estimates of the projects within a program vary considerably. A simpler program, where each project is expected to have a similar impact, will typically use a mean-per-unit estimate of savings. Figure A-3 provides a graphical representation of the two methods and shows why ratio estimation is a more precise method for non-residential programs.

Figure A-3: Mean-per-unit Estimation vs. Ratio Estimation



Ratio estimation relies on the ratio of verified gross savings estimates to reported (program tracking) gross savings estimates to assess the rate at which reported savings are being realized. This ratio of verified savings estimates to reported savings estimates in the evaluation sample is referred to as the realization rate of the program and is calculated as follows:

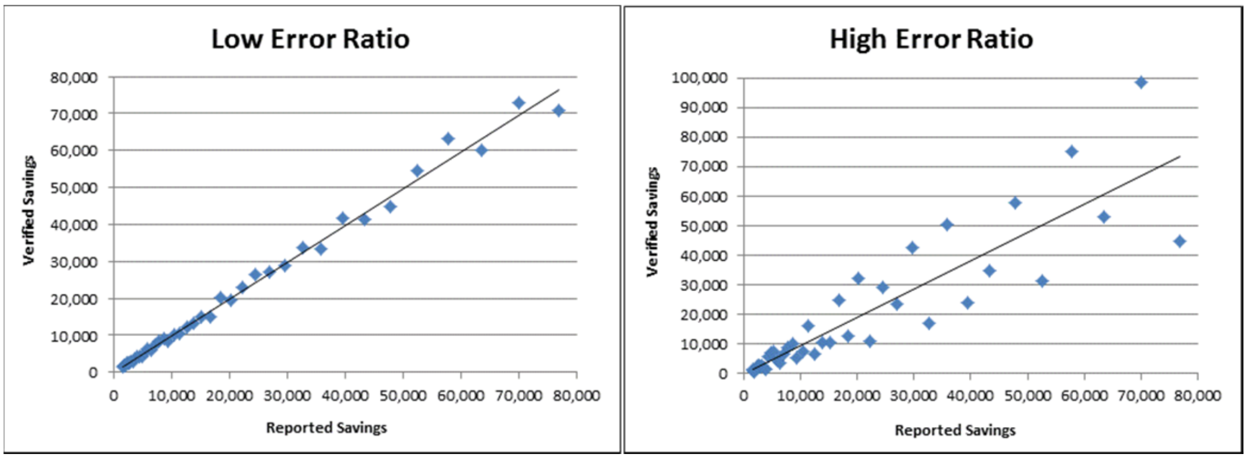
$$\frac{\sum Verified\ Savings\ Estimates}{\sum Reported\ Savings\ Estimates} = Realization\ Rate$$

In the graph shown on the right side of Figure A-3, the realization rate is equal to 0.97[85]. Based on the results observed in the evaluation sample, savings are being realized, or verified, at 97% of the reported savings estimate. To generate a verified savings estimate for the program, the reported savings estimate for each project in program is multiplied by 0.97 because it is assumed that the projects not included in the evaluation sample will realize savings at the same rate as the projects in the evaluation sample.

84 Ratio estimation is discussed in detail in Section 4.4.2 of the SWE Audit Plan.
85 The realization rate can also be thought of as the slope of the line shown in Figure A-3

Because a sample of projects is used to calculate the realization rate for the program, there is uncertainty associated with the estimate. It is possible that the sampled projects realized savings at a lower or higher rate than the program as a whole. The amount of uncertainty associated with the realization rate and the resulting verified savings estimate for the program is a function of the sample size and the amount of correlation between the reported and verified savings estimates. Figure A-4 shows an example of a program that is highly correlated and one that is not. This degree of correlation is assessed by a statistic called the error ratio.

Figure A-4: Ratio Estimation with High and Low Error Ratios



The error ratio is used in the calculation of required sample size for programs using ratio estimation in the same way that the coefficient of variation (the standard deviation divided by mean, abbreviated as "Cv") is used for programs which use mean-per-unit estimation. A large Cv means that a greater number of samples are required to achieve the desired precision level because the relationship between reported and verified savings is inconsistent between projects in the evaluation sample. The SWE audit of PY3 evaluation activities included a review of the Cv assumptions that were used in the sample design. In cases where the observed error was greater than the assumption used in the sample design, the SWE recommends that the PY4 sample design use a more conservative error estimate to ensure that program precision targets are met.

Relative precision is the metric of the amount of uncertainty associated with the verified savings estimate and is determined by the sample size and the observed error between the verified savings estimates and the reported savings estimates. The SWE Audit Plan requires that programs achieve 15% precision at the 85% confidence level annually. This means that the sampling strategy for the evaluation must be sufficient to produce results such that there is an 85% chance that the actual program savings are within +/- 15% of the verified savings estimate given the error observed in the results. The SWE audit of PY3 evaluation activities included a review of the calculation of relative precision values for each non-residential program. The SWE has made recommendations to the EDCs for improving precision values when the requirements set forth in the Audit Plan have not been met.

Appendix B Net-to-Gross Methodologies

Appendix B summarizes the net-to-gross (NTG) methodologies used by each of the EDCs to estimate program free ridership and/or spillover, from which a NTG ratio (NTGR) for a program (or if appropriate a sub-program or a group of programs) was derived for estimating EE&C program net savings.

West Penn Power did not conduct NTG analyses for its PY3 programs and thus not summarized herein.

B.1 Duquesne

B.1.1 Methodology Summary

NTG methodologies were developed for residential, commercial, and industrial sectors, with little variation among programs within each sector. For residential programs, Navigant (the Duquesne Program Evaluator) developed a survey instrument template that was tailored for each program. The intention of the survey was to gather feedback from program participants regarding their intention to procure the rebated measure(s) outside of the program and gauge the level of influence the program had on the participant's decision. The Duquesne Program Evaluator determined the NTGR by assuming a level of free ridership that corresponded with certain responses by the participant. Possible free ridership levels were 0%, 25%, 50%, 80%, 90% and 100%. The assumptions were outlined by the Duquesne Program Evaluator through the explanation of its algorithm, which qualified participant responses in order to rank the level of free ridership.

A weighted average of free ridership scores for surveyed participants was used to determine an overall free ridership score for the measure. A simple average of the measure free ridership scores determined the overall free ridership score for the program. The free ridership score represents the percentage of savings that would have occurred in absence of the program. Therefore, the free ridership score was subtracted from 100% to arrive at the NTGR.

A spillover score was not calculated for any program. Instead, the Duquesne Program Evaluator used survey responses in combination with deemed savings values to determine an average energy savings per surveyed participant. Participants were asked if they had taken any additional energy savings actions after participating in the program and to what extent the program had influenced the participant to take these additional energy saving actions. The Duquesne Program Evaluator discounted deemed savings for the top reported actions by the level of influence indicated by the participant to arrive at a savings value per surveyed participant.

Commercial and industrial programs followed a similar methodology to arrive at the NTGR. Data were collected via survey instruments from which participant responses were assessed based on an algorithm developed by the Duquesne Program Evaluator. Survey questions were preceded by a qualitative inquiry regarding the participant's decision process to install the measure. This feedback was cross-referenced against the follow-up survey in order to verify the consistency of the survey responses. Surveys were scored via a custom algorithm using a discrete scoring range of 0%, 25%, 50%, 75%, 90% and 100% free ridership. A weighted average by measure was calculated and a simple average of each measure's free ridership was taken to arrive at the program free ridership. Subtracting the final free ridership score from 100% determined the program NTGR.

Spillover was also assessed for commercial and industrial programs through survey responses. Participants were asked about the likelihood that their additional energy saving actions would have occurred in the absence of the program and to what degree the program influenced the participant to take these additional actions. Responses were recorded on a 1 -5 scoring scale and averaged to arrive at the final spillover value for each measure. However, no spillover score was calculated or factored into the final NTGR. The SWE audit of the Duquesne's NTG evaluation is presented in Section 4.4.5.

B.2 PECO

B.2.1 Methodology Summary

Navigant (the PECO Program Evaluator) provided varying levels of detail for its NTG methodology by program. For the Smart Equipment Incentives and Smart Construction Incentives Programs, the PECO Program Evaluator provided an explanation of the survey instrument used and how it was scored. Survey responses were not provided and therefore the actual scoring could not be verified. The remaining programs provided a very high level explanation with little discussion regarding NTG methodology. The program summaries below provide a description of the NTG methodologies used.

B.2.1.1 Smart Lighting Discounts Program

The Smart Lighting Discounts Program offers PECO customers discounted CFLs as well as promotes customer awareness and education regarding CFLs. The program underwent a strategic shift in PY3 that refocused the program on specialty CFLs. This resulted in a significant decrease in program participation. Due to this reduced number of program participants and the upstream nature of the program, a very large sample of PECO customers would have been required to collect sufficient data for the NTG analysis. As a result, the PECO Program Evaluator relied on PY2 survey data to conduct its NTG analysis. The PY2 NTG data were collected through surveys conducted with the general population, either by contact via telephone or at store purchase locations, and through surveys of trade allies. The NTG methodology was based on preference purchase modeling, which is an analysis of which goods a consumer prefers based on actions he/she takes when making a purchase. The simple weighted average of these separate studies was used to arrive at the NTGR of 38.1% for the Smart Lighting Discounts Program.

Spillover for the Smart Lighting Discounts Program was calculated based on the PY2 telephone surveys with the general population. The PECO Program Evaluator was able to survey both participant and non-participant groups and as a result was able to calculate spillover values for each group. Spillover questions were focused on efficient lighting equipment installed by the interviewee. A lighting purchase was considered spillover if the lighting was energy efficient, if the level of influence of the Program on the decision to make the purchase was sufficiently high to reasonably conclude that the purchase would not have occurred in the absence of the program, and if the customer did not receive any rebates for the efficient lighting. The overall spillover rate was calculated at 0.65% for the Program.

B.2.1.2 Smart Appliance Recycling Program

The Smart Appliance Recycling Program provides services and an incentive to customers who elect to have a refrigerator, freezer, or window air conditioner removed from their home. The NTG analysis for the program was based only on free ridership, as the PECO Program Evaluator stated that no plausible hypothesis exists for program-induced spillover. The PECO Program Evaluator described potential free rider activities as taking the appliance to the land fill or having another recycling service collect the appliance.

Telephone surveys were conducted to understand program participants' intentions and how the program influenced their decision. The PECO PY3 Annual Report does not state how many participants were surveyed as part of this exercise. The SWE assumes that the survey was administered at the same time surveys were conducted for the gross savings analysis and therefore 255 participants responded to the free ridership questions. Free ridership was determined to be 36% for refrigerators and 35% for freezers; the overall Program free ridership was calculated at 36%, which resulted in an overall Program NTGR of 64%. The PECO Program Evaluator noted that the Smart Appliance Recycling Program's NTGR has decreased since PY2 and that further survey data is required to determine the causal factors.

B.2.1.3 Smart Home Rebates Program

PECO offers customer rebates for a total of 22 types of qualifying appliances, lighting, and heating and cooling equipment through its Smart Home Rebates Program. For the NTG analysis, the PECO Program Evaluator conducted 200 telephone surveys with PY3 program participants, of which. 32 respondents indicated they had taken action to procure an eligible measure before learning of the Program. The survey thus indicated Program free ridership, for which the NTGR was calculated to be 16%.

Spillover data was also collected as part of the NTG survey. The PECO Program Evaluator reported 58 of 200 respondents indicated they had installed additional measures without receiving a rebate. The majority of these measures were CFLs. Replacing windows and doors were also common additional measures installed. However, the PECO Program Evaluator only credited those measures for which energy savings could be verified and therefore only considered the lighting measures in its spillover calculation. This reduced the number of spillover participants from 58 to 12, resulting in a 6% spillover rate for the Program.

A NTGR of 90% was calculated for the Smart Homes Rebate Program, based on the free ridership and spillover scores realized by the Smart Homes Rebate Program. The results indicate that the Program is very effective in influencing customers to install measures that they would not otherwise implement.

B.2.1.4 Low-Income Energy Efficiency Program

The PECO Program Evaluator did not complete a NTG analysis for the Low-Income Energy Efficiency Program. This was due to the generally accepted assumption that free ridership and spillover are not prevalent in low-income programs.

B.2.1.5 Smart Equipment Incentives Program- C&I Customers

The NTG analysis conducted for the Smart Equipment Incentives Program for C&I customers was accomplished by collecting participant data via a survey instrument. The objective of the survey was to collect and score data regarding:

- Influences that determined when and what type of measure to procure;
- Influence of the program to procure the measure; and
- the likelihood that the participant would have procured the measure now or at a later date if the program was not available.

Scores for each of these three factors were calculated for each surveyed participant. Spillover questions were also asked using the same survey; however, the questions were not designed to quantify an actual spillover score but rather indicate if spillover was occurring in the Program. The PECO Program Evaluator completed 35 surveys for the Program. At the time of the submission of PECO's PY3 Annual Report, the final free ridership score for the Program had not been determined. As spillover was not quantified, the NTGR will be determined based on the free ridership determined for the program. Per PECO's PY3 Annual Report, the PECO Program Evaluator estimated the Program's NTGR to be in the range of 57% to 70%.

B.2.1.6 Smart Equipment Incentives Program- GNP

The NTG analysis for the Smart Equipment Incentives program for GNP customers was conducted using the same methodology as was used for the C&I customers under the Smart Equipment Incentives Program. Similarly, the PECO Program Evaluator did not provide a final NTGR in PECO's PY3 Annual Report. The PECO Program Evaluator indicated that 43 surveys were completed for the GNP customer base, and estimated the Program's NTGR to be in the range 51% to 62%.

B.2.1.7 Smart Construction Incentives Program

PECO's Smart Construction Incentives program encourages energy efficiency to be incorporated into newly constructed facilities or facilities undergoing complete renovation or reconstruction. As design firms are typically the decision makers with regard to what energy efficiency measures and approaches will be taken, the PECO Program Evaluator targeted this group in its NTG analysis. However, some of the sampled projects only included contact information for the relevant trade ally. Therefore the PECO Program Evaluator included both participants and trade allies in its survey. The survey focused on the level of influence the Program played on the decision of the participant, and in absence of the Program, the likelihood of the same quantity of energy efficient measures being installed, and the likelihood of the measures being installed with the same level of efficiency.

It was often the case that an interviewee represented multiple projects. In these cases, the PECO Program Evaluator asked the interviewee to respond based on the largest measure (in terms of kWh savings) installed and then asked if his or her response would be different for any of the other installed measures. If the response varied among measures, the PECO Program Evaluator repeated key survey questions for the other measures. The PECO Program Evaluator collected responses from interviewees representing 37 of the program's 69 projects implemented in PY2 and PY3. It was noted that several of the projects were completed by national retailers that used prototypical building designs, which made the survey responses applicable to multiple projects.

A NTGR of 30% calculated was based on the survey responses on free ridership No spillover for the Program was indicated based on the survey responses.

B.3 PPL

B.3.1 Methodology Summary

Cadmus (the PPL Program Evaluator) followed a similar methodology for the NTG analysis for each EE&C program and tailored survey instruments to programs when necessary. Self-reporting surveys served as the primary data collection method for the NTG analyses. The PPL Program Evaluator conducted surveys for PPL's programs in PY1, PY2, and PY3. Additionally, some programs will be surveyed in PY4. For those programs, the NTG analysis is based on survey results from prior program years. The intention of the survey was to gather feedback from program participants regarding a participant's intention to procure the rebated measure(s) outside of the program and gauge the level of influence the program had on the participant's decision.

The PPL Program Evaluator developed its own model to score the level of free ridership based on survey responses. Additionally, the PPL Program Evaluator calculated the standard error of the free ridership scores based on the scores' distribution. The algorithm used in the scoring model was not disclosed by the PPL Program Evaluator in PPL's PY3 Annual Report. However, the PPL Program Evaluator did explain that its model calculates varying levels of partial free ridership based on the survey responses. The program's overall free ridership score was calculated based on the participants' responses, and an. overall score was calculated using the PPL Program Evaluator model. A detailed description of the calculation used in the model was not provided.

Spillover was also assessed by the PPL Program Evaluator for most programs through surveys. The spillover survey instrument was designed to understand to what extent a participant had taken any additional energy savings actions after participating in the program and to what extent the program had influenced a participant to take these additional energy saving actions. Only measures that are considered energy efficient, such as ENERGY STAR® appliances, CFLs and high efficiency air conditioners qualified for spillover savings. Measures that are not in the TRM or measures that require additional data to compute savings, such as insulation and windows, were not included in the spillover analysis.

The PPL Program Evaluator reviewed spillover data collected from the surveys and filtered (qualified) responses that met spillover requirements, which included a high level of influence from PPL programs and resulting from qualified measures. The energy savings for the qualified portion of sampled spillover participants was calculated to determine the spillover score for the program. The PPL Program Evaluator summed the total spillover energy savings achieved per survey respondent and estimated the program spillover score as the ratio of total spillover savings to total program savings for the sample.

Also noted was the Program Evaluator's assessment of non-participant spillover in its NTG analyses. While the Program Evaluator described its process of trade ally surveys to assess non-participant spillover, this analysis was not performed for PY3 and no adjustments were made to program spillover values. However, the Program Evaluator did conduct secondary research on prior non-participant spillover evaluation to inform the range of expected non-participant spillover values for various measures. These values observed during the literature were somewhat variable and are included within the PPL annual report for reference.

B.3.1.1 Residential Lighting Program

The Residential Lighting Program (RLP) is an upstream CFL discount lighting program. The SWE recommended that the Program be subject to an Enhanced level of rigor, due to the fact that it accounted for 39% of portfolio savings for PY2. However, based on the description provided by the PPL Program Evaluator, the NTG analysis for the RLP is considered by the SWE to have met a Standard level of rigor.

The PPL Program Evaluator conducted 266 surveys, but used responses from only 160 surveys that met the conditions needed to assess free ridership and spillover (respondents who were aware of CFLs and had purchased a CFL in the past 3 months). The PPL Program Evaluator reviewed records to determine how many CFLs were purchased by each surveyed respondent and conducted the NTG analysis on a per-CFL basis rather than a per-customer basis. Survey respondents were stratified based on the respondent's awareness of the RLP program. A weighted mean free ridership score with upper and lower bounds that also incorporated spillover effects was calculated for each stratum. A net free ridership score was estimated based on free ridership scores for each stratum and then was adjusted downwards slightly through judgment of the evaluation contractor. The NTGR was estimated at 70% for the RLP.

B.3.1.2 Appliance Recycling Program

The Appliance Recycling Program (ARP) offers PPL customers free pick up and recycling of older inefficient refrigerators, freezers, and room air conditioners that are still in working order. NTG data were collected via telephone surveys in PY3. The free ridership portion of the survey was designed to determine if participants would have disposed of their appliance in absence of the program. A total of 75 surveys were completed. The PPL Program Evaluator calculated a free ridership score of 39%. It was noted that free ridership did not change between PY2 and PY3.

The survey instrument also asked spillover questions to participants. The questions evaluated if the ARP had influenced participants to take any additional energy efficiency actions for which they did not receive a rebate. Survey responses described spillover actions as installing CFLs, windows, central air conditioning, and insulation. The PPL Program Evaluator estimated a spillover score of 2% based on the survey responses. Based on the free ridership and spillover scores, the ARP NTGR was estimated at 63%.

B.3.1.3 Efficient Equipment Incentive Program

The Efficient Equipment Incentive Program (EEIP) provides PPL customers incentives to purchase and install a range of high efficiency equipment including heating, cooling, lighting, water heating, appliances, and other measures. The PPL Program Evaluator conducted its NTG analysis via self-reported surveys across four program segments – residential, direct discount delivery channel, non-residential lighting and non-residential non-lighting. Surveys were customized to address the measures within each segment. The survey included questions aimed toward free ridership and spillover.

A total of 268 free ridership and spillover surveys were administered. Free ridership and spillover scores were calculated for each program segment which allowed the evaluation contractor to draw conclusions regarding the residential and non-residential sectors. The residential program had a free ridership score of 35%. Very little spillover was identified and calculated at just 0.1%. Therefore, the residential program's NTGR was estimated at 65%. The non-residential programs exhibited a range of free ridership. The PPL Program Evaluator noted however, that, while the lighting and direct discount programs had lower free ridership, the non-lighting program exhibited higher free ridership primarily due to the disproportionately high installation rate of variable frequency drives that were reported with a high free ridership score. No spillover was indicated for any of the non-residential programs. The NTGRs for the non-lighting, direct discount, and lighting programs were 33%, 90%, and 81%, respectively.

B.3.1.4 Energy Efficiency Behavior & Education Program

The PPL Program Evaluator did not conduct a separate NTG analysis for this Program, as the billing analysis conducted for estimating the Program's reported savings was assumed to account for free ridership and spillover.

B.3.1.5 Custom Incentive Program

PPL's Custom Incentive Program (CIP) offers incentives and a delivery channel for measures not offered by other PPL programs. The CIP is open to all sectors but is particularly focused on C&I customers. The NTG analysis was conducted based on data collected via surveys conducted in PY2. The next round of NTG surveys will be conducted in PY4. The PPL Program Evaluator felt that the PY2 survey responses were "reasonable and conservative" to use for estimating the PY3 NTGR.

A total of 19 surveys were conducted with participants who completed projects in PY2. A free ridership score for the CIP was estimated by taking a weighted average of each respondent's free ridership score weighted by the respondent's total savings. The CIP's free ridership score was calculated at 69%. Spillover questions were also asked in the survey; however, no respondent indicated taking any additional energy efficiency actions. Therefore, spillover was assumed to not have occurred. The NTGR for the CIP was estimated to be 31%.

B.3.1.6 Renewable Energy Program

The Renewable Energy Program provides PPL customers with rebates for upfront costs associated with installing solar photovoltaic or ground source heat pumps at their home or facility. The Program is currently closed to new applicants. A survey instrument was tailored to the Program offerings to assess free ridership and spillover. The Program had 18 participants in PY3. Only two participants responded; both were ground source heat pump rebate recipients. Due to the low response rate, the PPL Program Evaluator was unable to estimate a NTGR for the Program.

B.3.1.7 HVAC Tune-Up Program

PPL offers HVAC tune-up services to its small C&I customers who have existing split or packaged roof-top units. The incentive is paid to contractors that perform the tune-up using diagnostic tools required by the Program. The PPL Program Evaluator relied on data collected from surveys conducted in PY2 to perform its NTG analysis. It was determined that only one of the surveyed contractors was considered a free rider. This contractor did not participate in the program for PY3. Therefore, the PPL Program Evaluator concluded no free ridership was observed in the Program and the NTGR was thus estimated to be 100%.

B.3.1.8 Home Energy Assessment & Weatherization Program

The Home Energy Assessment & Weatherization Program (HEAWP) is offered to PPL's residential customers residing in single-family homes and provided information on their home's energy performance and recommended energy efficiency actions. The HEAWP offers participants the option of a walk-through survey or a comprehensive home audit. If possible, direct installation of low-cost measures is performed at the time of the audit. Otherwise, the HEAWP offers rebates for specific measures to encourage participants to improve the weatherization of their homes.

For the NTG analysis, the PPL Program Evaluator assumed that it was very unlikely that a customer would pay for an energy audit without the incentive offered through the program. Hence, free ridership was not assessed for the audit portion of the HEAWP. The PPL Program Evaluator instead focused on the potential for free ridership among participants installing recommended measures. Spillover was assessed for both audit and weatherization participants.

To assess free ridership in the weatherization portion of the HEAWP, the PPL Program Evaluator conducted 43 surveys with participants that installed recommended measures based on the home audit. Each surveyed participant's free ridership score was weighted by his or her energy savings to determine a savings-weighted free ridership score for the weatherization portion of the program. The free ridership score was calculated at 18%.

Spillover was assessed by calculating the savings resulting from additional measures installed by participants that were influenced by the HEAWP but did not receive a rebate. The energy savings per respondent was summed and divided by the total sampled energy savings of the HEAWP to determine a spillover ratio of 0.7%. Based on the spillover and free ridership scores, the NTGR for the HEAWP was estimated to be 83%.

B.3.1.9 Low-Income Energy Efficiency Program

The PPL Program Evaluator did not complete a NTG analysis for the Low-Income Energy Efficiency Program. This was due to the industry assumption that free ridership and spillover do not occur in low-income programs.

B.4 FirstEnergy Companies (Met-Ed, Penelec, and Penn Power)[86]

B.4.1 Methodology Summary

For residential programs, ADM (the FirstEnergy Program Evaluator) developed a survey instrument template that was tailored for each EE&C program. The intention of the survey was to gather feedback from program participants regarding a participant's intention to procure the rebated measure(s) outside of the program and gauge the level of influence the program had on the participant's decision. A free ridership rate was calculated for each measure category for each participant. Individual scores were then weighted to account for disproportionate sampling, non-response, and differential energy savings. 'Unlike' spillover was evaluated at the customer level, and was expressed as a percentage of program gross energy savings. A spillover rate was calculated for each participant surveyed by dividing spillover savings attributable to the program by the participant's total program gross energy savings. Individual scores were then weighted to account for disproportionate sampling, nonresponse, and differential program energy savings.

C&I programs followed a similar methodology to arrive at NTGRs. The decision-maker survey included a series of questions to assess the program's influence on the installation of energy-saving measures rebated through the program as well as to assess additional energy-saving actions taken by customers and the program's influence on these actions. A free ridership rate was calculated for each measure category for each participant. Individual scores were then weighted to account for disproportionate sampling, non-response, and differential energy savings.

A NTG study was not conducted for the following programs:

- Residential Behavioral Modification and Education Program;
- Residential Multiple Family Program; and
- Residential Low-Income (WARM) Programs.

The Residential Behavioral Modification and Education Program was launched in PY4, and NTG research is expected to begin once the program begins reporting savings impacts. There was no participation in the Residential Multiple Family Program in PY3 so NTG research was not conducted. No NTG research has been recommended by the SWE for the Residential Low-Income (WARM) program because it is generally accepted that free ridership or spillover in low-income programs is not prevalent.

[86] West Penn Power did not conduct NTG research in PY3 because of the transitional from the legacy program design to the FirstEnergy program model.

B.4.1.1 Residential Appliance Turn-In Program

The Residential Appliance Turn-In Program offers customers a cash incentive and removal of the old inefficient refrigerators, freezers and room air-conditioners at no cost to the participant. The decision-maker survey used a sequential approach asking program participants about the actions they would have taken if the program services had not been offered. This method walks survey respondents through their decision process with the objective of helping them recall the program's impact upon all aspects of project decision-making. A free ridership rate was calculated for each measure category for each participant.

The FirstEnergy Program Evaluator also collected data to calculate unlike spillover for this Program. The FirstEnergy Program Evaluator did not quantify spillover because the Program's design and implementation is not structured to induce additional non-program saving and, based on a review of the survey data, any potential spillover effects were considered minimal. Additionally, NTG studies of appliance recycling programs in other jurisdictions have shown spillover attributed to this type of program to be one to two percent.

B.4.1.2 Residential Energy Efficiency HVAC Program

The Residential Energy Efficiency HVAC Program provides financial incentives to customers and support to retailers that sell high efficiency heating and cooling systems. Free ridership was evaluated at the measure category level for each participant surveyed for the Program. A free ridership rate was calculated for each measure category for each participant. After calculation of a preliminary free ridership score, an adjustment was made to account for various channels through which the program may have influenced the participant. A downward adjustment to the free ridership score was made for participants who stated that any previous participation in FirstEnergy programs was influential in their decision to install the energy efficient equipment.

To quantify spillover savings, the FirstEnergy Program Evaluator referred to a variety of sources including the TRM and DEER. Unlike spillover was evaluated at the customer level, and expressed as a percentage of program gross energy savings. A spillover rate was calculated for each surveyed participant by dividing spillover savings (savings attributable to the program) by the participant's total program gross energy savings. Individual scores were then weighted to account for disproportionate sampling, nonresponse, and differential program energy savings.

B.4.1.3 Residential Energy Efficiency Products Program

The Residential Energy Efficiency Products Program provides financial incentives to customers and support to retailers that sell energy-efficient products such as ENERGY STAR® qualified appliances or CFLs. The NTG methodology for this program was the same as the Residential Energy Efficiency HVAC Program.

B.4.1.4 Residential Home Energy Audits and Outreach Program

The Residential Home Energy Audits and Outreach Program offers participants an audit of their homes to identify energy savings opportunities and provides direct installation of basic low-cost measures. The customer decision-maker survey included a series of questions to quantitatively assess the Program's influence on the installation of energy-saving measures received or rebated through the program. In addition, the survey included a series of questions to assess additional energy-saving actions taken by customers since participating in the program and the extent of the program's influence on these actions. Energy savings values from the TRM and DEER were applied to these additional measures to calculate the spillover rate for the Program.

B.4.1.5 Small and Large Commercial & Industrial (C&I) Equipment Programs

There are two distinct components to the C&I Equipment Programs. The equipment component of the Programs provides rebates for the implementation of cost effective, high efficiency lighting, HVAC, motor and custom measures. The energy audit and technical assessment component provides participants with technical assistance on how they can save energy in their facility, a list of auditors, and funds CFL installations.

NTG analysis was conducted for the Small and Large C&I Equipment Programs as a program group. The FirstEnergy Program Evaluator conducted a customer decision-maker survey that included a series of questions to quantitatively assess the Programs' influence on the installation of energy-saving measures rebated through the Programs. More specifically, this survey used a sequential approach asking program participants about the actions they would have taken if the program services had not been offered. This approach addresses program influence on project timing, end-use quantity, and efficiency levels while explicitly recognizing that the cost of energy-efficient equipment can be a barrier to installation absent energy efficiency programs. This method walks survey respondents through their decision process with the objective of helping them recall the program's influence upon all aspects of project decision-making. A free ridership rate was ultimately calculated for each measure category for each participant. Individual scores were then weighted to account for disproportionate sampling, nonresponse, and differential energy savings.

In addition, the survey included a series of questions to assess additional "like" energy-saving actions taken by customers since participating in the Programs and the extent of the Programs' influence on these actions. The questions addressed recent purchases (since program participation) of any additional energy-efficient equipment of the same type as those they had implemented through the Programs, but were purchased without any technical or financial assistance from the utility. A like spillover estimate is computed based on how much more of the same energy-efficient equipment the participant installed outside the Programs and did so because of their positive experience with the Programs.

Participant spillover was evaluated at the measure category level, and expressed as a percentage of program gross energy savings. A spillover rate was calculated for each participant surveyed by dividing spillover savings attributable to the Programs by the participant's gross energy savings for each measure category. Individual scores were then weighted to account for disproportionate sampling, nonresponse, and differential program energy savings.

B.4.1.6 Non-Profit and Remaining Governmental/Non-Profit Programs

The FirstEnergy Program Evaluator used for these Programs the same NTG methodology as it used for the C&I Equipment Programs.

Appendix C Process Evaluation Summaries

A Process evaluation identifies an EE&C program's objectives and goals, and assesses how the program's design and operation are effectively meeting those objectives and goals. This evaluation allows program managers to identify and understand different strengths and weaknesses that are affecting the program's success. Based on feedback collected during a process evaluation, changes to a program may range from minor to major to ensure the program is on the correct track to achieve its intended results.

This Appendix summarizes the process evaluations conducted by the EDCs' respective program evaluators in PY3 and SWE recommendations resulting from the evaluations and the SWE's audit activities.

C.1 Duquesne

C.1.1 Methodology Summary

The process evaluation conducted by Navigant (the Duquesne Program Evaluator) involved a multifaceted approach of data review and interviews. Process evaluation methodologies were developed for residential, commercial, and industrial programs; however, the approaches varied little between programs.

For residential programs, the Duquesne Program Evaluator conducted the following activities:

- Review of the 2011 TRM;
- Interviews with Duquesne program staff;
- Analysis of results based on selected questions included in the program participant surveys conducted during verification activities; and
- Review of program performance as reported in Duquesne's PMRS tracking system, including review of the tracking system itself.

For commercial and industrial programs, the Duquesne Program Evaluator's process evaluation approach was very similar and reported the following activities:

- Review of the 2011 TRM;
- Interviews with Duquesne program staff; and
- Review of program performance as reported in Duquesne's PMRS (DSM Tracking) system, including review of the tracking system.

The Duquesne Program Evaluator did not provide a description of the survey instrument, how the survey was assessed, or specifics on which sub-programs responded to the surveys.

Process evaluation findings were fairly brief for each program, especially for residential programs. Findings encompassed multiple areas but at a minimum included program performance with regard to savings targets, customer satisfaction and participation, and recommendations. In most instances, findings were presented in key bullet points. A summary of these findings by EE&C program is provided below.

Process evaluation findings were fairly brief for each program, especially for residential programs. Findings encompassed multiple areas but at a minimum included program performance with regard to savings targets, customer satisfaction and participation, and recommendations. In most instances, findings were presented in key bullet points. A summary of these findings by EE&C program is provided below.

C.1.2 Program-level Summaries

C.1.2.1 Residential Appliance Recycling Program

The Residential Appliance Recycling Program (RARP) provides service to collect and retire a single or multiple operational refrigerators or freezers from Duquesne customers. The Duquesne Program Evaluator reported that the RARP is very successful and exceeding its savings goals. Thirty-four percent of participants learned of the RARP via bill inserts while 20% reported learning of the RARP from other participants. Surveyed participants indicated a very strong likelihood to recommend the RARP to others. Participants also indicated that the primary reason for choosing the program was to remove their appliance. Other program drivers were the incentive offered and the convenience of home pick up. The RARP also received additional publicity after the oldest appliance recycled through the RARP was collected in Duquesne's territory.

C.1.2.2 School Energy Pledge

The School Energy Pledge (SEP) program includes the distribution of a kit of energy efficiency measures to families. The Duquesne Program Evaluator reported that the SEP was exceeding its savings goals and received very high satisfaction from customers. Moreover, 33% of SEP participants indicated they had recommended the program to others. These results are encouraging considering the SEP ended its call center recruitment due to resource constraints. The Duquesne Program Evaluator also recommended that the cost effectiveness of including furnace whistles in the SEP's kits be assessed. Currently, furnace whistles are still included in the SEP efficiency kits.

C.1.2.3 Residential Energy Efficiency Program

The Residential Energy Efficiency Program (REEP) is comprised of three distinct program offerings to Duquesne customers – rebates, kits, and an Upstream Lighting program. The Duquesne Program Evaluator reported that the REEP was exceeding its savings goals. The savings were being driven primarily by the Upstream Lighting program. It was also noted that the realization rate for the REEP's kit component had slightly increased from the previous year's evaluation. REEP participants were described as highly satisfied with the program with a high likelihood to recommend both the kits and rebates components to others. The Upstream Lighting program process evaluation did not involve participant surveys, therefore, it was assumed that feedback for this component is very limited. Thirty percent of participants learned of the REEP online and 22% reported learning of the REEP through a retail store. Duquesne has worked with retailers to increase in-store promotions for the Upstream Lighting program. Additionally, the Duquesne Program Evaluator previously recommended not including furnace whistles in the kits component, however, this recommended change was not implemented in PY3. However, furnace whistles will not be included in efficiency kits for Phase 2 of Act 129.

C.1.2.4 Residential Low-Income Energy Efficiency Program

The Residential Low-Income Energy Efficiency Program (LIEEP) included the same offerings of each Duquesne residential energy efficiency program targeted at the low-income population – LI REEP (rebates and kits), LI SEP, and LI RARP. The process evaluation concluded that the LIEEP was quite successful and exceeding its savings goals. The LIEEP's CSP has actively performed outreach for the program and is working with retailers to offer further incentives to the LIEEP's participants in the form of discounted measures. Forty percent of LI REEP customers reported learning of the program through a retail store. LI REEP-kits participant responses reported a very high level of satisfaction with the program, and both LI REEP-kits and LI REEP-rebates participants indicated a high likelihood to recommend the program to others. Thirty percent of LI RARP customers reported learning of the program through others – 15% from online, and 15% from the newspaper. Similar to the RARP program, LI RARP customers reported the main driver for choosing the program was to remove an old appliance followed by the incentive. LI RARP customers indicated a very high likelihood to recommend the program to others. Feedback for LI SEP was not reported.

C.1.2.5 Commercial Program Group

Duquesne's Commercial Program Group contains five sector-specific EE&C programs as well as an umbrella EE&C program that targets smaller commercial market segments. The results of the process evaluation for the Commercial Program Group were more in depth than those presented for the residential programs because they provided greater detail on a wider range of issues.

Satisfaction for the programs comprising the Group overall was not reported. However, specific participant feedback was provided and included reducing required paperwork to partake in the programs, reducing the rebate lead time, and developing better approaches to pair a given rebate check to a given measure.

The Duquesne Program Evaluator reviewed Duquesne's initial staffing plans for all its EE&C programs and noted that the programs are operating with fewer staff than initially planned. However, Duquesne reported that all administrative and program requirements are being met at the current staffing level. The Duquesne Program Evaluator recommended monitoring staffing needs moving forward and to consider additions if gaps are identified. The Duquesne Program Evaluator also recommended an annual review to assess staffing needs in addition to program assessments.

In regard to market sector definitions for the Commercial Program Group, the Duquesne Program Evaluator identified concerns for how the programs approached customers that operate multiple facilities that do not fall within a single sector. While the current approach that assigns a customer to a specific CSP has functioned well, there is question if there are missed opportunities by not allowing CSPs to coordinate efforts for a single customer. The Duquesne Program Evaluator recommended this topic be further investigated to determine the frequency of such overlap.

It was also noted that, while Duquesne account executives typically have the best knowledge on specific customers and their facilities, there has been a timing issue to connect the account executives and their knowledge to CSPs working with customers. Duquesne is currently working on an internal reorganization that will require account executives to play a larger role in Duquesne's EE&C programs.

Additional recommendations included enacting a pilot program to implementing a "neighborhood blitz" to target small businesses, updating participant data from SIC codes to NAISC codes, and continuing to push for consistent documentation of all projects noting locations of installed measures in facilities.

C.1.2.6 Industrial Program Group Programs

The Industrial Program Group is organized in a similar manner to the Commercial Program Group Programs in that three market sectors are specifically targeted while all remaining industrial market sectors are included in an umbrella program. Results from Group's process evaluation were fairly limited. It was noted that account executives may be able to play a strong role in promoting CSP-proposed improvements in context with other customer needs. Recommendations for this Group were similar to those for the Commercial Program Group.

C.1.2.7 PMRS Tracking System

The Duquesne Program Evaluator evaluated Duquesne's PMRS tracking system with regard to the Commercial and Industrial Program Groups. The system stores all of Duquesne's program data and tracks each program's progress. The following recommendations were made in the PY3 evaluation to improve the functionality of PMRS system.

- Allow project corrections to be made by Duquesne staff in addition to the PMRS system administrator. This allows quicker, more efficient project updates while maintaining data integrity.
- An auto-upload capability is being developed to streamline project data uploads. There are concerns with this protocol and Duquesne is moving carefully to ensure data integrity is maintained.
- IT support is managed by a non-local system administrator, however, Duquesne has designated IT staff to provide back up support if needed.
- A SharePoint site was developed for CSPs to deliver project information for review before being submitted to the PMRS system. This has replaced the previous protocol of submitting project information via email with no central depository.

Develop automated error-checking system to maintain data integrity among project files as well as a pre-defined PMRS reports

C.2 PECO

C.2.1 Methodology Summary

The process evaluation conducted by Navigant (the PECO Program Evaluator) involved surveys and interviews with program participants and program staff, and in some instances, program contractors were also interviewed. The interview and survey efforts sometimes occurred during different program years. In addition, the PECO Program Evaluator also performed reviews of key program documentation and/or site visits as part of its process evaluation efforts for some programs. The depth of presentation of questions asked and feedback provided by the PECO Program Evaluator in PECO's PY3 Annual Report varied among programs, but generally included program performance with regard to savings targets, customer satisfaction, participation, and recommendations. Process evaluation analyses were not complete for all of PECO's programs at the time PECO's PY3 Annual Report was submitted. A summary of the process evaluation findings by program is provided below.

C.2.2 Program-level Summaries

C.2.2.1 Smart Lighting Discounts Program

The Smart Lighting Discounts Program saw a dramatic drop in participation in PY3 due to strategic program changes. As a result, the PECO Program Evaluator conducted a phone survey with the general population rather than Program participants to gather information regarding customer relations with CFLs, such as satisfaction, familiarity, knowledge of substitute products, reasoning for purchasing CFLs, etc. The PECO Program Evaluator also conducted interviews with key Program staff at PECO as well as with the Program CSP.

Results from the general population survey indicated that the vast majority of PECO customers are aware of CFLs and had become aware of CFLs due to in-store marketing, television advertisements, and by word of mouth. The PECO Program Evaluator concluded that these findings support the strategy for marketing and outreach campaigns on CFLs and their benefits compared to incandescent bulbs. A large majority (82%) of surveyed customers indicated they had CFLs currently installed in their homes. Participant reasoning for installing CFLs included energy and cost savings as well as the longevity of CFLs compared to incandescent bulbs. However, the same proportion of customers only reported a general level of satisfaction with CFLs, which was similar to feedback provided by customers in PY2.

In regard to CFL substitutes, the survey indicated that a little over half of customers were familiar with the concept that LEDs could be used in standard lighting sockets. Only 29% of surveyed customers claimed to currently have LEDs installed in their homes. The reasoning for using LEDs was similar to the reasoning given for CFLs, however, some customers also noted that LEDs have better lighting quality than other bulbs. Approximately 37% of surveyed customers indicated an awareness of energy efficient incandescent bulbs, although less than 20% of these customers claimed to have installed high efficient incandescent bulbs in their home.

Interviews of Program staff revealed that customers' questions were transitioning from the energy savings of CFLs to concerns regarding the mercury in CFLs and questions about LEDs and the Energy Independence and Security Act (EISA). This demonstrates that customers are increasingly educated not only about CFLs but about the lighting market. With regard to CFL substitutes, staff interview responses stated that some customers were switching from CFLs to high efficiency incandescent bulbs. The staff interviews indicated that this switch to incandescent bulbs was partially due to customer concerns regarding the role of EISA in regulating lighting efficiencies. Lastly, the PECO Program Evaluator reported that 86% of customers claimed to be satisfied or very satisfied with PECO overall.

C.2.2.2 Smart Appliance Recycling Program

For the Smart Appliance Recycling Program, the PECO Program Evaluator focused the process evaluation on customer awareness and marketing, reasons for participation, and satisfaction. The Program provides services and an incentive to customers who elect to have a refrigerator, freezer, or window air conditioner removed from their home. Data were collected via telephone surveys; however, at the time of the PECO PY3 Annual Report submission, the final analysis was still being completed by the PECO Program Evaluator. The preliminary results of the process evaluation are presented below.

Program awareness was primarily achieved through marketing efforts including bill inserts, retailers, the PECO website, and newspaper advertisements. However, the PECO Program Evaluator noted that 22% of survey respondents indicated they learned of the Program through word-of-mouth. The PECO Program Evaluator interpreted this as a sign that the Program is maturing and is on course to be able to meet its goals with fewer marketing efforts.

Surveyed customers were asked to explain their reasoning for participating in the Program. Three responses that each carried nearly equal weight among participants were the incentive provided by PECO, the convenience of home pick-up, and the environmental benefits. This marked a change in customer motivation from PY2, for which the incentive was the dominant reason for participating in the Program. The PECO Program Evaluator believed the incentive was no longer the primary driver for program participation due to the reduced incentive level being offered in PY3.

Overall satisfaction with the Program was very high; 71% of responses ranked their satisfaction with the program at 10 out of 10. The PECO Program Evaluator indicated the Program was well administered and that survey participants reported high satisfaction with the sign-up process, convenience of appliance pick-up time, and the time to receive the incentive payment. Ninety-four percent of survey participants were satisfied with the appliance pick-up crew; 80% of responses to this question provided a satisfaction of 10 out of 10. Lastly, 75% of respondents reported being very satisfied with the incentive amount. However, a smaller proportion of customers reported being either neutral or dissatisfied with the incentive amount. The PECO Program Evaluator noted that the overall level of satisfaction with the incentive is lower than the previous year due to the reduced payment.

C.2.2.3 Smart Home Rebates Program

The Smart Home Rebates Program process evaluation was conducted through a review of program plans and documentation as well as through Computer-Aided Telephone Interview (CATI) survey calls with Program participants, survey interviews with participant and non-participant retailers and contractors, and in-depth interviews with PECO Program staff and the CSP's Program implementers. A total of 200 Program participants were reached for the CATI surveys while two Program staff members and 11 trade allies received in-depth interviews. All interviews and surveys were conducted between May and October of 2012.

Results from the surveys and interviews indicated that the Program is effective and well run. Installation rates were high among participants and participant satisfaction was also high, which is in line with previous EE&C program years. The PECO Program Evaluator stated that Program awareness was achieved a variety of ways; awareness from retailer store staff had increased significantly from PY2, but awareness from installation contractors had dramatically decreased since PY2.

Additionally, the PECO Program Evaluator noted a difficulty in obtaining contact information for trade allies from the CSP. Contact information was not provided in a timely manner, which consequently made evaluation of the Program problematic. The PECO Program Evaluator suggested that updated contact information would allow for more effective management of outreach to trade allies while also facilitating future evaluation efforts.

C.2.2.4 Low-Income Energy Efficiency Program

The process evaluation for the Low-Income Energy Efficiency Program included in-depth interviews, on-site visits, and participant surveys. These efforts occurred over multiple EE&C program years. The in-depth interviews were completed in PY1 and PY3 and were conducted with Program staff and weatherization contractors. The participant surveys occurred in PY4.

The in-depth interviews indicated that the program was running smoothly and that the CSP was meeting its target each quarter. The major concern noted from the interviews was how best to operate the Program in a complimentary manner with other state and federal weatherization programs, especially given the surge in funding and Program applicants caused by ARRA funding. The PECO Program Evaluator noted that PECO may need to explore new ways to work with other weatherization agencies.

On-site visits were completed at 23 sites to assess measure persistence and to identify any additional participant spillover, i.e., additional energy saving actions taken by the program participant. The PECO Program Evaluator focused on customers that received major measures or services such as a new refrigerator or blower door test. The PECO Program Evaluator found that the majority of measures installed at the time of the audit were still in place.

Customer surveys were administered to 118 participants to assess overall program satisfaction, measure installation rates, and assess additional energy efficiency actions taken. Satisfaction for the program ranked highly with an overall score of 9.1 out of 10. Installation rates were very high, especially for CFLs. Energy saving actions taken by participants included several behavioral efforts including turning off lights and reducing the use of appliances. However, only 5% of surveyed customers indicated they purchased additional energy efficiency measures. The PECO Program Evaluator stated this is not unexpected given that these are low-income customers. Overall, 52% of the surveyed participants had taken some form of energy saving action as a result of their participation in the Low-Income Energy Efficiency program. The PECO Program Evaluator asserted that these findings suggest that the program is creating longer term changes to participant behavior regarding energy usage.

C.2.2.5 Smart Equipment Incentives: Commercial & Industrial (C&I) and Government, Educational, and Non-Profit (GNP) Programs

The process evaluation for the Smart Equipment Incentives for C&I and GNP customers was conducted jointly. Data was gathered through primary research activities including program documentation review, in-depth phone interviews with PECO program staff and the CSP, KEMA, and Computer-Aided Telephone Interview (CATI) survey calls with program contractors, program participants and program wait-listed participants. The PECO Program Evaluator conducted a total of six in-depth interviews, 30 contractor surveys, and 18 wait list participant surveys. The PECO Program Evaluator completed 35 participant surveys with C&I customers and 43 participant surveys with GNP customers. All interviews and surveys were conducted between May – October of 2012. Unless noted, the results below reflect findings for both C&I and GNP customers. At the time of the report submission, analysis and results for some surveys were not yet complete.

Results from the in-depth interviews indicated that marketing efforts in PY3 shifted from an incentive-based marketing strategy to a customer education strategy. Both PECO and KEMA began to increase efforts to enter the customer decision-making process at an earlier stage in order to reduce free ridership within the program. Additionally, the interviews revealed that participating contractors were more dissatisfied with the wait list than the actual customers. Contractors use the program as a sales tool, and in some instances, contractors had hired additional staff to sell the program to customers. The CATI contractor survey also focused on the impact of the wait list; however, results from the survey were not included in the report. One additional finding for the GNP customer program was that PECO was considering increasing incentive payments by approximately 10% in Phase II of the program to sustain and increase GNP customer participation.

Preliminary results from the CATI survey with wait list customers indicated that approximately two thirds of the surveyed customers were dissatisfied with the program primarily due to the shortage of funding and lack of communication from PECO. These customers indicated they would like status updates from PECO. Furthermore, the PECO Program Evaluator claimed that results from the survey illustrated a general confusion among customers regarding the concept of the wait list.

The CATI surveys administered to program participants was delivered to two sample groups representing lighting customers and non-lighting/custom customers. The PECO Program Evaluator developed these stratified samples to determine if there was a significant difference in each customer-type's decision making process. For the process evaluation, the PECO Program Evaluator avoided contacting projects with a contractor as the point of contact, as the PECO Program Evaluator sought to survey the final decision maker which was the program participant. Results from the CATI participant survey were not provided in the report.

C.2.2.6 Smart Construction Incentives Program

PECO's Smart Construction Incentives program encourages energy efficiency to be incorporated into newly constructed facilities or facilities undergoing complete renovation or reconstruction. The evaluation contractor conducted the process evaluation for this program through a combination of program documentation and tracking system review, in-depth interviews with program staff and trade allies, and participant surveys.

Review of program documentation revealed that certain measures offered through the program are in need of updated definitions to reflect new baseline assumptions. Additionally, review of training documentation indicated that there has been very limited training to date. With regard to marketing and outreach, the PECO Program Evaluator found that the materials developed accurately reflect the program and its offerings. Review of the program tracking system found that the system had been updated to track C&I and GNP customers separately and that adjustments to the system had been made to properly reflect total savings. Despite documentation regarding these adjustments, the PECO Program Evaluator noted that these adjustments made program data analysis more difficult. Also, some inconsistencies regarding how measures were tracked were also noted. The PECO Program Evaluator found that some project documentation lacked clarity and required reaching out to the program implementer to understand the rationale for selecting certain baselines or other impact parameters. It was recommended that file organization and documentation be improved to avoid this confusion in the future.

In-depth program staff interviews indicated that both PECO staff and the CSP, KEMA, were able to work closely and effectively together on the program. Little feedback was available regarding outreach and marketing as these efforts were suspended after the program instituted a wait list. Therefore, it was reported the program had not reached out to the design community as much as was initially anticipated. This is also reflected in responses from some trade allies who did not seem to distinguish the Smart Construction Incentives program from other PECO programs. However, general satisfaction responses from trade allies as well as from the participant surveys indicated a high level of program satisfaction.

C.3 PPL

C.3.1 Methodology Summary

The process evaluation conducted by the Cadmus Group (the PPL Program Evaluator) involved surveys and interviews conducted in PY3 with program participants, program staff and trade allies as well as secondary research. It was noted that this process evaluation for PY3 was more narrowly focused and more forward looking than those evaluations conducted in PY1 and PY2. The reason for this shift in scope was to address the need to plan for the Phase II energy efficiency program cycle. An overall process evaluation of PPL's portfolio was completed that assessed savings achieved by programs relative to PPL's targets, feedback from program participants as well as participant decision-making drivers, effectiveness of marketing and outreach efforts, and design and delivery of PPL programs. In addition to the portfolio assessment, the PPL Program Evaluator performed process evaluations tailored to each program and reported findings and recommendations relative to each.

The PPL Program Evaluator reported that PPL's EE&C programs are well on track to exceed its 2013 compliance target for energy savings. Demand savings, however, may be more challenging to meet, as PPL has achieved less than half of its compliance target. However, demand response programs will begin to claim savings beginning in PY4. Participant feedback indicated that satisfaction is high across all programs with 80% of responses rating 8 or higher out of a scale of 1 to 10. Additionally, satisfaction has improved for certain PPL programs since PY1. Surveyed participants also indicated high satisfaction with PPL and responses suggested that PPL's programs may have improved customer opinions of PPL. Based on these findings, the PPL Program Evaluator recommended that PPL continue to focus on customer satisfaction as it moves into Phase II by keeping program incentives consistent, considering outreach strategies to keep customers and other stakeholders informed of program status, and continuing high-quality program operations.

The PPL Program Evaluator also noted PPL's success with its marketing and outreach efforts. PPL's market research was reported to have resulted in successful customer segmentation and subsequent target marketing efforts. Retail partners also played a large role in promoting residential programs resulting in dramatic increases in customer awareness of PPL's residential programs. The process evaluation also explained that program participants were primarily motivated by cost savings opportunities; however, other motives such as the replacement of old equipment and increased comfort were also drivers for program participation. Lastly, program design and delivery was noted to be performing very well, although, some programs encountered either technical difficulties or other challenges in meeting savings goals. The PPL Program Evaluator reported that PPL was aware of these issues and immediately addressed them to rectify the situation.

The following section expands on the process evaluation conducted for each individual program.

C.3.2 Program-level Summaries

C.3.2.1 Residential Lighting Program

For PPL's Residential Lighting Program (RLP), the PPL Program Evaluator conducted 265 telephone surveys with residential customers, 11 lighting manufacturer interviews, held discussions with program staff, and reviewed program materials and reports. PPL increased its own four-year savings and participation target in PY3 due to the success of the program.

The PPL Program Evaluator reported that its telephone surveys showed that awareness of new lighting standards was moderate and that additional education regarding compliant lighting may benefit customers. Approximately half of surveyed customers indicated they were aware that the Energy Independence and Security Act of 2007 (EISA) would mandate new efficiency standards for most light bulbs. However, manufacturers that were interviewed stated that even these customers were often confused or had received misinformation regarding EISA. Additional education would help alleviate this confusion; about one third of surveyed respondents felt PPL should provide this education. Additionally, manufacturers believed offering incentives for additional bulb options would be crucial as more types of incandescent bulbs are phased out by EISA. The PPL Program Evaluator recommended that education efforts be increased through PPL's ePower website, manufacturer and retailer partners and at CFL give-away events.

Survey responses indicated that most of PPL's customers are aware of CFLs and there is mostly one installed per home. Awareness of specialty CFLs was much lower, but was on an upward trend, and LEDs had an even lower level of awareness and likelihood to be installed in customers' homes. This was consistent with manufacturers' assessments, which stated that LEDs would not likely gain a significant market share until 2015. Based on this feedback, the evaluation contractor recommended that standard CFL incentives be reduced, that PPL should continue to educate customers on specialty CFLs and that PPL should ramp up promotion of LEDs as more LED options come available and prices fall.

Lastly, the PPL Program Evaluator noted that, while PPL customers have an above-average awareness of CFL recycling, additional education is still needed on this topic. Nearly half of surveyed customers indicated they had disposed of CFLs using their normal waste stream while less than one third of respondents indicated disposing of CFLs at proper recycling centers or retail stores. Furthermore, the survey responses revealed that a majority of customers were not aware of CFL disposal issues. The PPL Program Evaluator recommended that the informational campaign regarding CFL disposal be expanded at participating retailers, at CFL give-away events and on the ePower website.

C.3.2.2 Appliance Recycling Program (ARP)

The process evaluation revealed a consistent downward trend of participation during the winter months in PY1, PY2 and PY3. The PPL Program Evaluator stated that this observation was also seen with other utilities' appliance recycling programs. The PPL Program Evaluator recommended evaluating the cost effectiveness of increasing marketing efforts during these low participation months, as it was observed that marketing efforts also dropped off during this period.

The PPL Program Evaluator assessed the two data tracking systems used for the ARP. PPL's EEMIS tracking system was compared to the system used by the program operator, JACO. The PPL Program Evaluator found 389 units, or 2.6% of total units, had not been uploaded from the JACO database to the EEMIS database. A similar issue occurred in PY1. Due to these issues, the PPL Program Evaluator recommended that PPL develop a routine QA/QC process to prevent and/or identify any data transfer issues.

Lastly, in PY3 PPL began tracking the rate for which ARP participants replaced their recycled refrigerator or freezer. This tracking was conducted during the sign-up process for the ARP. The PPL Program Evaluator included questions regarding replacement in its process evaluation survey and found that approximately 70% of participants reported replacing their recycled appliance as opposed to the 15% of participants that reported during the sign up process that they would replace their appliance. This resulted in a significant change in gross verified savings for the program, and the PPL Program Evaluator recommended using the replacement factor from PY3 for future planning.

C.3.2.3 Efficient Equipment Incentive Program

The Efficient Equipment Program (EEIP) is PPL's largest program within its energy efficiency portfolio and offers a range of prescriptive measures for multiple sectors. PPL implemented several changes to the EEIP in PY3 to increase savings and participation while improving its cost-effectiveness. These changes included adding a direct discount delivery channel option targeted to small commercial customers for lighting and refrigeration, implementation of limited time offers, discontinuation of some measure rebates while adding some new measures, and adjusting rebate and eligibility requirements. The process evaluation for the EEIP included a total of 268 participant surveys and 184 record reviews. It was reported that the EEIP was on track to meet its planned energy savings.

The addition of the direct discount delivery channel was very successful for the EEIP. The channel proved to be an important and growing source of non-residential lighting savings by boosting participation among the small commercial and industrial sector and accounting for 16% of total lighting savings. Based on findings from the process evaluation, the PPL Program Evaluator believed the direct discount delivery channel could be further leveraged by engaging trade allies and recommended that PPL initiate efforts to do so. Although the direct discount delivery channel was a success, the PPL Program Evaluator reported that the Limited Time Offers was not as successful in impacting program participation. The Limited Time Offers were reported to account for only 4% of small commercial and industrial participation and 3%three percent of participation within the government/non-profit/institutional sector.

Lastly, the PPL Program Evaluator reported that an assessment of the EEIP's EEMIS tracking database was missing several key measure variables used for calculating energy savings. The PPL Program Evaluator recommended that PPL improve its data collection in efforts especially for chillers, high efficient compressors, and insulation.

C.3.2.4 Home Energy Assessment and Weatherization Program

The process evaluation for the Home Energy Assessment and Weatherization Program (HEAWP) included surveys with participants who received audits (71 surveys), participants who completed weatherization upgrades (43 surveys), and a review of program tracking databases. The PPL Program Evaluator reported that the HEAWP, which began in PY2, is not on track to meet its four-year participation targets, based on the number of home surveys and audits conducted. At the end of PY3, the HEAWP had completed only 47% of its participation target. With regard to energy savings, the HEAWP has exceeded its four-year compliance target when the savings from duct sealing and insulation upgrades, which were not part of the audit recommendation, are included. Without the savings from these upgrades, the EEIP has achieved 45% of its target savings.

Based on survey responses, the PPL Program Evaluator found that customers did not need an energy audit to decide whether to install weatherization upgrades. Thus, the audits and home surveys did not contribute significantly to weatherization savings.

The PPL Program Evaluator calculated a 9% conversion rate of audits to installations of recommended measures, which is low in comparison with similar audit and weatherization programs. Reviews of other audit and weatherization programs showed conversion rates ranging from 50%-80%. These higher conversion rates for other programs were directly related to the program design and structure, such as low or no up-front audit costs. To increase PPL's audit and weatherization conversion rate, the PPL Program Evaluator recommended that participants be pre-screened in order to reserve audits for those participants that are more likely to install recommend measures. Additionally, due to cost being a main driver in reducing conversion, the PPL Program Evaluator recommended that PPL offer larger rebates for insulation measures, consider reimbursing customers for the full cost of the audit if upgrades are made, consider limited time offers to encourage past audit participants to reengage in the HEAWP and install recommended measures, and to provide incentives to contractors who sell weatherization measures to audit participants.

C.3.2.5 Energy Efficiency Behavior & Education Program

The Behavior & Education Program (BEP) process evaluation included surveys with program participants who received home energy reports in 2010 and 2011, participants who opted out and non-participants, and interviews with program staff. The PPL Program Evaluator reported that the BEP had exceeded planned savings for PY3. Satisfaction was reported as high or very high for most participants, and some participants indicated an improved opinion in PPL after receiving their home energy reports. However, it was noted that many participants cited privacy concerns and expressed doubt regarding the validity of the neighbor comparisons. The PPL Program Evaluator recommended that PPL increase its education efforts on the neighbor comparison aspect of the BEP to help alleviate these issues.

The process evaluation did indicate that the home energy reports were effective based on responses from participants and non-participants. Participants showed greater likelihood to take energy saving actions such as adjusting thermostats or exploring additional opportunities to increase energy savings when compared to nonparticipants. Additionally, survey responses indicated that the reports made participants more aware of PPL's other programs than nonparticipants. Lastly, PPL Program Evaluator noted that participants that opted out of the BEP constituted a very small percentage of homes receiving home energy reports and should not be considered a concern for the BEP managers.

C.3.2.6 Custom Incentive Program

The evaluation efforts for the Custom Incentive Program (CIP) focused on program impacts and performing QA/QC reviews. The PPL Program Evaluator reported that the CIP is well-positioned to meet its savings compliance target. The CIP completed 65% of its 4-year goal with a very large pipeline of projects. However, the PPL Program Evaluator noted that all of these pipeline projects would need to be completed along with additionally identified projects to meet the compliance target.

A portion of the CIP's funding was reallocated in PY3 to another PPL program to better serve its customers. However, more budget reallocations are being proposed that would transfer other funds into the CIP. Additionally, rebate incentives were reconfigured for the CIP's technical studies.

The PPL Program Evaluator indicated that the CIP had successfully obtained participation from large customers, in part due to PPL's allowance for participants to enter retroactive projects into the CIP. PPL's account managers were also noted for driving strong participation. However, the CIP's net-to-gross ratio is low. The PPL Program Evaluator did not complete a formal net-to-gross analysis for PY3, but it is suggested that the eligibility of retroactive projects in the CIP may be having an adverse impact on the net-to-gross ratio. The PPL Program Evaluator recommended that PPL shift its focus to customers that have not yet completed projects. Additionally, the PPL Program Evaluator recommended that the program rules be amended for Phase II to place stronger restrictions on the eligibility of retroactive projects.

A risk to the CIP's cost effectiveness was identified due to the participation of combined heat and power (CHP) projects. Currently two large CHP projects account for 43% of the CIP's total savings. However, these projects have a small margin for passing the CIP's cost effectiveness test. The PPL Program Evaluator recommended that the procedure of making incentive payments to these projects only after post-installation performance data is received be continued. This will help mitigate risks of these projects negatively impacting the cost effectiveness of the CIP.

Lastly, the PPL Program Evaluator noted that the CIP's large projects have maintained stable realization rates due to strong collaboration between program implementers and Cadmus. However, where collaboration has faltered, the PPL Program Evaluator observed greater variability in realization rates. Therefore, it was recommended that implementers and evaluators continue collaborating on large projects, but not on smaller projects because the increased cost would not be justified due to the low impact on overall program savings by the smaller projects.

C.3.2.7 **E-Power Wise Program**

In its process evaluation of the E-Power Wise Program, the PPL Program Evaluator completed 66 phone surveys, received 361 mail-in surveys, conducted QA/QC reviews of Program records, and conducted discussions with PPL and program staff. The Program was reported to be on track to meet its savings and participation targets.

For PY3, PPL introduced a new direct-mail delivery channel in the fourth quarter that allowed eligible customers to receive energy savings kits. Participant survey responses were favorable for the direct-mail delivery and revealed high satisfaction with the Program. Survey responses also indicated that the direct-mail delivery channel was as effective as the existing agency-based channel in encouraging participants to change their energy behavior and install kit items. When compared to similar programs in other jurisdictions, installation rates were considered high. CFLs and nightlights had the highest installation rates while low-flow aerators and showerheads had the lowest installation rates.

The PPL Program Evaluator did indicate that internal improvements could be made. First, recruitment could be increased if PPL would provide more extensive lists of prequalified customers. Second, QA/QC of the Program's EEMIS tracking system revealed incomplete data in certain instances, particularly with participant contact information. The PPL Program Evaluator recommended that PPL consider expanding the list of prequalified participants and encourage agencies to collect and report complete participant contact information.

C.3.2.8 **HVAC Tune-Up Program**

In its evaluation of the HVAC Tune-up Program, the PPL Program Evaluator conducted a stakeholder interview, reviewed the program survey conducted by PPL and Field Service Diagnostic Instruments

(FDSI), the Program's CSP, and benchmarked the Program against other utility tune-up programs. The Program was reported to be far behind its energy savings compliance targets. To address the Program's low participation, PPL increased the Program's incentive structure to contractors who perform the tune-ups for customers. As a result, the PPL Program Evaluator reported that the Program had achieved 208% of its updated four-year plan demand savings and 63% of energy savings by the end of PY3. However, the PPL Program Evaluator reported that PPL's incentives are similar to or higher than the incentives given in other utilities' tune-up programs. Therefore, the increased incentive values may not be necessary to improve program participation.

Review of the PPL and FDSI survey showed that several contractors reported that use of the diagnostic tool required for the tune-up program was a major challenge due to the cost of the tool and the time needed to use it during the tune-ups. The PPL Program Evaluator recommended exploring alternative diagnostic models that do not require the use of an expensive tool and to consider an approach that pre-qualifies contractors for the program.

C.3.2.9 **C&I Load Curtailment Program**

No formal evaluation activities were taken in PY3 for the C&I Load Curtailment Program. Participant surveys and evaluation efforts will commence in PY4. For PY3, the PPL Program Evaluator conducted an early review which and reported that the Program has recruited sufficient commitments from approximately 350 program participants to meet planned savings in PY4.

C.3.2.10 **Peak Saver Program (Direct Load Control Program)**

The PY3 process evaluation efforts for the Direct Load Control Program included a summary report of its initial start-up process. Reported Program milestones included the program kick-off, enrollment of 35,000 residential and small commercial participants, installation of 43,000 direct load control devices (the plan anticipated installation of approximately 50,000 devices), and installation of measurement and verification metering devices. During the program's first two events, several technical issues occurred resulting in uncomfortable temperature changes in some homes, high call volume that the call center could not handle, and drop out of 930 participants. PPL followed up the first two events with surveys with continuing participants and dropout participants to adjust the Program, correct the technical difficulties previously encountered, and adequately resolve the call center issues. Subsequent events have not experienced the issues observed during the first two events.

Results from the survey indicated that the uncomfortable change in temperature was the driving force for participant dropout, reported as the reasoning for 79% of dropouts. The PPL Program Evaluator recommended testing systems before issuing an event with a sample of participants and setting up additional monitoring and control systems to prevent these issues from occurring in future events.

Another reason for participant dropout was misinformation regarding how the Program would function. Specifically, several participants stated they were told the Program would not create a difference in how their home or facility felt during an event. While this would generally be the case, the technical issues observed in the first two events likely did cause participants to notice a temperature change. Participant survey responses additionally suggested that customers be notified prior to a conservation event, most preferably via email. PPL has already taken steps to address these concerns and suggestions.

C.3.2.11 Renewable Energy Program

For the Renewable Energy Program (REP), evaluation activities involved reviews of 17 program records and two participant surveys. The PPL Program Evaluator recommended the consideration of expanding the rebate for ground source heat pumps (GHSPs) to PPL's Efficient Equipment Incentive Program. Additionally, the PPL Program Evaluator recommended that data tracking efforts for GHSP projects be improved as several key data points were either incorrect or not tracked for GHSP rebates. The PPL Program Evaluator suggested that PPL distinguish which type of GHSP system is installed, request system size data, and record system specific data points for conducting energy savings.

C.4 FirstEnergy Companies (Met-Ed, Penelec, Penn Power)

C.4.1 Methodology Summary

The process evaluation conducted by ADM, the FirstEnergy Program Evaluator, involved surveys and interviews. Process Evaluation methodologies were developed for residential, commercial, and industrial programs, with little variation between programs.

For residential programs, the FirstEnergy Program Evaluator conducted the following activities:

- Program participant surveys;
- Contractor surveys;
- Interviews with program managers and program implementation staff; and
- Interviews with trade allies.

For commercial and industrial programs, the FirstEnergy Program Evaluator's process evaluation approach included the following activities:

- Program participant surveys; and
- Program waitlist surveys.

C.4.2 Program-level Summaries

C.4.2.1 Appliance Turn-In Program

A participant survey was conducted with PY3 program participants in September and October 2012. The survey was designed to capture:

- Customer perceptions and program experiences;
- Overall satisfaction and across multiple program dimensions;
- Awareness and attitudes of energy efficiency and conservation;
- Net-to-gross impact; and
- Preliminary impact findings.

The data collection phase was recently completed and therefore no results were included in any of the PY3 Annual Reports for the FirstEnergy companies.

C.4.2.2 Energy Efficiency HVAC Program

The FirstEnergy Program Evaluator's process evaluation for the Program included the following:

- Program manager in-depth interview;
- Program implementation staff in-depth interviews;
- Participating trade ally contractor interviews; and
- Participant surveys.

The Program saw a slight reduction in program participation in PY3. Fifty-three percent of surveyed participants indicated that they received additional funding outside of what was provided by the Program. Both participants and contractors are highly satisfied overall with their applicable EDC and EDC Program. Overall, from the contractors' perspectives, the Program is meeting and occasionally exceeding expectations.

Contractors regularly discuss opportunities for increased energy efficiency with their customers and surveyed customers also reported that their contractors taught them how to maintain the equipment that was installed. The consensus from the contractor in-depth interviews was that they face challenges selling high efficiency equipment to their customers, primarily due to the current group of rebates not sufficiently reducing the incremental costs of moving from a 13 SEER to a 14.5+ SEER central air conditioner or heat pump.

C.4.2.3 Energy Efficiency Products Program

A participant survey was conducted with PY3 program participants in September and October 2012. The survey was designed to capture:

- Customer perceptions and program experiences;
- Overall satisfaction and across multiple program dimensions;
- Awareness and attitudes of energy efficiency and conservation;
- Net-to-gross; and
- Preliminary impact findings.

Since the data collection phase was recently completed, there are no results included in the FirstEnergy companies' respective PY3 Annual Reports. In order to achieve a 90% confidence with ± 10% level of precision in the results, approximately 70 completed surveys were attempted for each measure type (refrigerator, clothes washer, dehumidifier, room air conditioner, and heat pump water heater) rebated through the program, per EDC. The FirstEnergy Program Evaluator drew a random sample at the customer level after aggregating records by account numbers, which helped ensure that the measure mix for each replicate is similar to that of the overall sample frame. During the analysis phase, weight ratios will be applied to the data so that the analyses are reflective of the population.

C.4.2.4 New Construction Program

The FirstEnergy Program Evaluator conducted interviews with the EDCs' EE&C program staff. Following the interviews, the FirstEnergy Program Evaluator drafted a program logic model to as a visual representation for the program processes (subject to periodic review and update).

In real-time evaluations, there is also a strong component of "process feedback" that may result from impact evaluation activities. For example, the FirstEnergy Program Evaluator communicated the nature of the discrepancy related to the modeling of ground source heat pumps to the CSP. After a web-based meeting with the FirstEnergy Program Evaluator and CSP staff, the CSP developed a three-fold effort to remedy this potential issue. It appears that, in PY3, the occurrences of these errors were somewhat lower, though the problem has not been eliminated completely.

C.4.2.5 Home Energy Audits and Outreach Program

The process evaluation effort for PY3 included program participant surveys and contractor surveys. The objective was to investigate key process-related questions such as source of awareness, program satisfaction, and barriers to making energy efficiency improvements. Data collection for this effort has concluded and analysis is currently underway, therefore, process related results were not available.

C.4.2.6 Residential Behavioral Modification and Education Program

This program officially launched in PY4 and will be evaluated in PY4.

C.4.2.7 Residential Multiple Family Program

This program had no participation in PY3.

C.4.2.8 Low-Income (WARM) Programs

The FirstEnergy Program Evaluator completed a process evaluation for the residential Low-Income (WARM) Program in PY2. Given there were no significant issues identified through this process evaluation, and no change in program delivery in PY3, process evaluation activities were not included in the PY3 evaluation scope.

C.4.2.9 Small and Large C&I Equipment Programs

The FirstEnergy Program Evaluator conducted a telephone survey of C&I Equipment Program participants in PY3Q1, Q2 and Q3. The FirstEnergy Program Evaluator also attempted to contact all customers who had been placed on the wait list. All customers sampled for the study were sent an advance letter explaining the purpose of the phone call. Sampling was done to achieve a confidence level of 90 with ±10% level of precision.

Project measures were aggregated to the participant site level for a comprehensive view of the projects completed for each site. The initial sample frame included 1,030 records for PY3, representing 928 unique sites. Non-standard lighting projects were the most common projects, followed by standard lighting projects. Custom projects, HVAC, motors and drives, and specialty equipment account for less than 100 projects total across all three FirstEnergy companies. The sample was stratified by the equipment types within each EDC. Participants that performed projects at more than one site were flagged and subsequently contacted by experienced interviewers with methods developed to address the projects at all of the participant's sites without overburdening the respondent.

Key findings noted during the process evaluation activities included the following.

- Customers were most likely to hear about the Program from a contractor (approximately 44% noted this as the main source of program information).
- Nearly one-third of customers reported some challenges during participation in the Program. The challenges focused around the rebate application process. In particular, the application forms were difficult to understand and required detailed information.
- Wait list customers are receiving infrequent Program updates, if any. Only two-thirds of wait list customers have received updates on the status of the Program.
- Almost half of customers on the wait list have already moved forward with their projects. Thirty percent of wait list customers have already completed their projects and another 12% have started the project, but decided to complete in phases.

Satisfaction with the Program was generally high for those who completed projects. Seventy-seven percent of participants rated their overall satisfaction as very satisfied or somewhat satisfied compared to 57% of wait list customers giving the program high satisfaction ratings.

C.5 West Penn Power

C.5.1 Methodology Summary

Process evaluations identify a program's objectives and goals and assess how the program's design and operation are effectively meeting those objectives and goals. This procedure allows program managers to identify and understand different strengths and weaknesses that are affecting the program's success. Based on the feedback collected during a process evaluation, the program may be in need of minor changes or major overhauls to ensure the program is on the correct track to achieve its intended results.

C.5.2 Program-Level Summaries

C.5.2.1 Appliance Turn-In Program

ADM and Tetra Tech, the West Penn Power Program Evaluators, conducted a residential participant survey with a representative sample of customers who recycled qualified appliances and received a rebate in PY3 quarters one and two. The survey population included 1,434 "recycle only" customers, or customers that only received a rebate for recycling their appliance and did not receive a rebate for purchasing a qualified new appliance. A random sample of 203 records was selected from the population. Customers were sent a mail invitation to complete the on-line survey with email and telephone follow-up to maximize response.

Key Findings

- Most recycled appliances are replaced with high efficiency equipment. About 80% of recycled refrigerators and room air conditioners are replaced with a new, high efficiency appliance.
- Satisfaction with the program and with the implementation contractor is very high. Almost 90% of participants assign the program scores of eight or higher on a 10-point scale.

C.5.2.2 Residential Energy Efficient HVAC Equipment Program

The West Penn Power Program Evaluators conducted a residential participant survey with a representative sample of customers who received rebates from the Program during PY3Q1 and PY3Q2. A random sample of 426 records was selected from the population and included equal numbers of participants from each of the three program components; maintenance, heat pumps and central air conditioners. Data were collected on-line with a self-administered Web survey. Customers were sent a postcard that explained the goals of the study and asked them to complete the on-line survey. Email and telephone follow-up with non-responding households were used when possible to maximize response.

Key Findings

- Satisfaction with the program is high but expected energy savings are not always met. Upwards of 90% of participants give the program very high marks (eight or higher on a 10-point scale). Fewer participants (60 to 65%) are highly satisfied with the rebate amount or the energy savings that resulted from the installation.
- The energy benefits of central air conditioning are more often recognized than those deriving from a high efficiency heat pump.

C.5.2.3 Residential Energy Efficient Products Program

For the process evaluation of this Program, the West Penn Power Program Evaluators collected data on-line through the use of a self-administered web survey. Customers were sent a postcard that explained the goals of the study and asked them to complete the on-line survey. Email and telephone follow-up with non-responding households were used when possible to maximize response. A stratified random sample was established using the following steps:

- Identified and removed duplicate records within each appliance and grouped records where customers were able to receive multiple room air conditioner rebates;
- Randomly sampled rebate records at the appliance level; and
- Prepared sampled records for the web survey and grouped by household. For households that had received a rebate for more than one appliance, the West Penn Power Program Evaluators opted to focus the survey on a single appliance to reduce the respondent burden of completing a much longer survey across multiple appliance types.

Key Findings

- The Program’s marketing efforts and use of multiple channels have been successful. Retail stores, contractors, newspapers, and bill inserts are most often cited as a primary source of information by Program participants. According to the surveys, one in ten participants learned of the program from the utility’s website.

- Satisfaction with the Program is high but expectations of the energy efficiency appliances were not always met. Almost 90% of participants give the program very high marks (eight or higher on a 10- point scale). However, only two-thirds of participants express similar levels of satisfaction with the newly-installed appliance.

C.5.2.4 Residential Home Performance Program

The West Penn Power Program Evaluators collected data for the process evaluation activities using an on-line self-administered web survey. Customers were sent a postcard that explained the goals of the study and asked them to complete the on-line survey. Email and telephone follow-up with non-responding households were used when possible to maximize response.

Key Findings

- The distribution of CFLs in the home is consistent with the previous research conducted by West Penn Power. According to the survey, over half (63 percent) of installed CFLs are located in four rooms: the living room, kitchen, master bedroom, and the family room/den. The remaining 37% are dispersed throughout the home and outside. Few CFLs are located in typical low-use areas, such as closets, storage areas, and utility rooms.
- Survey results indicate 63% of CFL opt-in and smart meter participants reported that they would have purchased CFLs within one year had the promotion not been available; although, they would have purchased four CFLs on average, compared to the six they received through the giveaway.

C.5.2.5 Residential Critical Peak Rebate (CPR) Program

Process evaluation activities for this program will be detailed in PY4 reports. Activities to date include formal and informal interviews with West Penn Power staff and participant surveys following the first summer 2012 event. Additional surveys will be conducted with participants and with customers that un-enrolled during the summer of 2012 and results compared to the survey conducted directly after the first event.

C.5.2.6 Limited Income Energy Efficiency Program (LIEEP)

The West Penn Power Program Evaluators randomly sampled 525 participants with the aim of reaching 105 completed participant surveys out of a population of 5,020.

Key Findings

The audits are providing participants with new energy saving information and, as a result, customers are acting on some of those recommendations. With the exception of those that reside in multifamily buildings, most respondents recalled an auditor coming to their home and discussing ways to save energy. Auditors, on average, spent a little over an hour with customers. This time includes the 30 minutes of energy education as well as the walk-through audit. In addition, the Program appears to be providing participants with some specific behavioral and equipment suggestions on how to save energy in their homes. A varying percentage of customers report acting on some of the recommendations based on the audit experience, including turning lights off when not in the room and unplugging electronics when not in use.

C.5.2.7 Joint Utility Usage Management Program (JUUMP)

The West Penn Power Program Evaluators conducted a telephone survey of customers who participated in the Program in PY3Q1 and PY3Q2. They randomly sampled the 104 JUUMP participants with the aim of completing surveys with about 50% of the population. The findings from the JUUMP program were similar to the Limited Income Energy Efficiency Program.

C.5.2.8 Commercial & Industrial Small and Large Sector Equipment Programs

A process evaluation for the Commercial and Industrial Small and Large Sector Equipment programs was not conducted in PY3 due to the transition of West Penn Power’s programs to the implementation model of the legacy FirstEnergy operating companies.

C.5.2.9 Governmental and Institutional Program

A process evaluation for the Governmental and Institutional Program was not conducted in PY3 due to the transition to of West Penn Power program to the implementation model of the legacy FirstEnergy operating companies.

Appendix D Best Practices Overview

D.1 ACEEE 2003 Report[87]

The SWE reviewed program participation and penetration data in the American Council for an Energy Efficient Economy's (ACEEE's) March 2003 report on America's leading energy-efficiency programs. The information clearly demonstrates the wide range of high-quality energy-efficiency programs being offered in various areas of the United States today. A common characteristic of the programs profiled in the ACEEE report is their success in reaching customers through messages that effectively change the customers' practices and transform the market, whether regarding purchasing of new appliances, designing new office buildings, or operating existing buildings.

In particular, the winning programs featured in this study often exhibited the following traits that help define "best practices" for successful energy-efficiency programs in today's marketplace[88].

- "Comprehensive" approaches are being taken in all customer segments.
- Customized services and customer-focused approaches are common.
- Programs sell more than energy efficiency.
- Some very successful programs are tightly focused on a single service or technology.
- Program marketing and support services are essential for program success.
- Program incentives, including rebates, have not gone away.
- Resource acquisition as a program objective has not gone away.
- Market transformation is a significant program objective and model.
- Utilities are still major providers of energy-efficiency services.
- Non-utility programs are increasing.
- Partnerships and collaborations that bring together a wide variety of market actors are keys to achieving significant market impacts.
- Effective "supporting" programs and services are important to achieve program success.
- ENERGY STAR features prominently in many of these programs.

D.2 NYSERDA 2005 Gas Efficiency Study[89]

The 2005 NYSERDA-sponsored study, "An Evaluation of Natural Gas Efficiency Programs" summarized best practices among the leading gas-efficiency programs in North America and specifically targeted types of programs or program characteristics that could improve end-use natural gas efficiency in New York. The study's findings support the implementation of a gas Service Benefit Charge (SBC) similar to NYSERDA's existing electric SBC program.

According to the report, successful gas-efficiency programs contain these key elements[90]:

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87 ACEEE. "America's Best: Profiles of America's Leading Energy Efficiency Programs." April 11, 2003.
88 Ibid., p. 6.
89 NYSERDA. "An Evaluation of Natural Gas Efficiency Programs." Prepared for the New York State Energy Research and Development Authority. July 15, 2005.

- Strong relationships among contractors, retailers, and trade allies;
- Strong training programs;
- Well-designed and well-executed program management and monitoring;
- Results-based marketing and promotion;
- Consistent delivery of marketing and promotion messages;
- Stability of regulatory treatment over time;
- Responsiveness to customers and quality service; and
- Appropriate incentive levels for both service providers and consumers.

The study also details specific ways that each of the key program elements can be applied to different end-use market segments, and lists suggestions and characteristics that contribute to the successful implementation of these program elements.

D.3 2004 National Energy Efficiency Best Practices Study[91]

The purpose of the December 2004 National Energy Efficiency Best Practices Study prepared by Quantum Consulting was to develop and communicate excellent practices nationwide in order to enhance the design, implementation, and evaluation of energy-efficiency programs. The study used a benchmarking methodology to identify best practices for a wide variety of program types. The following excerpt is from the study; the SWE finds that the best practices listed in the study apply equally well to other types of energy-efficiency programs.[92]

Program Theory and Design

- Develop a complete and well thought-out program plan
- Involve multiple stakeholders
- Have a well-articulated theory or program logic
- Build feedback loops into the program design and implementation process
- Include features targeting supply-side actors in the program design
- Understand local market conditions
- Do not over-promise results

Program Management: Project Management

- Put the process plan, including program management, in writing
- Keep management teams small
- Include stakeholders in developing program implementation plans
- Capture and retain institutional memory in-house
- Spread implementation dollars among multiple “implementers,” who may be distributors or contractors themselves

90 Ibid., p. 7.
91 Quantum Consulting, Inc. "National Energy Efficiency Program Best Practices Study." December, 2004.
92 Ibid., p. R2-7.

Program Management: Reporting and Tracking

- Define and identify the key information needed to track and report early in the program development process
- Clearly articulate the data requirements to measure success
- Minimize duplicative data entry by linking databases to exchange information dynamically
- Conduct regular checks of tracking reports to assess program performance
- Develop accurate algorithms and assumptions on which to base estimates of savings
- Use the Internet to facilitate data entry and reporting; build in real-time data validation systems that perform routine data quality functions
- Automate routine functions such as monthly reports
- Build in rigorous quality control screens for data entry
- Carefully document the tracking system and provide manuals for all users

Program Management: Quality Control and Verification

- Develop inspection and verification procedures during the program design phase
- Consider administrative cost in designing the verification strategy
- Provide quick and timely feedback to applicants
- Ensure that inspectors have adequate training in identifying and explaining reasons for failure
- Use the inspection and verification function as a training tool for the market, especially in market transformation programs
- Establish a streamlined inspection scheduling process
- Build in statistical features to the sampling protocol to allow reduction in required inspections based on observed performance and demonstrated quality work

Program Implementation: Participation Process

- Review and understand product availability before establishing product eligibility
- Offer personal assistance in preparing and submitting program applications, or provide thorough application procedures manuals or online help tools
- Use the Internet to facilitate program participation, include procedures to report installation details
- Provide contractors with easy-to-use load software for running the Manual J calculations if these calculations are required
- Avoid being the middleman
- Keep participation simple
- Provide contractors training on proper installation practices
- Develop a technical and procedural manual for participating market actors
- Use incentives to provide the impetus that prompts upstream market actors (contractors, distributors, and manufacturers) to promote high-efficiency air conditioners and customers to consider the high-efficiency alternative

Program Implementation: Marketing & Outreach

- Use the ENERGY STAR® logo to instill consumer confidence
- Communicate with customers through multiple media
- Cooperate with retailers and contractors to promote the program
- Know your target consumer demographic and tailor your messages, incentive structures and promotional messages to the audience

Program Evaluation

- Regularly complete and utilize program evaluation to support program rationale and program design
- Develop evaluation metrics that are in line with program goals
- Clearly explain to participants early in the process any role they may be asked to play in the evaluation
- View evaluation results in the context of the overall market
- Periodically review and update market-level information about AC distributor and contractor installation practices and consumer awareness of benefits associated with high efficiency, matched systems, proper sizing and proper installation practices
- Periodically review and update algorithms for calculating project savings

D.4 Best Practices of Energy Efficiency Portfolios

Among the papers presented at the Association of Energy Services Professional's (AESP's) 2008 18th National Energy Services Conference was "Best Practices of Energy Efficiency Portfolios," a report in progress as part of the above-summarized National Energy Efficiency Best Practices Study. The paper summarizes best practices benchmarking results across nine energy-efficiency portfolios from around the country, highlighting findings from selected portfolio practices. The paper identifies specific administrative and policy-level approaches that have been found to be most useful and summarizes lessons learned in conducting the study. Portfolios of interest for this study were comprehensive in their coverage of technologies and practices, and included a wide range of different types of programs that addressed multiple customer sectors, equipment markets, vintage segments, and policy goals. Excerpts from the paper are the following.[93]

Best practices for setting and tracking Portfolio Objectives

- Develop and use clearly articulated objectives that are internally consistent, actionable, and if possible, measurable.
- Establish goals and objectives that bring clarity to all aspects of the portfolio's operation. The more specificity, the better.
- Set quantitative goals that are consistent with portfolio and policy objectives; informed by sound research; aligned with the portfolio administrator's available resources, program tools, and financial risk/reward mechanisms; and periodically updated.

93 Ibid., p. P1-4.

- Develop tools to track the portfolio's performance against these objectives on a continuous basis and report progress back to the organization.

Best practices for Portfolio Planning

- Design programs in the portfolio based on sound program plans; where appropriate, use clearly but concisely articulated program theories.
- Solicit stakeholder input into the portfolio and program plans either through a formal interview process or a collaborative planning process involving key stakeholders.
- Conduct selective market analyses around information gaps and key issues in order to understand market conditions.
- Conduct baseline research.
- Allocate market research efforts strategically across the portfolio. Target resources toward the largest markets and those that are least understood.
- Use a structured and disciplined portfolio and program planning process, to ensure the integrity of the filed portfolio and program plans.
- Develop a long-term market strategy and use it to guide market entry/exit decisions.
- Link strategic approach to policy objectives and constraints.
- Build feedback loops into program design and logic.
- Maintain the flexibility to rebalance portfolio initiatives, as needed, to achieve the portfolio's goals and objectives.

Best practices for Adaptation to Changes in Technologies and Market Conditions

- Maintain a separate Research and Development (R&D) function (even if it is small) to keep abreast of new developments in technologies and program delivery strategies.
- Proactively track new codes and standards that affect program baselines. Adjust programs when appropriate based on the longer term market strategy.
- If possible, participate in the development of new codes and standards.
- Be willing to experiment with new program approaches that have proven successful elsewhere. Balance these against established, proven strategies.
- Network with industry leaders and peers; stay connected to developments in the market.
- Foster close relationships with market actors; rely on them for market intelligence.

Best practices for Program Integration

- In designing an integration strategy, seek to include programs with related and complementary goals (for example, energy conservation, water conservation, renewables, and demand response).
- Simplify participation in multiple programs. Offer one "bundle" that may consist of energy efficiency, renewables, and financing measures from several different organizations but are seamless to the customer.

- Efficiently deliver integrated programs to all end-users regardless of their size. Larger customers should be assigned a single point of contact that represents all related programs. Smaller customers should be offered a whole building strategy that incorporates measures from multiple programs.
- In assigning roles and responsibilities among complementary organizations, play to each organization's strengths and key interests. Clearly define roles and responsibilities that leverage their strengths.
- Leverage relationships from complementary organizations such as utilities, trade allies, industry specialists, etc.

Best practices for Reporting and Tracking

- Clearly articulate the data requirements for measuring portfolio and program success.
- Design tracking systems to support the requirements of all major users: program administrators, managers, contractors, and evaluators.
- Use the Internet to facilitate data entry and reporting; build in real-time data validation systems that perform routine data quality functions.
- Automate, as much as is practical, routine functions (e.g., monthly portfolio and program reports, financial tracking).
- Integrate financial tracking and payment functions.
- Develop accurate algorithms and assumptions on which to base savings estimates.
- Conduct regular checks of tracking reports to assess program performance; if possible, develop real-time reporting capability.
- If possible, incorporate data likely to be needed for project assessments (such as historical billing data for large end-users).
- Periodically "mine" tracking data to understand historical portfolio and program experiences.

D.5 2006 National Action Plan for Energy Efficiency (NAPEE)[94]

The NAPEE report provides detailed information on the lessons learned across the United States from implementation of energy-efficiency programs. For example, the report states that the majority of utilities and energy-efficiency organizations reviewed are acquiring electric energy-efficiency resources for about $0.03/lifetime kWh for electric programs. The report notes that in many cases, energy efficiency is being delivered on the order of half the cost of new supply. The report also notes that energy-efficiency organizations operate in diverse locations under different administrative and regulatory structures. The SWE used the best practices provided in Chapter 6 of the NAPEE report as a guide for developing the initial list of recommendations for natural gas energy-efficiency programs for the CECONY Service Area.

94 U.S. DOE/U.S. EPA, "National Action Plan for Energy Efficiency." July 2006.

The best practices presented in Chapter 6 of the NAPEE report are organized into four areas, as follows[95].

1. Recognize energy efficiency as a high-priority energy resource.
   - Establishing strong leadership at multiple levels to enact policy change.
   - Align organization to ensure that goals are realized.
   - Understanding the opportunities and costs of developing the efficiency resource to develop appropriate measures for all customer classes.

2. Develop a strong, long-term energy-efficiency plan.
   - Align goals with funding.
   - Provide programs for all key customer classes.
   - Use cost-effectiveness tests that are consistent with long-term planning.
   - Consider building codes and appliance standards when designing programs.
   - Plan for developing and incorporating new technology.
   - Consider efficiency investments to alleviate transmission and distribution constraints.
   - Create a road map that documents key program components, milestones, and explicit energy-reduction goals.

3. Broadly communicate the benefits of, and opportunities for, energy efficiency through strong program design and delivery.
   - Conduct a market assessment with input from stakeholders, customers, and trade allies.
   - Leverage private-sector expertise, external funding, and financing.
   - Start with demonstrated program models; build infrastructure for the future through education and training.

4. Provide sufficient and stable program funding to deliver energy efficiency where cost effective.
   - Budget, plan, and initiate evaluation from the onset; formalize and document evaluation plans and processes.
   - Develop program and project tracking systems.
   - Conduct process evaluations to ensure that programs are working.
   - Conduct impact evaluations to ensure that mid- and long-term goals are being met.
   - Communicate evaluation results to key stakeholders. Include case studies to make success more tangible.

95 Ibid., p. 6-1.

Appendix E Audit Activity Detail – Residential Programs

This appendix provides further detail on the SWE audits performed for residential programs in PY3, excluding low-income programs, which are discussed in Appendix F.

E.1 Duquesne

E.1.1 Upstream Lighting

Duquesne's Program was initiated July 2010. In PY3Q1, the SWE was unable to verify Duquesne's use of the appropriate 2011 TRM protocols or baseline assumptions, as per-bulb savings and algorithms were not provided to the SWE. More data were provided to the SWE in the following quarters and thus the SWE was able to able to verify both the use of TRM protocols and the baseline assumptions.

E.1.2 Appliance Recycling

In the sample check for PY3Q1, the SWE found that Duquesne was using a kWh savings value of 1,407 kWh rather than the stipulated 1,659 kWh (for non-replaced appliances) and 1,205 kWh (for replaced appliances) values stipulated in the 2011 TRM. Duquesne explained the use of the adjusted value in the below excerpt from the PY3Q1 quarterly report.[96]

> The change in measure savings occurred after the measures were entered into the PMRS database for PY3 Q1. In order to account for the revised savings, Navigant had to create an adjusted savings per unit for each RARP measure. Based on data collected by JACO at the time of appliance pickup, Navigant found the distribution of primary and secondary units, as well as the number of appliances replaced or retired. For primary units, it is assumed that every unit is replaced (100%). For secondary units, Navigant used an average of replacement rates reported in the JACO database and those reported in Program Year 2 Quarters 3 and 4 telephone verification surveys (35% replacement and 65% retirement). Data from the telephone verification surveys were also used to find the percentage of participants who replaced their refrigerator or freezer with an ENERGY STAR® model (87%).

The Interim Measure Resolution[97] stipulates that different savings for refrigerators/freezers replaced with standard versus non-ENERGY STAR® refrigerators/freezers. As a result, gross savings had to be adjusted for this Program by Navigant, the Duquesne Program Evaluator. Duquesne used data from a telephone verification survey conducted in PY3Q1 to estimate the percentage of refrigerator/freezer participants who replaced their appliance with an ENERGY STAR® unit versus a non- ENERGY STAR® unit. This review resulted in savings adjustments to 997 reported savings values in PY3.

E.1.3 REEP - Rebate Program

In the random samples selected in PY3, the SWE found no quality control errors between the customer applications and the corresponding entry in Duquesne's database. The samples pulled for PY3 reflected a range of rebated products. For the calculation of gross savings in Duquesne's PY3 Annual Report,

96 Duquesne PY3Q1 Quarterly Report, p. 46.
97 Pennsylvania Statewide Evaluator Interim Measure Resolution for Refrigerator and Freezer Savings

savings for a few rebated products (ENERGY STAR® dehumidifiers, programmable thermostats and whole house fans) had to be adjusted to be consistent with the protocols of the 2011 TRM.

E.2 PECO

E.2.1 Smart Lighting Discounts Program

In the quarterly audits of PECO's Smart Lighting Discounts Program, the SWE was able to complete each piece of the audit activities required. The SWE verified the number of bulbs rebated, energy savings and demand savings according to PECO's database against the numbers reported in PECO's quarterly and annual reports. The SWE verified that PECO used the correct 2011 TRM protocols to estimate savings and establish baselines for CFL bulbs. However, in the calculation of LED lighting savings under PECO's Smart Homes Rebates Program, PECO based savings for LED bulbs on the TRM algorithm for CFL bulbs. This error was corrected in the M&V of the program by Navigant, the PECO Program Evaluator, and is reflected in the savings reported in the PY3 Annual Report. Lastly, the SWE reviewed selected invoices to verify the number of bulbs sold and distributed.

E.2.2 Appliance Recycling

In the quarterly audits, the SWE found that PECO applied the correct savings values from the TRM for replaced and recycled refrigerators and there were no quality control errors between the database and the submitted work orders for recycled appliances. Because the Interim Measure Resolution stipulates different savings for refrigerators/freezers replaced with standard refrigerators/freezers versus non-ENERGY STAR® refrigerators/freezers, gross savings had to be adjusted for this program by the PECO Program Evaluator.

E.2.3 Smart Home Rebates Program

In the quarterly audits, the SWE found a few instances where a customer failed to upload all pieces of the rebate application required for a rebate. In all of these instances, a PECO representative contacted the customer and informed him or her of the missing data. The customer then sent a completed rebate application to PECO and the rebate was paid. The samples pulled for PY3 reflected a range of rebated products.

E.3 PPL

E.3.1 Residential Lighting

In the PY3Q1 audit, the SWE found a difference of 8% in the gross demand reduction reported in the PY3 quarterly report and the demand savings in PPL's database. In verifying the use of 2011 TRM protocols, it was found that PPL under-reported energy savings for residential lighting because the database applied the in-service rate for CFLs (84%) instead of the in-service rate for LEDs (95%) to LED measures. This was corrected in the *ex ante* savings.

E.3.2 Appliance Recycling

In the quarterly audits, the SWE found that PPL applied the correct savings values from the 2011 TRM for replaced and recycled refrigerators and there were no quality control errors between the database and the submitted work orders for recycled appliances. Because the Interim Measure Resolution stipulates different savings for refrigerators/freezers replaced with standard refrigerators/freezers versus non-ENERGY STAR® refrigerators/freezers, gross savings had to be adjusted for this program by the Cadmus Group, the PPL Program Evaluator.

E.3.3 Smart Equipment Incentives Program

In the random samples selected in PY3, the SWE found no quality control errors between the customer applications and the corresponding entry in PPL's database. The samples pulled for PY3 reflected a range of rebated products.

E.4 FirstEnergy Companies (Met-Ed, Penelec, Penn Power)

E.4.1 Residential Lighting

Because FirstEnergy companies' (EDCs') residential lighting programs are a subset of their respective Energy Efficient (EE) Products Programs, the EDCs do not separately report energy savings and demand reductions in their quarterly reports. Therefore, the SWE was unable to complete M&V on these items as a part of the quarterly audits. This information is available in each EDC's PY3 Annual Report and has been verified for PY3. Additionally, the SWE verified that all baseline assumptions and TRM protocols were used appropriately. For Met-Ed, SWE found a variance of 403 bulbs that were reported in the PY3Q2 report but not in Met-Ed's database. For Penelec, the SWE found a variance of 124 bulbs that were reported in the PY3Q2 report but not in Penelec's database, and found a variance of 600 bulbs that were reported PY3Q3 report but not in Penelec's database. For Penn Power, the SWE found a variance of 37 bulbs that were reported in the PY3Q2 report but not in Penn Power's database, and found a variance of 582 bulbs that were reported PY3Q3 report but not in Penn Power's database.

E.4.2 Appliance Recycling

In the quarterly audits, the SWE found that each EDC applied the correct savings values from the 2011 TRM for replaced and recycled refrigerators and there were no quality control errors between the database and the submitted work orders for recycled appliances. Because the Interim Measure Resolution stipulates different savings for refrigerators/freezers replaced with standard refrigerators/freezers versus non-ENERGY STAR® refrigerators/freezers, gross savings had to be adjusted for this program by ADM, the FirstEnergy Program Evaluator.

E.4.3 Energy Efficient Products

In the random samples selected in PY3, the SWE found no quality control errors between the customer applications and the corresponding entries in each EDC's databases. The samples pulled for PY3 reflected a range of rebated products.

E.4.4 New Construction

As prescribed in the 2011 TRM, energy savings from the New Construction Programs are estimated using a combination of REM/Rate™ reported savings and TRM algorithms for appliances and lighting. Demand savings from the Programs are estimated using an algorithm in the New Construction section of the 2011 TRM. The gross energy and demand savings reported by each of the EDCs for PY3 were a direct output of REM/Rate™ and thus needed to be adjusted through the impact evaluation process.

The FirstEnergy Program Evaluator conducted an engineering review of a sample of projects from PY3. The review involved inspection of REM/Rate™ models associated with rebated homes. Stratified random sampling with three strata was used due to the skewed distribution of energy savings among homes of various sizes and HVAC equipment. The SWE selected three homes from each stratum of the FirstEnergy Program Evaluator sample for each EDC to serve as the SWE sample, for a total of 9 homes per company, and 27 homes total. For each of these homes, the SWE performed the following.

- REM/Rate™ Verification: Checking that the savings estimates produced by REM/Rate™ are accurate and consistent with the TRM.
- Demand Savings Verification: Checking that the demand savings algorithm from the TRM was used correctly.
- Appliance and Lighting Savings Verification: Checking that the savings for high efficiency appliances and lighting was estimated accurately using the appropriate TRM protocols, not REM/Rate™.
- Construction Verification: Confirming that the home was built.

<u>REM/Rate™ Verification</u>

The FirstEnergy Program Evaluator developed an evaluation spreadsheet that it used for the verification of the REM/Rate™ models for the homes in its sample. The spreadsheet allowed the FirstEnergy Program Evaluator to make key determinations regarding the following questions.[98]

1. Are the baseline specifications in accordance to those in the 2011 PA TRM?
2. Are the claimed impacts attributable to improved construction practices and premium efficiency HVAC systems and appliances, or do they result from modifications that are not supportable by the TRM? [99]
3. Is the REM/Rate™ Modeling performed correctly and does it provide accurate results?

The SWE reviewed the evaluation spreadsheet for each of the 27 homes in the SWE sample and found that it appropriately and accurately determines whether or not the REM/Rate™ models are consistent with the TRM, claiming unsupported savings, and providing accurate savings estimations.

For seven of the homes in the SWE sample, REM/Rate™ did not produce accurate savings associated with ground-source heat pumps. While the input to REM/Rate™ for the baseline home was a heating coefficient of performance (COP) equal to three (3), the modeled COP based on estimated heating load and energy use was significantly lower, leading to an overestimation of energy consumption by the baseline home and thus an overestimation of savings. The FirstEnergy Program Evaluator caught this issue during its evaluation and developed equations that corrected for this overestimation and adjusted

98 Adapted from each of the FirstEnergy companies' PY3 Annual Reports, pages 59-60.

99 For example, the baseline and qualifying homes should have the same thermostat temperature set-points. Savings cannot be claimed for lowering the heating set-point temperature and raising the cooling set-point temperature in the qualifying home versus the baseline home.

the savings accordingly. The SWE reviewed these calculations for the seven homes and found them an appropriate way to correct for the REM/Rate™ calculations. The REM/Rate™ calculations for the other homes in the SWE sample were found to produce accurate results.

Demand Savings Verification

The *ex ante* reported savings reported by each of the EDCs were direct outputs of REM/Rate™ and thus needed to be adjusted by the FirstEnergy Program Evaluator during impact evaluation. The SWE checked that this adjustment was performed correctly and found no errors in the FirstEnergy Program Evaluator's adjustments.

Appliance and Lighting Savings Verification

The *ex ante* reported savings by each of the EDCs were a direct output of REM/Rate™ and thus needed to be adjusted through impact evaluation.

The first step in this adjustment was to remove the REM/Rate™ reported appliance savings, lighting savings, and internal heating and cooling load effects from the total *ex ante* reported savings for each home. In general, the SWE found that this was performed correctly by the FirstEnergy Program Evaluator. In one home in the Penn Power territory, there was a typographical error in the amount of savings subtracted. A correction of this error would change the Penn Power new construction realization rate from 101% to 99%, but would have a negligible effect of total portfolio savings.

The next step in the adjustment was to add back the TRM-based savings estimates for appliances and lighting. The REM/Rate™ model for each home did not provide enough information to follow TRM appliance protocols (e.g. the REM/Rate™ model does not include the refrigerator configuration which is a required input to determine savings in the TRM). Therefore, to estimate appliances savings, the FirstEnergy Program Evaluator attempted to contact home occupants and builders of homes within its sample to get information on the appliances installed in the homes. The FirstEnergy Program Evaluator was able to contact six homes within its Met-Ed sample, 13 homes within its Penelec sample, and five homes within its Penn Power sample. For the homes in each territory the FirstEnergy Program Evaluator was unable to contact, the average of the TRM-based appliance savings for the contacted homes was used as an estimate. The SWE found this approach to be appropriate given the difficulty in obtaining information about the installed appliances in homes.

For lighting savings, REM/Rate™ requires an input of the total percentage of lighting fixtures in a home that have CFLs installed while the TRM requires an exact bulb count. Therefore, the REM/Rate™ files once again did not contain enough information to directly use the TRM algorithms, and another source of data was needed. The FirstEnergy Program Evaluator used the SWE Residential Baseline Study to determine an average number of fixtures per square foot that could be used to determine the total number of fixtures in a home. Additionally, the FirstEnergy Program Evaluator performed site visits to 13 homes in the Met-Ed, Penelec, and Penn Power territories combined, in which the percentage of CFLs observed was compared to the reported REM/Rate™ percentage of CFLs installed and found to be approximately 75% of the REM/Rate™ values. The FirstEnergy Program Evaluator therefore capped the percentage of CFLs in the new home at 75%. The FirstEnergy Program Evaluator additionally capped the total number of fixtures per home at 70. The SWE believes that this methodology was relatively conservative and thus is appropriate given the difficulty in obtaining lighting information for each home.

Construction Verification

To verify that the homes were built, the SWE reviewed builder's certificates for each home in the SWE sample. A builder's certificate is a document that states the name of a home's builder and rater, date of rating, address, and percent of energy savings relative to a standard new home built to code. This is produced for each home that participates in the Program. The SWE additionally reviewed, where available, on-site inspection photographs taken by the FirstEnergy Program Evaluator and photographs of meters with home ID numbers to ensure that they matched the REM/Rate™ files and tracking database. The SWE found no issues in this portion of the audit.

E.5 West Penn Power

E.5.1 Residential Lighting

Because West Penn Power's residential lighting program is a subset of the Residential Energy Efficient Products Program, West Penn Power does not separately report energy savings and demand reductions in the quarterly report. Therefore, the SWE was unable to complete M&V on these items as a part of the quarterly audits. This information is available in West Penn Power's PY3 Annual Report and has been verified for PY3. Additionally the SWE verified that all baseline assumptions and TRM protocols were used appropriately. In PY3Q1 West Penn Power noted that an invoice inadvertently reported bulbs sold outside West Penn Power's service territory, resulting in a difference between the bulbs tracked and the bulbs reported.

E.5.2 Appliance Turn-In

In the quarterly audits, the SWE found that West Penn Power applied the correct savings values from the TRM for replaced and recycled refrigerators and there were no quality control errors between the database and the submitted work orders for recycled appliances. Because the Interim Measure Resolution stipulates different savings for refrigerators/freezers replaced with standard refrigerators/freezers versus non-ENERGY STAR® refrigerators/freezers, gross savings had to be adjusted for this program.

E.5.3 Energy Efficient Products

In the random samples selected in PY3, the SWE found no quality control errors between the customer applications and the corresponding entry in West Penn Power's database. The samples pulled for PY3 reflected a range of rebated products.

Appendix F Audit Activity Detail – Low-Income Programs

This appendix provides further detail on the SWE audit performed for residential low-income programs in PY3.

F.1 Duquesne

The SWE completed eight inspections of PY3Q1 LEEP installations. Duquesne hired a third-party inspector to complete ten inspections per quarter of Q2, Q3 and Q4 installations. The SWE reviewed the reports, compiled the findings, and provided feedback to Duquesne. The most notable findings were as follows.

- No furnace whistles were installed (nine locations).
- Of the 46 LED nightlights inspected, only 14 were reported to have replaced incandescent nightlights. The remaining 32 nightlights were incremental energy users.
- 70% of the smart strips were installed, of which 50% were installed correctly such that they were saving energy.[100]

F.2 PECO

As part of the responsibility to audit PECO's low-income program, the SWE conducted 39 site inspections of PY3 LEEP installations. The SWE issued site inspection reports to PECO, which contained findings, recommendations, and commendations. The most notable inspection findings were as follows.

- Of the measures inspected, only CFLs were found to have an installation rate less than 100% (CFLs =95 percent).
- Some customers had as many as eight bulbs that were reported to have burned out.
- Several customers purchased additional CFLs since receiving the LEEP CFLs.

F.3 PPL

Forty Act 129 WRAP site inspection reports were reviewed by the SWE. PY3 WRAP savings are deemed by job type based on a billing analysis of participants in prior program years. Therefore, the most important goal of the review was to ensure participants were assigned the correct job type in the participant database extract based on the comprehensiveness of measures installed, space heating fuel and/or domestic hot water heating fuel. The SWE found no cases where the job type assigned in the database, the installation contractor's audit form and the third party inspector's report disagreed. The SWE also compared invoices and the third-party inspector's findings to the measures listed in the database. Overall very few discrepancies were found. The most common issues noted were:

[100] Smart power strips are equipped with a "master" outlet, "control" outlets and "always on" outlets. Many electronics continue to draw power even when off and therefore the smart power strip is intended to turn off electronics plugged into the "control" outlets when the power draw from the "master" outlet is reduced by a fixed percentage. Non-energy-efficient use of the smart strips occurs when participants plug equipment into the "always on" outlets and do not utilize the "control" outlets.

- Uninstalled measures (10 measures);
- Inspector did not verify all measures (4 participants); and
- Disagreement between invoice and database (3 measures)

The discrepancies noted above represent a very small percentage of the total number of measures installed and none affected the job type assigned to each participant. Also, the inspection reports indicate that PPL is following up when work is found to be incomplete. For example, the inspector found that the attic insulation was less than reported for a participant and the contractor returned to add additional insulation.

F.4 Met-Ed

Forty site inspection reports were reviewed by the SWE. Since the effects of PY3 participation will not be measured until PY4, the determinant of PY3 participant savings is assignment of job type. [101] Thus, a PY3 participant was assigned a job type based on measures installed, space heating fuel and/or water heating fuel. The savings for each PY3 job type was based on the calculated impacts the program had on PY2 participants by job type. The SWE's primary objective when reviewing the WARM Plus inspection reports, audit forms and associated invoices was to verify that the correct job type had been assigned in the Met-Ed tracking database extract. Of the reports reviewed in PY3, none were found to have a job type assigned in the database extract that contradicted the measures installed, space heating and/or water heating type. The SWE also reviewed the site inspection reports to ensure participants were receiving all measures invoiced and entered into the database and that customers were satisfied with the installation contractor's quality of work. In general the SWE noted very few instances of uninstalled measures. There were instances where work was incomplete and Met-Ed followed up with the customer or returned to the site to complete work. The following are notable examples.

- Customer had a refrigerator replaced that was smaller than the original and was unhappy with the freezer size. Met-Ed followed up and gave the customer a small 5 cubic foot freezer.
- Following the site inspection, the auditor followed up to complete a recommended AC clean-and-tune and install a missing railing.
- Job was not "passed" by Met-Ed until the chimney damper was repaired.
- At least two instances where a refrigerator was not delivered. The auditor followed up to ensure the refrigerators were delivered.

In addition, the SWE reviewed 24 Met-Ed WARM Extra Measures site inspection reports. Some of these participants also participated in the WARM Plus program. The WARM Extra Measures program distributes measures such as CFLs, LED night lights, furnace whistles and smart power strips. The SWE noted that most measures were installed. A total of seven CFLs were not installed at the time of the

[101] The three job types used by Met-Ed are as follows: electric heat jobs involve weatherization and provide measures with a value of at least $250 to reduce space heating energy usage for electrically heated homes; electric water heat jobs that provide measures with a value of at least $25 to reduce water heating energy usage for homes that have electric water heaters, and electric base load jobs, which may include refrigerator/freezer replacement and lighting retrofits.

inspection. These uninstalled bulbs are not necessarily the result of contractor failure, but may also be due to bulbs breaking, failing, being moved, or other reasons. No other measures were reported as uninstalled, though one LED nightlight and one smart power strip were unverified by the site inspector. Overall, the results of the site inspection report reviews support the in-service rates reported by the FirstEnergy Program Evaluator.

F.5 Penelec

Forty low-income site inspection reports were reviewed by the SWE. Since the effects of PY3 participation will not be measured until PY4, the determinant of PY3 participant savings is assignment of job type. [102] Thus, a PY3 participant was assigned a job type based on measures installed, space heating fuel and/or water heating fuel. The savings for each PY3 job type was based on the calculated impacts the program had on PY2 participants by job type. The SWE's primary objective when reviewing the WARM Plus inspection reports, audit forms and associated invoices was to verify that the correct job type had been assigned in the Penelec tracking database extract. Of the reports reviewed in PY3, none were found to have a job type assigned in the database extract that contradicted the measures installed, space heating and/or water heating type. The SWE also reviewed the site inspection reports to ensure participants were receiving all measures invoiced and entered into the database and that customers were satisfied with the installation contractor's quality of work. In general the SWE noted very few instances of uninstalled measures. There were instances where work was incomplete and Penelec followed up with the customer or returned to the site to complete work. The following are notable examples.

- Attic insulation was not completed. A follow-up was completed and the contractor was unable to blow insulation due to too much storage in the attic and therefore the invoice was debited appropriately.
- Participant received a dented freezer and had a freezer removed that after the audit realized he did not want removed. Both issues were resolved with the participant.

There were cases where the CSP had incomplete documentation, such as not noting the locations of CFLs in the participant's home. The FirstEnergy Program Evaluator recommended changes to ensure the auditor documents all measures. Overall, this type of follow-up and thorough documentation provides the SWE confidence in the quality of WARM Plus installations.

In addition, the SWE reviewed thirty-three Penelec WARM Extra Measures site inspection reports. Some of these participants also participated in the WARM Plus program. The WARM Extra Measures program distributes measures such as CFLs, LED night lights, furnace whistles and smart power strips. The SWE noted that most measures were installed. A total of two CFLs were not installed at the time of the inspection. These uninstalled bulbs are not necessarily the result of contractor failure, but may also

[102] The three job types used by Penelec are as follows: electric heat jobs involve weatherization and provide measures with a value of at least $250 to reduce space heating energy usage for electrically heated homes; electric water heat jobs that provide measures with a value of at least $25 to reduce water heating energy usage for homes that have electric water heaters, and electric base load jobs, which may include refrigerator/freezer replacement and lighting retrofits.

be due to bulbs breaking, failing, being moved, or other reasons. No other measures were reported as uninstalled; though two smart power strips were unverified by the site inspector. Overall, the results of the site inspection report reviews support the in-service rates reported by the FirstEnergy Program Evaluator.

F.6 Penn Power

Thirty-four low-income site inspection reports were reviewed by the SWE. Fewer than forty site inspection reports were received because the Penn Power WARM Program closed in March 2012 due the fact that the program exceeded its EE&C Plan targets through 2013 and had minimal funds. Since the effects of PY3 participation will not be measured until PY4, the determinant of PY3 participant savings is assignment of job type. [103] Thus, a PY3 participant was assigned a job type based on measures installed, space heating fuel and/or water heating fuel. The savings for each PY3 job type was based on the calculated impacts the program had on PY2 participants by job type. The SWE's primary objective when reviewing the WARM Plus inspection reports, audit forms and associated invoices was to verify that the correct job type had been assigned in the Penn Power tracking database extract. Of the reports reviewed in PY3, none were found to have a job type assigned in the database extract that contradicted the measures installed, space heating and/or water heating type. The SWE also reviewed the site inspection reports to ensure participants were receiving all measures invoiced and entered into the database and that customers were satisfied with the installation contractor's quality of work. In general the SWE noted very few instances of uninstalled measures. When work was not complete, the contractor returned to ensure there were not missed opportunities. For example, in one instance the contractor followed up to complete floor insulation.

In addition, the SWE reviewed thirty-two Penn Power WARM Extra Measures site inspection reports. Some of these participants also participated in the WARM Plus program. The WARM Extra Measures program distributes measures such as CFLs, LED night lights, furnace whistles and smart power strips. The SWE noted that most measures were installed. A total of five CFLs were not installed at the time of the inspection. These uninstalled bulbs are not necessarily the result of contractor failure, but may also be due to bulbs breaking, failing, being moved, or other reasons. No other measures were reported as uninstalled. Overall, the results of the site inspection report reviews support the in-service rates reported by the FirstEnergy Program Evaluator.

F.7 West Penn Power

The SWE reviewed 40 West Penn Power low-income site inspection reports. West Penn Power reported in its PY3 Annual Report that the realization rate for low-flow showerheads and faucet aerators was 58% and 41%, respectively. West Penn Power reported that the reason for the low installation rates for these

[103] The three job types used by Penn Power are as follows: electric heat jobs involve weatherization and provide measures with a value of at least $250 to reduce space heating energy usage for electrically heated homes; electric water heat jobs that provide measures with a value of at least $25 to reduce water heating energy usage for homes that have electric water heaters, and electric base load jobs, which may include refrigerator/freezer replacement and lighting retrofits.

measures was because participants reported not receiving the measures. In addition, a significant number of participants reported that their water heating fuel was something other than electric.

The SWE's review of site inspection reports found similar results. Before accounting for water heating fuel type, the installation rate for showerheads and faucet aerators was 73% and 88%, respectively. After accounting for fuel type (as reported in the invoices report included with the inspection report), the installation rate for showerheads and aerators was 41 and 49 percent, respectively. The sample the SWE reviewed is relatively small and the reported rate codes may not always be accurate, but the primary finding is that the SWE's results support the West Penn Program Evaluators' findings. West Penn Power is aware of the issue and therefore the SWE expects improvement in PY4. Additionally, the diversity of measures offered increased in PY3Q4 as West Penn Power's low-income programs became more integrated with the legacy FirstEnergy companies' low-income programs. This should allow the opportunity for all low-income customers to access a diverse set of Act 129 measure, regardless of water heating fuel.

Appendix G Non-Residential Programs

This appendix provides further detail on the SWE audits performed for non-residential programs in PY3.

G.1 Duquesne

G.1.1 Site Inspection Findings

Table G-1 presents all findings and resolutions from non-residential site inspections conducted during PY3. Columns headers are defined as:

- **SWE ID:** The SWE assigned each project that received a site inspection a unique identifier.
- **Measures:** Measures that were reviewed as part of the site inspection.
- **Insp. Type:** Either Ride-Along (RA) or Independent (IND).
- **Finding:** Issues discovered through site inspections and review of evaluator reports (for RA only).
- **Finding Type:** Categorized into Evaluation (Eval), Process (Pro) or TRM (TRM) findings.
- **Resolution:** Actions taken to resolve the issues due to findings.

Table G-1: Duquesne Non-Residential Site Inspection Findings

SWE ID	Measures	Insp. Type	Finding	Finding Type	Resolution
DLC-301	Lighting	RA	TRM precluded evaluator from accounting for peak demand impact of photocell controls	TRM	Consider changes for future TRM
DLC-302	Strip Curtains	RA	Evaluator did not inquire about baseline condition	Eval	Evaluator will emphasize in PY4 inspections the importance of collecting baseline information
DLC-303	Lighting	RA	Evaluator's calculations did not account for high-output ballasts	Eval	Evaluator agrees that high-output ballast should have been accounted for in calculations
DLC-304	Air Compressors	RA	Evaluator should provide explanation and supporting documentation for baseline compressor operation	Eval	Evaluator will better document and explain all inputs and assumptions for PY4 projects
DLC-305	Cooling Tower, VFDs	RA	Evaluator's analysis not yet complete		Not applicable
DLC-306	VFDs	RA	Evaluator did not provide evidence for deviating from TRM fan efficiency values and analysis was not consistent with all site visit findings	Eval	Evaluator agreed with SWE and will provide such evidence and use SWE's recommended analysis approach in the future.
DLC-307	Lighting	RA	Reported hours differed significantly from TRM building type hours and 2011 TRM does not allow interview-reported hours to be used	TRM	Addressed in 2012 TRM (more flexibility to use interview hours)
			Evaluator failed to inquire about holidays or obtain suitable documentation to support EFLH that differed from Table 3-5	Eval	Evaluator will emphasize in field forms the importance of collecting detail on how operating schedules are affected by holidays
DLC-308	Lighting	IND	Implementer did not account for photocell controls or clearly document baseline controls and hours	Pro	Duquesne will work to better document baselines in PY4
DLC-309	Anti-Sweat Controls	IND	Application and post-inspection report did not state type of cases retrofitted	Pro	Duquesne will emphasize collecting more detailed data on refrigeration measures in PY4

G.1.2 Review of Savings Database

Duquesne has listed eleven EE&C programs under the non-residential umbrella, which are listed in Table G-2. As shown, each of the eleven programs achieved energy and demand savings during PY3. The gross reported energy savings of these programs was 51,014 MWh and the gross reported demand savings was 8.672 MW[104] during PY3, with a total of 760 participants.

Table G-2: Duquesne Non-Residential Programs Annual Summary

Program	Participants	MWh/yr	MW
Commercial Sector Umbrella	83	2,809	0.349
Healthcare	13	2,751	0.361
Industrial Sector Umbrella	4	2,898	0.641
Chemical Products	3	319	0.039
Mixed Industrial	48	7,375	1.309
Office Building - Large	47	11,427	1.125
Office Building - Small	116	3,515	0.918
Primary Metals	12	3,346	0.393
Government, Educational, and Non-Profit (GNP)	94	2,850	0.884
Retail Stores - Small	299	6,336	1.591
Retail Stores - Large	41	7,388	1.062
Total	**760**	**51,014**	**8.672**

Following each quarter in PY3, Duquesne submitted program tracking data to the SWE for review. The SWE combined these quarterly data extracts and compared them to the values shown in Table G-2 and found the two sources to agree perfectly. This shows that Duquesne's reported savings impacts are finalized once entered into the PMRS system and are not altered after the close of the quarter they were first reported in.

G.1.3 Review of Project Files

The SWE review of non-residential projects completed by Duquesne customers during PY3 was completed using project documentation files uploaded to the SWE SharePoint site quarterly by Duquesne. The uploaded project files included project level savings calculation workbooks, specification sheets for equipment installed, invoices, customer incentive agreements and post-inspection forms. The documentation provided was comprehensive, detailed, well-organized and allowed for a complete review of all uploaded projects.

Project files from the commercial sector were found for all quarters in PY3, but the Industrial uploads were only found for Q3 and Q4, leaving review of all PY3 selected industrial projects incomplete. Q1 only had one completed industrial project, so the inability to review documentation for a single project is not a primary concern. However, Q2 had a total of 36 projects divided between the Chemical Products, Mixed Industrial and Primary Metals categories. These 36 projects covered a total of 188 measures, but no project documentation was uploaded to the SharePoint site. There is an uploaded spreadsheet that

[104] Duquesne adjusted the gross reported MW to reflect a line loss factor of 6.9%.

lists a sample of five industrial projects from Q2 for review. This leads the SWE to believe there was an oversight in uploading the project files that should be able to be corrected. In addition to the unavailable industrial project files, the SWE observed several minor inconsistencies between the project worksheets, associated documentation, and the program tracking data. These inconsistencies are highlighted below with a focus on the largest program kW and kWh impacts uncovered during the review.

G.1.3.1 Equivalent Full Load Hours (EFLH) Differs from TRM Expectation

Two of the projects reviewed used an Equivalent Full Load Hours (EFLH) value in their calculations that differed from the building type EFLH expectation provided by Tables 3-2 and 3-5 in the 2011 PA TRM.

Project number 8000006714.20.12 incented the replacement of 90W incandescent bulbs with 20W LED lamps. The project parameters (incentive, fixture quantity, kWh, kW) were identical in the savings worksheet and program tracking data. Documents for the project stated that the new lighting is located in the lobby of the building and Duquesne rebated the project under its 'Office Buildings – Large' program. According to the 2011 TRM an 'Office - Large, Lobby' has an annual EFLH of 2,692 hours. The worksheet uses 5,616 for the EFLH input. The project files did include an operating schedule that supported the 5,616 EFLH figure. The SWE supports using facility-specific schedules when they differ significantly from TRM values and recommends Duquesne continue including this type of supporting evidence when EFLH values differ from the TRM to make audits as transparent as possible.

Project number 5000589004.20.01 covered the replacement of 50W PAR20 lamps with 9W LED equivalents. Again, many of the project parameters between the worksheet and database are identical, but there was an inconsistency in the EFLH without any additional explanation. The project worksheet listed EFLH at 3900 with the TRM expecting 2,692 EFLH for an 'Office - Large, Lobby'. Duquesne provided an email from the customer which supported the 3900 EFLH value after being alerted of the issue, but the SWE requests this type of supporting information be included in the original project file uploads.

G.1.3.2 kW and kWh Inconsistencies

Project number 1000442988.24.01 is a custom interior lighting project with occupancy sensor installation. The three measures under review covered the replacement of 400/750/1000W metal halide lamps with 4/6/8 lamp T5 HO fixtures with motion control, and all three showed variation in demand and consumption between the project savings calculators and the program database. The calculations and savings values on the project worksheet were found to correspond with the 2011 TRM methodologies for savings, leading the SWE to determine that the worksheet values are the accurate savings for the project. When all three measures are added together, the entire project has demand savings of 53.37 kW and energy savings of 700,168 kWh. The program tracking data summary provided to the SWE and Duquesne's PMRS system show values of 69.62 kW and 777,610 kWh. These inconsistencies represent project level adjustments of -16.25 kW (-30.4%) and -77,442 kWh (-11.1%). The PMRS database inputs were reviewed and the differences in kW and kWh are due to differences between the worksheet and PMRS inputs. These inconsistencies include the wattage levels of the baseline and retrofit lamps/fixtures, and the use of cooling based interactive effects in the project (the worksheet lists no interactive effects).

The use of interactive effects in the tracking data calculations is responsible for most of the difference in kW and kWh. The presence of air conditioning in the production area of the plant is unclear from the project files. An electrical drawing of the building was included in the project files, but HVAC equipment was not called out. The SWE recommends Duquesne document and verify this parameter before applying interactive effects in the future in spaces where air conditioning may not be present. Including a mechanical drawing of the building in the project files is a simple way to document the presence of the air conditioning in a building space. We also recommend verifying that the wattage inputs used for different lamps and fixtures in the PMRS database are consistent with the values used in the TRM's Appendix C lighting calculation worksheet lookup tables to ensure consistency.

Projects numbered 9000008882.17.02 and .03 were a lighting retrofit in a single story, large retail store. Most of the measures covered T12 linear fluorescent fixtures retrofitted with T8s and the addition of occupancy sensors. Comparison of the project savings worksheet and program tracking data showed variations in the quantities of installed measures and the estimated total kWh and kW saved. The measure quantity was 1.6% higher on the worksheet than the database (1617 measures compared to 1592), with estimated consumption savings 0.7% higher (368,740 kWh compared to 366,039 kWh). The estimated demand savings was 2.8% lower in the calculation worksheet than in the program tracking data (64.32kW compared to 66.15kW). Invoices included with the project upload were not sufficient to determine the exact number of measures purchased, so the SWE was unable to confirm either fixture count. However, all available documentation pointed towards a total number of measures installed around 1600 and the SWE is confident the savings expected have been achieved.

G.1.3.3 Incentive Inconsistencies

Project number 7000613413.23.01 was a lighting retrofit in a mixed industrial building that included the retrofit of T12 fluorescent lamps with T8's, the replacement of incandescent exit signs with LED exit signs, and the replacement of metal halide lamps with high output T5 fixtures or lower wattage metal halide lamps. Review of the project savings worksheet and the customer incentive agreement (CIA) showed an expected rebate amount of $7,428.55, which differs from the database incentive amount of $7,264.21 by $164.34 (+2.2%). This difference is not a concern since there were 24 total measures in the project and incentive amounts are often adjusted between the initial application and completion of the project.

Project number 5000007893.16.02 contained T8 lighting retrofits and occupancy sensor installations in a building that falls under the CSUP Commercial Umbrella. The Lighting Inventory Form showed 23 occupancy sensors with a rebate of $16.50 per sensor for a total sensor rebate of $379.50. Database inputs for the project show a different breakdown of occupancy sensors with 16 sensors controlling a total load less than 500W, and the remaining seven7 sensors controlling a load of greater than 500W. According to the database, the incentive for sensors controlling the less than 500W is $16.50 each, matching the LIF, but the incentive for the remaining seven sensors7 (greater than 500W) is $20.00 each. The discrepancy between the information in the database and on the LIF resulted in a database incentive of $140 instead of the $115.50 expected by the LIF.

G.1.3.4 Data Entry Error

Project number 6000006605.22.02 was a custom lighting project for a building within the ISUP Industrial Umbrella. Key project values such as incentive, quantity, kW, and kWh are identical in the program database and on the project worksheet. However one line item on the worksheet included an apparent typo in the Equivalent Full Load Hours (EFLH) cell, as 260 was entered instead of 2600. This oversight had a negative impact on the annual kWh savings estimate for the project. An EFLH value of 2600 would increase the projects savings from the reported value of 127,375 to 129,011 kWh (+1.3%). It also would have increased the total expected incentive for the project from $11,040.90 to $11,188.08 (+1.3%).

Overall, the forms uploaded were well organized, easy to work with, and provided all the information required to complete a thorough review of the selected projects. The issues highlighted above were only observed on a very small number of projects and the project specific inconsistencies are minimal given the volume of projects processed by Duquesne. The remaining projects reviewed had values that showed consistency between the database and project specific files. The SWE believes the uploaded documents provided sufficient insight into the savings calculations for DLC and the associated reported savings estimates are valid.

G.2 PECO

G.2.1 Site Inspection Findings

Table G-3 presents all findings and resolutions from non-residential site inspections conducted during PY3. Column headers are defined as:

- **SWE ID:** The SWE assigned each project that received a site inspection a unique identifier.
- **Measures:** Measures that were reviewed as part of the site inspection.
- **Insp. Type:** Either Ride-Along (RA) or Independent (IND).
- **Finding:** Issues discovered through site inspections and review of evaluator reports (for RA only).
- **Finding Type:** Categorized into Evaluation (Eval), Process (Pro) or TRM (TRM) findings.
- **Resolution:** Actions taken to resolve the issues due to findings.

Table G-3: PECO Non-Residential Site Inspection Findings

SWE ID	Measures	Insp. Type	Finding	Finding Type	Resolution
PECO-301	Lighting	RA	Minor fixture count and control type discrepancies	Pro	None needed
PECO-302	EMS & VFDs	RA	Peak demand impact not consistent with reported hours	Eval	Evaluator agrees and will follow SWE's recommended approach for future projects
PECO-303	VFDs	RA	Heating hours incorrectly reported by evaluator	Eval	SWE and evaluator agreed that hours should be adjusted in common areas
PECO-304	Lighting	RA	Implementer should use parking garage deemed values and not retail store hours	Pro	Evaluator corrected building type
			Incorrect fixture wattage	Pro	Evaluator corrected fixture wattage
PECO-305	Lighting	RA	Evaluator did not inquire about space conditioning or account for emergency lighting, uninstalled occupancy sensor, or holidays in calculations	Eval	Evaluator agreed with findings and will update evaluation procedures to ensure the cited factors are accounted for
PECO-306	Lighting	RA	Implementer did not document fixture locations and applied 8,736 hours to all fixtures	Pro	PECO agreed with findings and that implementers should better document fixture EFLH and installation locations
PECO-307		RA	Evaluator used incorrect pre- and post-installation average demand to evaluate a portion of the project	Eval	Evaluator corrected inadvertent error
PECO-308	Cooling Tower	IND	Implementer incorrectly characterized base cooling load	Pro	PECO agreed with the SWE's analysis and stated that any change in cooling load must be documented

G.2.2 Review of Savings Database

PECO's non-residential portfolio consists of two programs, Smart Equipment Incentives (SEI, with C&I and GNP sectors) and Smart Construction Incentives (SCI). The retrofit, appliance recycling and multi-tenant portions of the SEI Equipment program are reported separately and both programs are separated by sector for reporting and for evaluation. Table G-4 displays the number of participants, reported energy savings and reported demand savings from each reporting category in PY3 based on PECO's PY3 Annual Report.

Table G-4: PECO Non-Residential Programs Annual Summary

Sector	Program	Participants	MWh/yr	MW
C&I	Smart Equipment Incentives - Retrofit	734	66,094	12.1
C&I	Smart Equipment Incentives - Multi-tenant	361	139	0
C&I	Smart Equipment Incentives -Appliance Recycling	9	16	0
C&I	Smart Construction Incentives	44	4688	0.9
GNP	Smart Equipment Incentives - Retrofit	275	39,440	5.3
GNP	Smart Equipment Incentives - Multi-tenant	74	144	0
GNP	Smart Equipment Incentives -Appliance Recycling	5	33	0
GNP	Smart Equipment Incentives - New Construction	21	8,479	1.2
Total		**1523**	**119,033**	**19.5**

In previous program years, PECO has adjusted all participant level peak demand impacts by a line loss factor of 7.1% to account for transmission and distribution losses. In PY3, PECO began using separate line losses for each program. The line loss multipliers of the SEI C&I, SEI GNP and SCI programs were 1.111, 1.117 and 1.113 respectively. The PY3 line loss adjustments are larger than those used in previous years and were calculated to estimate the losses which occur during the top 100 hours of system demand. Conceptually, the SWE agrees that losses are greater during periods of high system demand, but requests PECO provide additional documentation showing how the program-level line loss factors were determined.

The SWE compared the figures shown in Table G-4 to the program tracking data that PECO submitted following the close of each quarter of PY3. No discrepancies were observed. In PY3Q1, the SWE noted some inconsistencies in the way participants were counted in the multi-tenant components of PECO's non-residential programs. This issue was corrected and the annual participation counts for PECO's non-residential programs are consistent with other programs.

In PY3Q4, PECO changed the sector classification of a number of PY3 projects which had previously been submitted as C&I to GNP. In the PY3Q4 tracking data submission, PECO identified each of the projects and documented the change. The SWE was able to alter the records in the SWE database based on this exception report and recreate all of the reported impacts in PECO's PY3 annual report. The SWE understands that program tracking is a continuous process and project details are subject to change after they are first reported to the SWE. The SWE commends PECO for alerting the SWE and documenting these changes in a transparent fashion.

G.2.3 Review of Project Files

PECO provided the SWE team with project files for 97 individual projects completed during PY3. Table G-5 contains a count of the projects the SWE received documentation from for each program and quarter.

Table G-5: PECO Project Files Received by Program and Quarter

Quarter	Smart Equipment - C&I	Multi-Tenant	Smart Equipment - GNP	Smart Construction
PY3Q1	8	7	7	3
PY3Q2	6	6	7	5
PY3Q3	7	6	7	5
PY3Q4	8	3	9	3

The SWE reviewed multiple projects from each program for each quarter of PY3 to ensure that all programs and timeframes were considered in the review. There was a considerable variety of upgrade measures reported in the project files. The majority of projects reviewed consisted of retrofits to lighting, controls, HVAC equipment and appliances. Other, less common measures in the project files reviewed included cooler gasket upgrades and traffic light replacements.

Generally, each project folder contained all of the SWE's requested items. These items included application forms, equipment specifications, invoices, and savings calculation worksheets. Additional notes, e-mail transcripts, inspection reports, and site plans that were relevant to projects were also included, adding more clarity to the overall project documentation. Organizationally, the items within each set of project files were usually appropriately named for its contents, allowing for simple navigation and review.

Project files from the multi-tenant program were the least robust of the projects reviewed by the SWE because savings measures from this program are small and straightforward. Documentation for projects from this program normally only consisted of scanned copies of the customer application along with a receipt for the rebated equipment. The project files did not contain any savings calculation worksheets because the rebated measures follow a deemed savings protocol. In these cases, the SWE checked for consistency between the rebate applications and the submitted receipts and invoices.

A significant number of the projects reviewed contained conflicting energy savings and incentive amount data. The data supplied in the application summaries, savings calculation worksheets, and PECO's database usually had some consistency between subsets of the documents, but routinely lacked a unanimous consistency among all of the documents. The SWE recognizes and takes into consideration that applications are filled out by the customer and are frequently inconsistent with other documents. The application summary reports tended to always agree with either the PECO database or the application/energy savings worksheets. In some cases, which are discussed individually below, there was little consistency across any of these documents.

The majority of the project files included the necessary information and notes to follow how an energy savings estimate was achieved, usually through including a PECO energy savings calculator for each measure. Also, additional notes and data such as follow-up inspection reports and logger data were found useful in understanding the project file. The values used in the calculators (EFLH for HVAC or HOU for lighting) were normally seen as appropriate for the measures, if not exactly as specified in the TRM. However, certain instances did arise where it was not clear how the energy savings were derived. Those are noted in the individual project discussions below.

Verifying unit types and quantities was difficult if the submitted invoice was either unclear in its line item descriptions or did not offer any granularity outside of a lump sum payment. The lump sum invoice was most common for new construction projects, where billing typically covers much more than the incentivized aspects of the project.

G.2.3.1 Multi-Tenant

Projects PECO-11-91481 (PY3Q1), PECO-11-91769 (PY3Q2), PECO-11-91944 (PY3Q4), Project PECO-11-91943 (PY3Q4) all involved a clothes washer upgrade. Each of the project files submitted to the SWE team included a rebate application form and an invoice for the washer purchased. However, the rebate applications revealed inconsistent rebate amounts - $100, $50, $25, $100 for each project, respectively. Also, the forms used for projects from Q1 and Q2 appear to be for a residential appliance rebate, while the forms used in the project files in Q4 appear to be for a multi-unit building. The PECO database listings for energy and demand savings of 93.7 kWh and .0147 kW, respectively, were common among the project files reviewed. While the demand savings value matches what is listed for ENERGY STAR® clothes washers in the TRM’s residential deemed values, there is no documentation in the project files as to how the 93.7 kWh energy savings was calculated. The SWE assumes that this value is a weighted average of the TRM clothes washer estimates of 26 kWh for natural gas water heating and 258 kWh for electric water heating where the weighting factors are water heating fuel shares in the PECO service territory, but this calculation was not documented in any of the project files.

Other multi-unit projects, PECO-11-91589 and PECO-11-91868, involved refrigerators and dishwashers. Both project files included incentive applications and invoices for the efficient equipment. Despite one project using a residential rebate application and the other using a multi-unit application, both agreed on the rebate amounts per appliance. Neither project file included any documentation explicitly stating how the PECO database energy savings were calculated. However, the energy savings appeared to be within the range of deemed values in the TRM for each appliance.

G.2.3.2 Commercial and Industrial Retrofit

Project PECO-10-01629 involved a lighting upgrade. The files submitted to the SWE for this project included an application form, invoices, equipment specifications, and a savings calculation worksheet. The application form’s product quantities matched those listed on the invoice. The application summary, PECO database, and energy savings calculator agreed on the incentive amount and energy savings. Further, the correct building type was selected in the energy savings calculator, ensuring the proper hours-of-use value was applied. However, the incentive amount listed in the application summary and in the PECO database did not agree with the amount listed on the application form.

Project PECO-10-02475 also involved lighting upgrades. The files submitted to the SWE for this project included an application, savings calculation worksheet, and invoices. The incentives derived from the incentive calculation worksheet were consistent throughout the application summary and PECO database. The savings found in the lighting calculator were relatively consistent throughout the other documents. Further, the correct building type was selected in the energy savings calculator, ensuring the TRM specified hours-of-use was applied.

Project PECO-11-02379 involved cooling tower fan VFD upgrades. The files submitted to the SWE for this project included an application, invoices, equipment specifications, inspection report, and CT logger data. The energy savings were clearly tabulated in the CT logger data spreadsheet and the corresponding incentive amount was clearly calculated in the application. Further, there was consistency in these values across all documents submitted to the SWE.

Project PECO-10-01541 involved changing the control scheme on laboratory exhaust fans. The files submitted to the SWE for this project included an application, invoices, equipment specifications, and documents supporting the energy saving calculations. The incentive amount and energy savings listed in the application form, application summary report, and the PECO database all agreed with one another. The project file contains a variety of calculations and documentation supporting the energy savings found for the new upgrades.

Project PECO-11-02506 involved Energy Management System (EMS) upgrades. The files submitted to the SWE for this project included an application, EMS general information worksheet, and an inspection report. The EMS general information worksheet included details about the use of the EMS such as HVAC temperature setback points and other HVAC control strategies. However, the project files lacked any documentation that showed how the information in the general information worksheet translated into energy savings. Thus, it is not clear how the overall energy savings were calculated. The project files did not contain an invoice but the system's installation was confirmed by the post-installation inspection report.

G.2.3.3 Government and Non-Profit

Project PECO-10-01458 involved the installation of a new ground source heat pump system. The files submitted to the SWE for this project included an application, incentives worksheet, invoices, equipment specifications, and an energy savings calculator. All of the documents in the project files agreed with one another except for the quantity of heat pumps. The invoice showed a quantity of 37 heat pumps while the other documents in the project file showed a quantity of seven. It was not clear which of the 37 heat pumps purchased were the ones referenced by the other documents. Also, the incentive worksheet shows the installed units have EER values ranging from 14.7 to 15.4, which is below the minimum required (17.0) to qualify for the incentive as listed on the incentives worksheet.

Project PECO-10-01033 involved LED traffic signal upgrades. The files submitted to the SWE for this project included an application, fixture counts, invoices, and equipment specifications. The project file's documents agreed with one another on the energy savings and incentive amount. The invoice indicated that slightly higher quantities were ordered for each type of light, presumably purchased as future replacements.

Project PECO-11-02747 involved an ice maker upgrade. The files submitted to the SWE for this project included an application, invoice, equipment specification, and supporting notes. The project documents agreed with one another with respect to the incentive amount and supported the selected ice maker's qualifications for the incentive. However, the application summary report and PECO database differed on energy savings. The explicit calculations of the reported energy and demand savings were not included but are assumed to be per the TRM protocol.

G.2.3.4 New Construction

Project PECO-10-00159 involved energy efficient lighting. The files submitted to the SWE for this project included site plans, an application, invoices, equipment specifications, and an energy savings calculator. The energy savings calculator determined the difference in energy use between the installed lighting and a baseline dictated by ASHRAE 90.1-2007. The PECO tracking database agreed with the energy savings calculator on the energy savings and also agreed with the application summary on the incentive amount. However, the application indicates a much larger project than the other documents show – an incentive amount, fixture quantity, and energy savings roughly three to four times greater than what is shown in the other documents.

Project PECO-11-03488 involved occupancy sensor upgrades. The files submitted to the SWE for this project included an application, equipment specifications, invoices, and an energy savings calculator. The incentive amount calculated in the application did not match the incentive amount in the PECO database. Moreover, the energy savings calculator indicates slightly different savings values for both the lighting and control tabs than what is reported in the PECO database. Verification of quantities and equipment types was not possible as the invoice included in the project files did not contain line item descriptions or quantities for the equipment installed.

Project PECO-02773 involved HVAC upgrades. The files submitted to the SWE for this project included an application, equipment certifications, an invoice, and an energy savings calculator. PECO's tracking database agreed with the savings estimate found in the energy savings calculator but disagreed on the incentive amount in the application form.

G.3 PPL

G.3.1 Site Inspection Findings

Table G-6 presents all findings and resolutions from non-residential site inspections conducted during PY3. Columns headers are defined as:

- **SWE ID:** The SWE assigned each project that received a site inspection a unique identifier.
- **Measures:** Measures that were reviewed as part of the site inspection.
- **Insp. Type:** Either Ride-Along (RA) or Independent (IND).
- **Finding:** Issues discovered through site inspections and review of evaluator reports (for RA only).
- **Finding Type:** Categorized into Evaluation (Eval), Process (Pro) or TRM (TRM) findings.
- **Resolution:** Actions taken to resolve the issues due to findings.

Table G-6: PPL Non-Residential Site Inspection Findings

SWE ID	Measures	Insp. Type	Finding	Finding Type	Resolution
PPL-301	Lighting	RA	Lack of clarity in 2011 TRM regarding application of usage groups led to different interpretation between SWE and evaluator of usage groups EFLH	TRM	Addressed by 2012 TRM (more flexibility to use interview hours to define usage groups)
PPL-302	Lighting	RA	Minor fixture count and EFLH adjustments	Pro	Evaluator adjusted savings consistent with SWE findings
PPL-303	Lighting	RA	Incorrect EFLH used by implementer	Pro	Evaluator and SWE findings agree
PPL-304	AC, Evap Fan Controls, Anti-Sweat Controls	RA	Incorrect baseline fan assumptions	Eval	Evaluator adjusted case fan assumptions and for future projects evaluator will assume average of possible fans
PPL-305	Floating head pressure controls, high-efficiency compressors	RA	Project application incorrectly listed total compressor horsepower as total compressor tonnage	Pro	Evaluator corrected the error
PPL-306	Compressor VFD, Lighting	RA	Evaluator's calculations did not account for fact that the small hydronic heating pumps ran fully loaded all year prior to installation of VFDs	Eval	Evaluator adjusted savings to account for SWE's finding
PPL-307	VFDs	RA	VFDs operated at a reduced, though constant speed	TRM	Possible TRM addition or custom measure guidance
			Reported hours differed from TRM deemed hours based on building type	TRM	SWE recommends using best estimate of actual motor operating hours
PPL-308	Lighting	RA	Lack of clarity in 2011 TRM regarding application of usage groups led to different interpretation between SWE and evaluator of usage groups EFLH	TRM	Addressed by 2012 TRM (eliminated Table 3-2 and allows greater flexibility to use interview hours)
PPL-309	Lighting	RA	Lack of clarity in 2011 TRM regarding application of usage groups led to different interpretation between SWE and evaluator of usage groups EFLH	TRM	Addressed by 2012 TRM (eliminated Table 3-2 and allows greater flexibility to use interview hours)
PPL-310	Lighting	RA	Minor fixture count discrepancies found by evaluator and SWE	Pro	None needed

PPL-311	Lighting	RA	Incorrect building type classification	Pro	Evaluator agreed with SWE adjustment to building type classification
PPL-312	Refrigeration Measures	IND	Reported savings not consistent with invoices and TRM protocols	Pro	PPL and their implementation CSP are working to improve data tracking in EEMIS and project documentation for refrigeration measures
PPL-313	Lighting	IND	Interval meter data should not be used to determine EFLH	Pro	None yet; awaiting EDC response
PPL-314	Lighting	IND	Fixture cut sheets inconsistent with reported savings	Pro	None yet; awaiting EDC response

G.3.2 Review of Savings Database

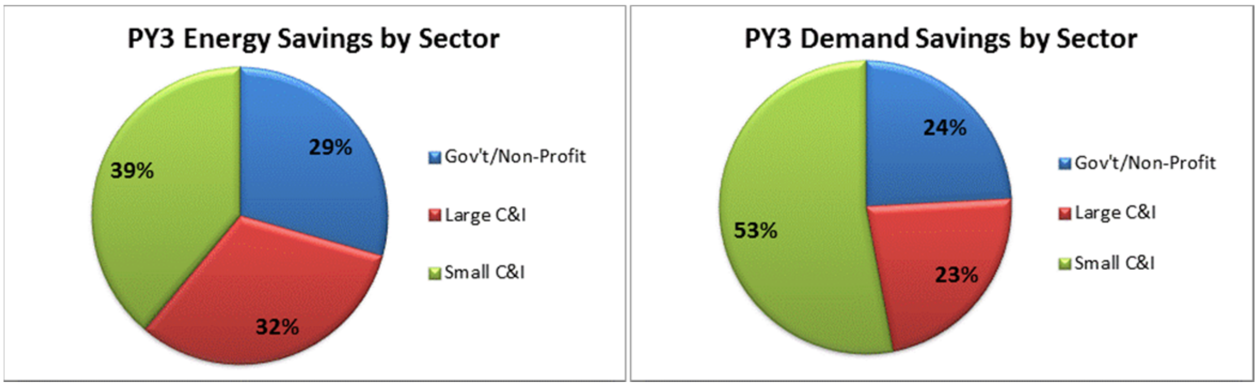
PPL's programs are designed to be cross-cutting, allowing customers from all rate classes to participate. This section only addresses the non-residential portions of these programs. PPL separates impacts by sector in the quarterly tracking data submitted to the SWE, and in PY3 the program tracking data contained impacts from the small C&I (SCI), large C&I (LCI), and GNP sectors for five programs in PY3. Table G-7 shows the distribution of participants, energy savings and demand savings across PPL's non-residential portfolio for PY3 based on the quarterly tracking data submitted to the SWE. The Efficient Equipment Incentive Program is separated into three sub-groups; C&I Lighting – New Construction, C&I Lighting Retrofit and EE Non-Lighting.

Table G-7: PPL Non-Residential Impacts by Program and Sector

Program	Sector	Participants	MWh/yr	MW
Appliance Recycling	GNP	49	81	0.01
Appliance Recycling	LCI	2	3	0.00
Appliance Recycling	SCI	338	629	0.11
C&I Lighting - New Construction	GNP	68	4,560	1.28
C&I Lighting - New Construction	LCI	10	1,530	0.31
C&I Lighting - New Construction	SCI	54	4,788	8.23
C&I Lighting Retrofit	GNP	721	34,831	7.74
C&I Lighting Retrofit	LCI	154	50,217	7.28
C&I Lighting Retrofit	SCI	2,451	108,020	22.80
Custom Incentives	GNP	29	45,640	4.61
Custom Incentives	LCI	47	46,537	6.38
Custom Incentives	SCI	63	4,115	0.55
EE Non-Lighting	GNP	883	3,694	0.52
EE Non-Lighting	LCI	73	964	0.16
EE Non-Lighting	SCI	2,795	3,134	0.45
HVAC Tune-Up Program	LCI	19	-3	0.00
HVAC Tune-Up Program	SCI	703	820	0.59
Renewable Energy Program	GNP	125	3,017	0.78
Total		**8,584**	**312,578**	**61.81**

The non-residential components of PPL's EE&C programs achieved a gross reported energy savings of 312,578 MWh/yr and a gross reported demand savings of 61.81 MW in PY3. This represents 60.7% of the energy savings and 81.7% of the peak demand savings in PPL's portfolio for PY3. Figure G-1 shows the PY3 contribution of energy and demand savings from the SCI, LCI and GNP sectors.

Figure G-1: PPL Non-Residential Impacts by Sector: PY3



The SWE combined the four quarters of the PY3 program tracking data submitted by PPL and compared the sums of the energy and demand impacts to the figures used to calculate verified gross savings for programs which were stratified by sector for evaluation. The Appliance Recycling Program was not evaluated separately for non-residential sectors so it is excluded from the following comparison. Table G-8 shows the reported gross savings for the non-residential portions of PPL's programs that were presented in the final annual report. PPL performs an ex ante adjustment on these figures prior to applying the realization rates determined by the Cadmus Group, the PPL Program Evaluator.

Table G-8: PPL Non-Residential Reported Gross Savings by Program: PY3 Annual Report

Program	MWh/yr	MW
Custom Incentives	96,291	11.54
Efficient Equipment	212,325	49.01
Renewable Energy Program	2,627	0.74
HVAC Tune-Up	817	0.60
Total	**312,060**	**61.89**

The values shown in Table G-9 summarize the contents of the program tracking data submitted to the SWE for PY3.

Table G-9: PPL Non-Residential Reported Gross Savings by Program: PY3 Program Tracking Data

Program	MWh/yr	MW
Custom Incentives	96,291	11.54
Efficient Equipment	211,739	48.77
Renewable Energy Program	3,017	0.78
HVAC Tune-Up	817	0.60
Total	**311,864**	**61.69**

In

Table **G-10**, the variances between the reported figures and the information contained in the tracking data extracts are presented.

Table G-10: Variances between PPL Tracking Data and Annual Report

Program	MWh/yr	MW
Custom Incentives	0	0.00
Efficient Equipment	586	0.24
Renewable Energy Program	-390	-0.04
HVAC Tune-Up	0	0.00
Total	**196**	**0.20**

All variances are reported as:

$$\textbf{Reported Figure } - \textbf{Database Summary} = \textbf{Variance}$$

Please note that variances do not necessarily indicate inadequate QA/QC, incorrect reported savings or incorrect verified savings.

The source of the discrepancy for the Renewable Energy Program is a GSHP project in a school district in PPL service territory. The program data extract (Appendix R) provided by PPL for PY3Q1 listed eight8 measures being installed with a reported energy savings of 390.7 MWh/yr and a reported demand savings of 0.045 MW. A second tracking spreadsheet submitted to the SWE did not include the project. The impacts from the project were also reflected in the Renewable Energy Program summary statistics in PPL's PY3Q1 report, so the SWE considered the project as reported. It appears that PPL did not ultimately count this project as part of the Renewable Energy Program in PY3 because the PPL PY3Final Annual Report shows no participation for PY3Q1 and the energy and demand impacts associated with the project were not included in the gross reported savings totals for the program. The SWE was also unable to locate the project in PPL's online tracking system, EEMIS, at the time of this report.

The SWE also noted minor differences between the program tracking data and the final gross reported savings figures for the Efficient Equipment Incentive Program. This variation is often the result of program implementers or evaluators 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 understands that program tracking is a continuous process and historical corrections are expected and encouraged. Given the volume of rebates processed by PPL in PY3 and the complexity of the Act 129 tracking and reporting requirements, the SWE believes PPL's EEMIS tracking system is performing quite well. No modifications are recommended to the EEMIS system or to the tracking data extracts that are submitted to the SWE.

G.3.3 Review of Project Files

The SWE review of non-residential projects completed by PPL's customers during PY3 was completed using project documentation files uploaded quarterly to the SWE SharePoint site. The uploaded project files included project level savings calculation worksheets, specification sheets for equipment installed, invoices, customer incentive agreements and post-inspection forms. Documentation provided was comprehensive, detailed, organized and allowed for complete review of all uploaded projects.

Project files for most requested programs and projects were properly uploaded, although there were a few file requests that did not provide the information requested. The Commercial Non-Lighting program exhibited issues in both Q1 and Q4 documentation which prevented the SWE from completing an evaluation. In Q1 the documentation uploaded covered rebates for residential appliances delivered to single family homes. It appeared that project files were uploaded from the residential appliance rebate program instead of from the expected Commercial Non-Lighting projects. This oversight left the SWE team without any projects to review for Q1. Documentation uploaded to the SharePoint site for Q4 only included a single evaluation worksheet for each project outlining verified savings analysis completed by the evaluation contractor. All 10 projects were missing files such as applications, invoices, and specification sheets, that were needed to complete a thorough evaluation of each project, and as a result, the SWE team was unable to complete an evaluation for any Q4 Commercial Non-Lighting projects. One additional project missing files was discovered in Q2 of the Commercial Lighting Program (project ID: PPL-10-02534). The other nine Q2 projects from the Commercial Lighting program provided thorough documentation which allowed for proper evaluation. Overall the uploaded files were very well organized and allowed for comprehensive review of all required projects. In addition to the unavailable, inaccurate, or missing documentation, the SWE observed several inconsistencies between the project worksheets, associated documentation, and the program tracking data. These inconsistencies are highlighted below with a focus on the largest program kW and kWh impacts uncovered during the review.

G.3.3.1 Custom Incentives Program

Projects in the Custom Incentive Program consistently provided thorough documentation for the SWE team to review. A review of these documents revealed several inconsistencies in kWh and kW savings values between the savings calculation worksheets and the database.

Project #148 involved a lighting retrofit across a number of municipal parking garages. Database savings values of 288,033 kWh/yr and 26.43 kW conflicted with project worksheet which expected savings of

805,792 kWh and 74.09 kW (an increase of 180% for kWh and kW savings over the database values). Further inspection into the project documentation provided a Custom Internal Review form which determined the energy savings of the project to be identical to the values in the database (288,033kWh and 26.43 kW). The SWE concluded that the project worksheet included in the files was not current and did not reflect the final scope of the project. This project was discussed with PPL and it was determined that the original application submitted by the customer contractor included three municipal parking garages. The implementer eventually broke up the three parking garages into separate projects. After the projects were broken up, only one location remained in project #148. Project 200 is a combined heat and power project which allowed the participant to generate electricity on-site instead of purchasing it from PPL. The heat output from the turbine is also used to heat water to steam, which satisfies the heating needs of the site during winter months.

The SWE determined that kWh savings were calculated correctly, and that an adjustment is needed to the reported verified demand savings. The verified demand savings was calculated based on a 24 hour metered average of gas turbine output, net of auxiliary load, from June 1, 2012 through September 18, 2012 with the period from September 19 through September 30 prorated based on the September metered output through the 18th. Since gas turbine output characteristically increases as ambient temperature declines, this average value includes the higher power output that occurs during the cooler nighttime hours. Only power generated June through September on non-holiday weekdays between 12:00 and 20:00 hours (when the 100 hours of highest peak demand would typically occur) should be included in the average. The SWE used meteorological data and gas turbine manufacturer's performance data included in the project files to adjust for this ambient temperature effect. The SWE recommends an adjustment to the verified kW savings of 3,642 kW to 3,495 kW based on the above, for a 96% attainment percentage.

G.3.3.2 Direct Discount Program

The Efficient Equipment Direct Discount Program uploads were well organized and easy to review but lacked all of the different types of project files expected. Files for each project were restricted to the E-power Direct Discount Inspection Form, which provided annual savings (kWh and kW), the incentive paid to the participant, and a table listing basic information about the baseline and replacement equipment. Additional requested documentation includes project specific savings calculations, invoices, and specification sheets.

In addition to the documentation limitations, each of the 20 projects reviewed showed inconsistencies between the kWh and kW annual savings provided by the E-power Inspection Form and the database values listed for the program. Although the magnitude of the inconsistencies was different for each project, the average across all 20 projects showed that energy (kWh) savings in the database are 20% higher than expected by the Inspection Forms, and the database demand (kW) savings are 10% higher. Only five of the 20 projects showed an inconsistency in the rebate amount leading to an average incentive of 0.2% lower than expected by the Inspection Forms. The SWE believes that the use of self-reported lighting hours-of-use in the project documentation instead of TRM values was the source of the difference between the projects files and the database because PPL's tracking system relies on TRM hours-of-use values. The SWE recommends that when the self-reported hours-of-use differ significantly from TRM assumptions for a given building type the project should be flagged and investigated to determine if the correct building type is being applied. Once an accurate value has been determined, it should be used consistently across all segments of the project so discrepancies in savings values between the database and individual project files are minimized.

Overall the forms uploaded were well organized, easy to work with, and provided all the information required to complete a thorough review of the selected projects. The issues highlighted above were only observed on a very small number of projects and the project specific inconsistencies are minimal compared to size of the overall program. The inconsistencies reported are minor database oversights and data entry errors, which are expected given the volume of projects processed by PPL. The remaining projects reviewed showed consistency between the database and project specific files. The SWE believes the uploaded documents provided sufficient insight into the savings calculations and documentation processes used by PPL and believes the associated reported savings estimates are valid.

G.4 Met-Ed

G.4.1 Site Inspection Findings (FirstEnergy Companies combined)

The following table presents all findings and resolutions from non-residential site inspections conducted during PY3. Columns headers are defined as:

- **SWE ID:** The SWE assigned each project that received a site inspection a unique identifier.
- **Measures:** Measures that were reviewed as part of the site inspection.
- **Insp. Type:** Either Ride-Along (RA) or Independent (IND).
- **Finding:** Issues discovered through site inspections and review of evaluator reports (for RA only).
- **Finding Type:** Categorized into Evaluation (Eval), Process (Pro) or TRM (TRM) findings.
- **Resolution:** Actions taken to resolve the issues due to findings.

Table G-11: FirstEnergy Non-Residential Site Inspection Findings

SWE ID	Measures	Insp. Type	Finding	Finding Type	Resolution
FE-301	Lighting	RA	2011 TRM allowed little flexibility to define 24/7 usage groups without logging	TRM	Addressed by 2012 TRM (more flexibility to use interview hours)
FE-302	Lighting	RA	Evaluator did not inquire about baseline EFLH	Eval	Evaluator will emphasize interviewing site contacts to gather as much detailed information about baselines as possible in PY4
			Evaluator used usage groups despite project impact of < 50 kW	Eval	Issue resolved by 2012 TRM , which lowered the threshold that whole-building hours shall be used to < 20 kW and allows interview hours to be used to define usage groups
FE-303	Lighting	RA	Evaluator did not inquire about baseline fixture counts and whether the project included adding or reducing the number of fixtures	Eval	Evaluator will emphasize interviewing site contacts to gather as much detail about projects in PY4 as possible (e.g. emergency lighting, baselines, etc.)
FE-304	Lighting	RA	Fixture type not deemed in TRM	TRM	Possible TRM addition
			Less than one week of logger data	Eval	Evaluator will log future projects for at least three weeks
FE-305	Lighting	RA	Evaluator incorrectly characterized conditioning in one building	Eval	Evaluator concurred that space was improperly characterized and will improve tracking site visit findings in PY4
	Lighting		EFLH in one building inconsistent with customer reported hours	Eval	Evaluator and SWE resolved EFLH inconsistency and adjusted savings accordingly
FE-306	VFDs	RA	None – dropped from evaluator sample and no process findings		Not applicable
FE-307	Lighting, Enthalpy Controls, AC	RA	Incorrect fixture controls	Pro	None yet
FE-308	VFDs	RA	Two pumps/VFDs unaccounted for	Pro	None yet
FE-309	Lighting	IND	Building EFLH significantly lower than 2011TRM deemed value	TRM	Addressed by 2012 TRM (more flexibility to use interview hours)

G.4.2 Review of Savings Database

Met–Ed reported savings from five non-residential programs in PY3. The Met-Ed program definitions are generally based on sectors, with each distinct customer segment in the non-residential customer base being assigned to a program. Table G-12 presents the participant count, gross reported energy savings and gross reported demand savings figures that were presented in the final annual report. The Small C&I Equipment Program was responsible for 69% of the energy savings and 61% of the peak demand savings in Met-Ed's PY3 non-residential portfolio.

Table G-12: Met-Ed Non-Residential Program Impacts

Program	Participants	MWh/yr	MW
Small C&I Equipment	190	40,688	8.53
Large C&I Equipment	41	11,880	1.47
Street Lighting	44	776	0.00
Non-Profit	7	87	0.03
Remaining Government/Non-Profit	110	5,392	3.99
Totals	**392**	**58,823**	**14.02**

Each of the Pennsylvania EDCs is required to submit program tracking data from its EE&C programs to the SWE each quarter. Non-residential program tracking data is requested in section 3a of the SWE Quarterly Data Request. SAIC, the CSP, used a different set of program definitions from the ones used for reporting that are based on equipment type. In PY3Q3, Met-Ed began mapping each completed project to the reporting category in its quarterly data request response to the SWE. For the first two quarters of PY3, the SWE assigned projects to reporting categories based on the 'Sector' field in the data.

Table G-13 summarizes the quarterly tracking data submitted to SWE by Met-Ed in PY3.

Table G-13: Met-Ed Non-Residential Program Tracking Data

Program	Participants	MWh/yr	MW
Small C&I Equipment	192	40,715	8.76
Large C&I Equipment	41	11,880	1.47
Street Lighting	41	769	0.00
Non-Profit	49	4,031	3.61
Remaining Government/Non-Profit	70	1,447	0.41
Totals	**393**	**58,842**	**14.25**

In Table G-14, the variances between the reported figures and the information contained in the program databases are presented.

Table G-14: Met-Ed Non-Residential Program Variances

Program	Participants	MWh/yr	MW
Small C&I Equipment	-2	-27	-0.23
Large C&I Equipment	0	0	0.00
Street Lighting	3	7	0.00
Non-Profit	-42	-3,944	-3.58
Remaining Government/Non-Profit	40	3,945	3.58
Totals	**-1**	**-19**	**-0.23**

All variances are reported as:

$$\textbf{Reported Figure} - \textbf{Database Summary} = \textbf{Variance}$$

Table G-14 shows some minor variation in the total non-residential impacts between the Met-Ed PY3 Annual Report and the contents of the quarterly tracking data. It appears that one project was reported in the quarterly tracking data that was not ultimately counted toward the PY3 savings. The SWE understands that program tracking is an ongoing process and that, in an effort to report the most accurate savings estimates possible, it is sometimes necessary to change key parameters of a project after the quarter it was originally reported in as new information becomes available or QA/QC processes uncover errors.

The large variations in Table G-14 come at the program level. During PY3Q1 and PY3Q2, projects were not mapped to the reporting category of which they would ultimately be a part. This was primarily an issue for the Non-Profit and Remaining Government/Non-Profit programs because the distinction between the two programs was not clear. In PY3Q3 and PY3Q4, the reporting program of each project was identified in the tracking data submitted to the SWE and the issue was resolved. The SWE encourages Met-Ed to continue presenting program tracking data in this manner in PY4.

G.4.3 Review of Project Files

FirstEnergy provided the SWE with supporting documentation from projects from all non-residential programs in PY3. The SWE conducted a single review for Met-Ed, Penelec and Penn Power because the program design and implementation contractor are the same across the three EDCs. Most of the projects submitted in PY3 were part of the gross impact evaluation sample and therefore were also reviewed by the ADM, the FirstEnergy Program Evaluator. The SWE requests that FirstEnergy supply project files for projects that are not part of the evaluation sample to avoid redundancy and so that a greater number of projects are reviewed. Files were provided for each program in the non-residential portfolio and represented projects completed in Q1, Q2, and Q4. Project files were not provided for projects completed in Q3. The SWE audited a sample of projects for each quarter, looking for consistency between the data presented in the files and the tracking database and supporting program documents. The projects were chosen at random for each quarter and each of the FirstEnergy companies.

Of the 15 projects reviewed across the FirstEnergy companies' combined EE&C portfolios, few projects reported consistent energy and demand savings figures between the project files and the database. Many projects appeared to have their savings estimates altered at some point through the application process. For many of these projects, it was unclear what led to the changes or which values were the correct values. The majority of the project folders contained some important project documents but not all of the requested items. Documents that were commonly missing were savings calculation sheets, project approval documents and verifications of installations. The majority of project folders contained application materials, equipment invoices and cut sheets, and program calculators, though the calculators were not always complete. Table G-15 below outlines the discrepancies found between the project files and the database. The major discrepancies are also discussed below with project examples.

Table G-15: Project File and Database Comparison: FirstEnergy PY3

Project Number	Reported kW Savings	Project File kW Savings	Reported kWh Savings	Project File kWh Savings
NSLB15546	8.15	8.15	22,785	15,116
SLB10163	0.45	0.62	3,046	2,242
CI30456	0	0	11,218	11,218
MD29978	4.63	4.63	36,340	36,340
NSLB30080	36.94	18.26	229,467	124,734
SALTS9598	2.07	2.38	18,153	N/A
CI9985	0	2.38	831,758	831,758
HVAC36868	0.11	N/A	147	N/A
MD29979	5.74	5.74	43,766	43,766
SALTS40066	0	0	3,896	N/A
NSLB38004	3.73	4.03	28,033	29,016
SALTS51844	0	0.455	1,956	N/A
SLB10266	0.784	N/A	4,615	N/A
MD49828	1.787	N/A	26,713	N/A
NSLB19922	13.52	10.7	70,943	69,905

Project NSLB15546 was a lighting project completed in the Penelec service territory in Q1. The main discrepancy for this project was that the savings and incentive values reported in the project documents did not match what was presented in the savings database. The project folder contained the majority of the necessary documents -program application, equipment specifications, savings calculator and the invoice tracking tool- but did not include any actual project invoices for the rebated equipment. The differences in kWh savings between the calculator and program tracking data are due to the EFLH assumption. The savings calculator used EFLH values of 2,340 and 585 instead of the TRM value of 2,808 for the "Office – Small" building type. It appears that the TRM value was used to calculate the savings values stored in the program tracking database, but the spreadsheet calculator was not updated accordingly.

Project CI30456 was a custom process improvement project completed in the Met-Ed service territory in Q1. The project folder contained the project application, invoice information, analysis methods and a third party review of the project savings. Both the incentive amounts and energy savings values matched between the database and the project documentation. The only main project documents that the folder was missing were a product specifications document and a document verifying project installation. The method used to calculate savings seemed reasonable and was well described. Installation dates were consistent between the database and supporting project documents. Overall, this project was documented very well. Savings estimates and incentive amounts matched the database, and project documentation was easy to follow.

Project MD29978 was an evaporator fan motor project completed in the Met-Ed service territory in Q1. This project appears to be one of a few projects completed by the customer. The project folder contains the customer applications, product specifications, savings calculations, cost effectiveness information, and invoices. The folder also includes a review document that correctly calls out the savings values and explains how the implementer's savings calculations that were ultimately reported were different from a preliminary savings calculator created by the installation contractor that was included in the project files. The differences stemmed from the way refrigeration savings were calculated and the incorporation of more realistic fan run times in the algorithm. MD29979 was similar to a project completed at another location of the same chain of stores from the Met-Ed service territory reported in Q2. This project included three sets of energy savings estimates; one by the installation contractor, one provided in the original application and one provided in the FirstEnergy Implementation Contractor review of the project. The energy savings estimates included in the database matched the review provided by the FirstEnergy Implementation Contractor.

SALTS9598 was a traffic lighting project completed in the Met-Ed service territory in Q1. Installation appears to have been verified by a FirstEnergy representative. The folder contained a lot of information regarding the project, but in some cases, it was still difficult to determine what was actually installed. It appears that the project was modified after the preliminary application was submitted. There is no kWh savings number presented in the application, but the demand savings value and incentive values do not match what is presented in the database. Changes to the project scope with limited supporting documentation were a common issue throughout the FirstEnergy project files.

HVAC36868 was an air conditioning project completed in the Met-Ed territory in Q2. The project covered the installation of a new 14 SEER unitary heat pump. There was very limited information provided in the project file, but it did give a basic understanding of what was installed. However, the project files did not include any information about how energy savings were calculated. Since the verified savings estimate for the project matched the reported savings estimates, it follows that algorithms from Section 3.6 of the 2011 TRM were used, but this information should be included in the supporting documentation.

NSLB38004 was a lighting project completed in the Penn Power territory in Q4. The project included the installation of energy efficient lighting and control equipment. The major discrepancy for this project was that the calculator included in the project does not seem to include all of the equipment that was purchased. The calculator included 40 high bay fixtures controlled by occupancy sensors. The invoice included in the project file showed a quantity of 38 fixtures, the majority of which were not shipped according to the invoice. According to the invoice, only six of the 38 fixtures were shipped at the time of the invoice, and there is no additional documentation showing the completion of the project. The project also uses HOU values that differ from the TRM assumption for an unconditioned storage space, which is where the project was installed.

The SWE review of these projects identified a number of overarching issues seen throughout the sampled projects. The majority of projects reviewed provided a good deal of information on the equipment that was installed as part of the project, but many files were lacking clear descriptions of installed quantities and documentation, especially for projects that underwent changes after the initial application. Overall, the project files did not present an accurate picture of how the savings values that were ultimately stored in the program tracking database and reported in the quarterly and annual reports were calculated. The SWE recommends that FirstEnergy incorporate TRM assumptions and algorithms earlier in the implementation process by requiring use of the TRM Appendix C (Lighting Inventory Tool) and Appendix D (Motor and Variable Frequency Drive Inventory Tool) during the rebate application process.

G.5 Penelec

G.5.1 Review of Savings Database

Penelec reported savings from five non-residential programs in PY3. Like each of the FirstEnergy companies, the Penelec program definitions are generally based on sectors, with each segment in the non-residential customer base being assigned to a program regardless of the type of efficient equipment that was installed. Table G-16 presents the participant count, gross reported energy savings and gross reported demand savings figures from each program that were presented in the final annual report. Penelec reported a gross energy savings of 65,355 MWh/yr and a gross demand savings of 16.63 MW from the non-residential sector in PY3.

Table G-16: Penelec Non-Residential Program Impacts

Program	Participants	MWh/yr	MW
Small C&I Equipment	464	28,065	5.28
Large C&I Equipment	58	18,224	3.79
Street Lighting	58	423	0.00
Non-Profit	26	643	0.11
Remaining Government/Non-Profit	340	18,000	7.45
Totals	**946**	**65,355**	**16.63**

Each of the Pennsylvania EDCs is required to submit program tracking data from its EE&C programs to the SWE each quarter. Non-residential program tracking data is requested in section 3a of the SWE Quarterly Data Request. SAIC, the CSP, used a different set of program definitions from the ones used for reporting that are based on equipment type. In PY3Q3, Penelec began mapping each completed project to the reporting category in its quarterly data request response to the SWE. For the first two quarters of PY3, the SWE assigned projects to reporting categories based on the 'Sector' field in the data. Table G-17 summarizes the quarterly tracking data submitted to SWE by Penelec in PY3.

Table G-17: Penelec Non-Residential Program Tracking Data Summary

Program	Participants	MWh/yr	MW
Small C&I Equipment	457	28,475	5.45
Large C&I Equipment	61	18,417	3.82
Street Lighting	9	30	0.00
Non-Profit	289	14,028	6.35
Remaining Government/Non-Profit	145	5,383	1.29
Totals	**961**	**66,333**	**16.91**

In Table G-18, the variances between the reported figures and the information contained in the program databases are presented.

Table G-18: Penelec Non-Residential Program Variances

Program	Participants	MWh/yr	MW
Small C&I Equipment	7	-410	-0.17
Large C&I Equipment	-3	-193	-0.03
Street Lighting	49	393	0.00
Non-Profit	-263	-13,385	-6.24
Remaining Government/Non-Profit	195	12,617	6.16
Totals	**-15**	**-978**	**-0.28**

All variances are reported as:

$$\textbf{Reported Figure} - \textbf{Database Summary} = \textbf{Variance}$$

Table G-18 shows some minor variation in the total non-residential impacts between the Penelec PY3 Annual Report and the contents of the quarterly tracking data. It appears that not all of the projects that were reported in the quarterly tracking data were ultimately counted toward the PY3 savings. The SWE understands that program tracking is an ongoing process and that, in an effort to report the most accurate savings estimates possible, it is sometimes necessary to change key parameters of a project after the quarter it was originally reported in as new information becomes available or QA/QC processes uncover errors.

The large variations in Table G-18 come at the program level. During PY3Q1 and PY3Q2, projects were not clearly mapped to the reporting category of which they would ultimately be a part. This was primarily an issue for the Non-Profit and Remaining Government/Non-Profit programs because the distinction between the two programs was not clear. In PY3Q3 and PY3Q4, the reporting program of each project was identified in the tracking data submitted to the SWE and the issue was resolved. The SWE encourages Penelec to continue presenting program tracking data in this manner in PY4.

G.5.2 Review of Project Files

The SWE project file review of the FirstEnergy legacy companies can be found in Section G.4 of this Appendix.

G.6 Penn Power

G.6.1 Review of Savings Database

Penn Power reported savings from three non-residential programs in PY3. Like each of the FirstEnergy companies, the Penn Power program definitions are generally based on sectors, with each segment in the non-residential customer base being assigned to a program regardless of the type of efficient equipment that was installed. Table G-19 presents the participant count, gross reported energy savings and gross reported demand savings figures from each program that was presented in the Penn Power PY3 Annual Report. Penn Power reported a gross energy savings of 20,042 MWh/yr and a gross demand savings of 5.18 MW from the non-residential sector in PY3. The Small C&I Equipment Program was responsible for 79% of the non-residential energy savings and 68% of the non-residential demand savings.

Table G-19: Penn Power Non-Residential Program Impacts

Program	Participants	MWh/yr	MW
Small C&I Equipment	41	15,913	3.52
Large C&I Equipment	7	634	0.10
Remaining Government/Non-Profit	29	3,495	1.56
Totals	**77**	**20,042**	**5.18**

Each of the Pennsylvania EDCs is required to submit program tracking data from its EE&C programs to the SWE each quarter. Non-residential program tracking data is requested in section 3a of the SWE Quarterly Data Request. SAIC, the FirstEnergy Implementation Contractor used a different set of program definitions from the ones used for reporting that are based on equipment type. In PY3Q3, Penn Power began mapping each completed project to the reporting category in its quarterly data request response to the SWE. For the first two quarters of PY3, the SWE assigned projects to reporting categories based on the "Sector" field in the data. Table G-20 summarizes the quarterly tracking data submitted to SWE by Penn Power in PY3.

Table G-20: Penn Power Non-Residential Program Tracking Data Summary

Program	Participants	MWh/yr	MW
Small C&I Equipment	42	16,175	3.52
Large C&I Equipment	7	634	0.10
Remaining Government/Non-Profit	29	3,495	2
Totals	**78**	**20,304**	**5.18**

In Table G-21, the variances between the reported figures and the information contained in the program databases are presented.

Table G-21: Penn Power Non-Residential Program Variances

Program	Participants	MWh/yr	MW
Small C&I Equipment	-1	-262	0.00
Large C&I Equipment	0	0	0.00
Remaining Government/Non-Profit	0	0	0.00
Totals	**-1**	**-262**	**0.00**

All variances are reported as:

$$\textbf{Reported Figure} - \textbf{Database Summary} = \textbf{Variance}$$

Table G-21 shows a slight difference in the total non-residential impacts between the Penn Power annual report and the contents of the quarterly tracking data. The SWE understands that program tracking is an ongoing process and that, in an effort to report the most accurate savings estimates possible, it is sometimes necessary to change key parameters of a project or reclassify a project after the quarter it was originally reported in as new information becomes available or QA/QC processes uncover errors.

Penn Power did not report any participation in the Non-Profit Program, so the confusion about whether a project belonged in the Non-Profit Program or Remaining Government/Non-Profit Program, which was discussed above in the Met-Ed and Penelec audit sections, did not apply for Penn Power. The SWE was encouraged to see Penn Power's program tracking data submitted in a consistent format in both PY3Q3 and PY3Q4. In addition to the transparency that comes with a standard format, the Q3/Q4 tracking data identified the reporting program of each project. The SWE encourages Penn Power to continue presenting program tracking data in this manner in PY4.

G.6.2 Review of Project Files

The SWE project file review of the FirstEnergy legacy companies can be found in Appendix G.4.

G.7 West Penn Power[105]

G.7.1 Review of Savings Database

Each of the Pennsylvania EDCs is required to submit program tracking data from its EE&C programs to the SWE each quarter. Non-residential program tracking data is requested in section 3a of the SWE Quarterly Data Request. The participant counts, energy and demand impacts reflected in the program tracking are compared to EDC quarterly and annual reports to ensure that the *ex ante* program impacts are being tracked and reported accurately. West Penn Power underwent a major change in the second half of PY3 when program implementation and tracking shifted to the model used by the FirstEnergy legacy companies. All program tracking changes were well-documented and from the SWE perspective, the transition was as seamless as possible.

In its PY3 Annual Report, West Penn Power reported impacts from three non-residential programs. These program definitions were the same as the legacy FirstEnergy companies and were divided along sectors. Table G-22 shows the participant counts, gross reported energy savings and gross reported demand savings by program from West Penn's PY3 Annual Report.

Table G-22: West Penn Power Non-Residential Gross Impacts by Program - PY3

Program	Participants	MWh/yr	MW
Commercial & Industrial Equipment Program - Small	26,006	59,193	17.6
Commercial & Industrial Equipment Program - Large	37	20,065	3.4
Governmental and Institutional Program	229	69,463	10.2
Total	**26,272**	**148,721**	**31.2**

[105] Sections G.7.2.1 through G.7.2.4 discuss legacy West Penn Power programs that were discontinued in mid-PY3. At that time, West Penn Power transitioned to the FirstEnergy companies' EE&C programs structure. Section G.7.2.5 discusses West Penn Power's non-residential projects implemented under the FirstEnergy companies' EE&C programs structure.

The SWE attempted to reconcile the reported impacts in Table G-22 with the contents of West Penn Power's quarterly tracking data submissions. Projects from Q1 through Q3 that were initially reported under the West Penn Power naming conventions were mapped to the FirstEnergy program definitions using the "customer segment" field of the quarterly data request response. Table G-23 summarizes the program tracking data submissions from PY3.

Table G-23: West Penn Power Savings Database Summary – PY3

Program	Participants	MWh/yr	MW
Commercial & Industrial Equipment Program - Small	26,027	59,157	18.2
Commercial & Industrial Equipment Program - Large	36	18,720	2.8
Governmental and Institutional Program	220	69,459	10.2
Total	**26,283**	**147,336**	**31.2**

In Table G-24, the variances between the reported figures and the information contained in the program databases are presented.

Table G-24: West Penn Power Non-Residential Program Variances

Program	Participants	MWh/yr	MW
Commercial & Industrial Equipment Program - Small	-21	36	-0.6
Commercial & Industrial Equipment Program - Large	1	1345	0.6
Governmental and Institutional Program	9	4	0.0
Total	**-11**	**1385**	**0.0**

All variances are reported as:

$$\textbf{Reported Figure} - \textbf{Database Summary} = \textbf{Variance}$$

Minor variations were observed between the tracking data submitted to the SWE and the final PY3 reported impacts. The SWE understands that program tracking is a continuous process and the quarterly tracking data submissions are just a "snapshot" of the tracking system at a given point in time. The differences shown in Table G-24 are expected given the volume of projects rebated by West Penn Power in PY3. The SWE commends West Penn Power's handling of the transition to the FirstEnergy program model in PY3 with regard to program tracking.

G.7.2 Review of Project Files

West Penn Power provided the SWE with project files for 107 individual projects completed during PY3. The SWE reviewed projects in all four quarters to check the savings recorded in the program tracking databases against actual project files to verify consistency in the reporting process and to identify potential opportunities for improvement.

West Penn provided project files for the requested number of projects for Q1, Q2 and Q3, with the exception of Nonstandard Lighting program for Q3, for which no files were uploaded. In addition, the only project files that were uploaded for Q4 were for Custom Incentives program and the Nonstandard Lighting program; project files were missing for the remaining programs.

The project files for all quarters were all uploaded into one folder, and they had an inconsistent naming methodology by program. For instance, for commercial programs, the files were named by "Unique ID – Business Name – Document Description." For other programs, the files were named by "Unique ID – Program Name – Document Description." It would be easier to recognize the files if a single naming convention were used for all project file uploads. It is also recommended that West Penn provide the SWE with a spreadsheet identifying sampled projects from each program or flag them in the program tracking data to provide clarity.

Overall, most of the project file uploads included the requested files. Some programs were missing invoices, while others were missing final reports or equipment specification sheets. The energy and demand savings numbers from the project files matched the database for most of the projects that were reviewed. The rebate amount was not always included in the project files, so it was not always verified. The project files included enough information on baseline and retrofit equipment to determine what was installed, and it was clear how the savings were generated. The TRM measures used protocols from the 2011 TRM, and the custom measure project files included a report that outlined how the savings were calculated.

During the second half of PY3, West Penn Power transitioned from implementing its own non-residential programs to using SAIC, the CSP. The file uploads from SAIC-implemented projects were less transparent than files from projects implemented by West Penn. The SAIC projects included a number of excess files (W9's, blank images) and there wasn't always a clear description of how the savings were calculated. Each program is detailed individually below.

Figure G-2: SWE Project File Review Summary – West Penn Power

Unique ID	Project Files kWh	Database kWh	kWh Difference	Project Files kW	Database kW	kW Difference	Project Files Rebate	Database Rebate	Rebate Difference
PCCST00000046	704818	681725	23093	145	144	1	NX	$35,000	NX
PCCST00000049	1214119	1214119	0	189	189	0	NX	$150,000	NX
PCCST00000064	406883	356809	50074	103	90	13	NX	$33,925	NX
PCCST00000023	962649	962649	0	450	450	0	NX	$100,000	NX
PCCST00000048	195461	195461	0	22	22	0	NX	$13,500	NX
PCDRV00000007	109833	252991	-143158	68	4.6	64	NX	$8,700	NX
PCDRV00000011	323025	323025	0	38	38	0	NX	$19,048	NX
PCCST00000050	32272	32272	0	2.32	2.32	0	NX	$1,850	NX
PCCST00000052	66479	66479	0	8	8	0	NX	$23,500	NX
PCDRV00000019	96218	96218	0	0	0	0	NX	$ -	NX
PCTCH00000028	38217	38217	0	10	10	0	NX	$5,350	NX
PCTCH00000025	149984	149984	0	37	37	0	NX	$9,000	NX
PCTCH00000026	456583	456583	0	52	52	0	NX	$50,531	NX
PCTCH00000029	50209	50209	0	11	11	0	NX	$2,500	NX
PCTCH00000007	357225	357225	0	164	164	0	NX	$87,000	NX
PCTCH00000032	875199	875199	0	110	110	0	NX	$45,000	NX
PCTCH00000042	1041887	1041877	10	75	75	0	NX	$2,681	NX
PCHVC00000113	1937	1937	0	0.48	0.48	0	$375	$375	NX
PCHVC00000163	1540	1540	0	1.37	1.37	0	$805	$805	NX
PCLGT00001118	42803	42803	0	17	17	0	$8,875	$8,875	NX
PCLGT00001402	53016	53016	0	13	13	0	$4,316	$4,316	NX
PCLGT00001416	15549	15549	0	5.41	5.41	0	$1,116	$1,299	$183
PCLGT00001381	31805	31805	0	7	7	0	$1,363	$1,363	$ -
PCLGT00000231	142423	142423	0	27	27	0	$5,725	$5,725	$ -
PCLGT00001552	496	496	0	0.12	0.12	0	$19	$485	$466
PCLGT00001259	5284	5284	0	1.89	1.89	0	$ -	$ -	$ -
PCLGT00001630	18681	18681	0	2.55	2.55	0	$ -	$ -	$ -
PCLGT00000887	762	762	0	0.39	0.39	0	$ -	$ -	$ -
CI66300	49864002	49864000	2	5936	5936	0	$1,745,240	$ -	NX
CI50527	126323	123490	2833	129	104	25	$6,175	$ -	NX
NSLB49843	75258	89999	-14741	26	0	26	$3,067	$ -	NX
NSLB47013	68051	68051	0	20	20	0	$3,403	$ -	NX

G.7.2.1 Custom Applications Program and Custom Technology Applications Program

The Custom Applications Program and Custom Technology Applications Program file uploads included an acceptance letter, an application with support documents, an Eaton report, and a final letter for each project. The estimated yearly kW and kWh savings are reported in most of the applications and supporting documents, and the CSP report then either justifies these values or documents the change based on a metering study or a change to one of the variables in the savings equation, such as number of units installed or operating hours. The methodology used to produce *ex ante* savings estimates is clear and the approaches are reasonable. Rebate amounts could not be verified since there were no documents that included the rebate amount in the files. The application includes the level of rebate that the business applied for, but the actual rebate received almost never lines up with this value. The only element missing from the requested files was an invoice for the purchase of the efficient equipment, but the post evaluation letter verified installation. There were also pictures of the pre and post retrofit scenarios, which were very helpful.

Project PCCST00000046 is a lighting retrofit project. The project files submitted to the SWE contained an acceptance letter, an application, specification sheets, a final report, and a post evaluation letter. There was no savings calculation spreadsheet included in the files, but the 'Pennsylvania Act 129 Lighting Audit and Design Tool' screen shot detailed the HOU and the lighting factors used to estimate savings. The majority of the lights in the building are on 8760 hours a year, and the HOU values used for the restrooms did not match the TRM values for the building type described. The TRM values for coincidence factors were used. The energy savings in the CSP report were slightly higher than the database reported numbers. The CSP report mentions that there was an error when counting the fixtures, so the savings numbers were modified the accordingly. However, this did not explain why the savings numbers don't match the database.

Project PCDRV00000007 is a variable frequency drive project. The project files submitted to the SWE contained an acceptance letter, an application, specification sheets, an invoice, and a post evaluation letter. The project files did not contain a final report or a savings calculation spreadsheet. The energy savings in the rebate application were significantly higher than the database reported numbers. These reported numbers were probably adjusted based on further analysis, but there is no final report to verify what changed.

Project PCTCH00000028 is an exterior lighting project. The project files submitted to the SWE contained an acceptance letter, an application with support documents, a report and a post evaluation letter. The baseline and retrofit lighting system descriptions were clearly detailed, but there were no invoices included. The application explains that the HOU values were based on an operating schedule, and there were no coincidence factors used since the lights are only on at night. There was no need to use the TRM values for this project.

Project PCTCH00000032 was also a lighting project. The project files submitted to the SWE contained an acceptance letter, an application and supporting documents, a report, and a post evaluation letter. The project files did not contain any invoices, but the post evaluation letter provided verification of purchase. The application explains that the HOU values were based on an operating schedule. The screen shot of the "'Pennsylvania Act 129 Lighting Audit and Design Tool was not readable, so it was unclear whether the TRM coincidence factors were used. The savings values changed from the application but were detailed thoroughly in the change of scope document and match the database.

G.7.2.2 Commercial HVAC Efficiency Program

Project files for sampled projects from the Commercial HVAC Efficiency Program included an incentive worksheet, an invoice, and a reported savings worksheet for each project. The incentive worksheet calculated the estimated savings based on the equipment specs. The reported savings worksheet updated the estimated savings calculations with any changes, matching the kW and kWh savings numbers in the database. The equipment from the invoices matched up to the worksheets. The *ex ante* savings were calculated using the 2011TRM protocols, and the heating and cooling EFLH and baseline SEER values were taken from the TRM tables. There were no specification sheets to provide more information about the equipment installed.

Project PCHVC00000113 is an HVAC project involving a 5 ton heat pump. The project files submitted to the SWE contained an incentive worksheet and an invoice. The TRM was used correctly to estimate the EFLH and the SEER of the heat pump. The recommended savings algorithms from the TRM were also used to calculate the energy and demand savings for both cooling and heating, as described in the incentive worksheet. The project files did not include a final report or any verification of installation. There were also no equipment specifications besides the numbers recorded in the incentive worksheet.

G.7.2.3 Lighting Efficiency Program

The Lighting Efficiency program file upload included an application, invoices, and a final reported worksheet for each project. The reported savings worksheet included columns for savings and customer incentive, which mostly matched up with the database. It appears that the *ex ante* savings were calculated using the EFLH values and the coincidence factors from the 2011 TRM.

The project files submitted to the SWE for project PCLGT00000231 contained an application, an invoice, and a savings calculation spreadsheet. The project files did not contain a final report or any verification of installation. The number of fixtures from the invoice matched up to the number of fixtures used to calculate the savings. The energy savings in the project files and the database varied slightly.

The project files for Project PCLGT00001416 submitted to the SWE contained the application, the invoices, and the reported worksheet. The energy and demand impact estimates in the reported worksheet match the database, but the incentive is off by nearly $200.

G.7.2.4 PA Free CFL & Exit

The PA Free CFL & Exit program file uploads only include two files for each project. The application includes a savings calculations spreadsheet that documents the number of fixtures and the fixture wattage, as well as the kW and kWh savings. The *ex ante* savings appear to be calculated using the protocols in the TRM. However, there is no information on the baseline lighting system, invoices or specification sheets to verify the equipment or installation.

The project files submitted to the SWE for Project PCLGT00000887 included an application and a reported savings worksheet. The savings values in the application are different than those in the reported savings spreadsheet because the application documents 14 CFLs and the reported savings states eight CFLs. There are no documents to support the quantity of CFLs that were given out or if they were installed.

G.7.2.5 Custom Incentives and Nonstandard Lighting for Business

The SAIC Custom and Nonstandard Lighting program file uploads included various files including invoices, analysis, notes, applications, approval memos and calculators. The volume of unrequested files makes it is difficult to establish what was installed and what were the baseline equipment, or what are the reported savings. Additionally, the methodology used to calculate the savings is not clear. There was no report detailing how the savings were produced, or what equations were used. There were various spreadsheets without labels and emails detailing the communication about the project measures. The database did not include any rebate amounts for the SAIC projects and thus could not be verified.

Project CI66300 is a combined heat and power project which allowed the participant to generate electricity on-site instead of purchasing it from West Penn Power. The heat output from the turbine is also used to heat water to steam, which satisfies the heating needs of the site during winter months. The project files included invoices, a savings calculation spreadsheet with about nine months of combustion turbine power output trend data, an application, and an approval memo. The SWE determined that kWh and kW savings were calculated correctly.

Project CI50527 is an energy management system project to control HVAC and lighting. The project files submitted to the SWE contained invoices, a spreadsheet detailing kWh per square foot both pre and post project, a project summary, a review of the savings estimates by SAIC, an application, and a document detailing site control savings. The documents that were uploaded detail the energy and demand savings information for seven retail stores, and Project CI50527 represents only one of the projects. The savings calculations were based on eQuest data, and store-specific calculations were included in the file. The energy and demand savings provided in the “PA Store Info” spreadsheet and the ‘‘Site Control Savings” document matched, but they did not agree with the energy and demand savings values in the database. The values provided in the review by SAIC matched the database, but it was unclear why the values varied from the other files.

Project NSLB49843 is a lighting project. It was not clear from the variety of project files submitted which contained the reported savings. None of the savings numbers in the project files matched up to the database. The replaced and installed equipment was clearly defined in the application and the lighting calculator. However, since the lighting savings calculation worksheet did not match the database, it isn’t clear whether the project scope changed or if some parameters were incorrect in the savings calculator.

Project NSLB47013 is a lighting project. The project files submitted to the SWE contained equipment specification sheets, an application, invoices, a savings calculation worksheet, and some certification documentation. The energy and demand savings from the calculator and the application matched the database. The replaced and installed equipment was clearly defined in the application and the lighting calculator.

Appendix H Audit Activity Detail – Total Resource Cost Test

This appendix provides further detail regarding the SWE audit of each EDC's Total Resource Cost (TRC) Test calculations.

H.1 Duquesne

H.1.1 Non-Residential Programs

Duquesne had eleven non-residential EE&C programs that produced energy and demand savings during PY3 (see Table 4-2). The SWE performed a spot check to verify that there were no differences between energy and demand impacts, incentive amounts, and participant count in Duquesne's TRC model, the figures listed in Duquesne's PY3 Annual Report, and the extract level databases. The SWE also checked the measure lives in the TRC models to ensure that they are consistent with the 2011 TRM Appendix A as well as the measure cost information to ensure that the sources used are reasonable.

The SWE checked five measures, which include two custom, one lighting, one variable frequency drive (VFD), and one door gaskets commercial refrigeration projects. The savings figures, incentive amounts, and participant counts detailed in the selected sample matched exactly with the database for all the projects. The SWE found it difficult to match savings for some measures because measures were named differently in the TRC model and the tracking database. The SWE, however, was able to verify the savings and other measure attributes at the program level for all measures. The savings calculations, realization rates, and NTG ratios were found to be transparent and applied correctly in the TRC model.

A measure life of 15 years was applied to measures such as commercial lighting, VFDs, motors, and other custom projects, which is consistent with the TRM Appendix A. For measures not specified in the TRM such, as commercial refrigeration measures, the TRC model assigns measure lives. The SWE examined several of these values and found them to be reasonable. However, the SWE found that Duquesne's TRC model doesn't specify the source for the measure lives for measures not included in the TRM. When requested, Duquesne's Program Evaluator provided the SWE sufficient insight into how these values were determined.

Table H-1 and Table H-2 contain a comparison of the values contained in the TRC model to the savings databases. The two data sources agree perfectly.

Table H-1: TRC Model Measure Attributes

Program	Measure	TRC Model kWh	TRC Model kW	TRC Model Incentive	TRC Model Quantity	TRC Model Meaure Life
Chemical Products EE	Custom, C&I, Other	263,512	30	$13,176	1	15
Chemical Products EE	T5 - 4' 3 Lamp - HO - Electronic Ballast	2,691	1	$375	5	15
Commercial Sector Umbrella EE	Door Gaskets on Solid Doors for Coolers	1,388	0	$309	77	4
Office Building – Large – EE	Variable Frequency Drives for Chilled Water Loop	1,766,980	123	$111,850	1035	15
Retail Stores Large	Custom, C&I, Other	1,299,726	0	$103,978	1	15

Table H-2: Program Tracking Database Measure Attributes

Program	Measure	Database kWh	Database kW	Database Incentive	Database Quantity	TRM Measure Life
Chemical Products EE	Custom, C&I, Other	263,512	30	$13,176	1	Custom Measure
Chemical Products EE	T5 - 4' 3 Lamp - HO - Electronic Ballast	2,691	1	$375	5	15
Commercial Sector Umbrella EE	Door Gaskets on Solid Doors for Coolers	1,388	0	$309	77	4 (2012 TRM)
Office Building – Large – EE	Variable Frequency Drives for Chilled Water Loop	1,766,980	123	$111,850	1035	15
Retail Stores Large	Custom, C&I, Other	1,299,726	0	$103,978	1	Custom Measure

H.1.2 Residential Programs

Duquesne listed four programs under the residential umbrella: Residential Energy Efficient Products, Appliance Recycling, Low-Income Energy Efficiency, and the School Energy Pledge. Each of these programs achieved energy and demand savings during PY3. The SWE Team performed a spot check to verify that there are no differences in terms of energy and demand impacts, incentive amounts, and participant count in Duquesne's TRC model with the figures listed in Duquesne's PY3 Annual Report and extract level databases. The SWE Team also checked the measure lives to ensure that they are consistent with Appendix A in the TRM as well as the measure cost information to ensure that the sources used are reasonable.

The SWE was able to verify the savings and other measure attributes at the program level for all measures. The comparison between extract database and annual report is already described in the audit activities and findings sections of the SWE PY3 annual report. The savings calculations, realization rates, and NTG ratios were found to be transparent and applied correctly in the TRC model. In addition, the SWE found no consistency issues between the TRC model and the measure useful lives listed in the 2011 TRM.

H.2 PECO

H.2.1 Non-Residential Programs

PECO had three non-residential programs (Smart Equipment Incentives – C&I, Smart Equipment Incentives – GNI, and the Smart Construction Incentives) that produced energy and demand savings during PY3.

The SWE performed a spot check to verify that there are no differences between energy and demand impacts, incentive amounts, and participant count in PECO's TRC model and the figures listed in PECO's PY3 Annual Report and program tracking data. PECO provided quarterly program tracking databases capturing all PY3 activity to the SWE team for review. The SWE team also checked the measure lives in the TRC models to ensure that they are consistent with the 2011 TRM Appendix A as well as the measure cost information to ensure that the sources used are reasonable.

The SWE checked four measures which include LED exit signs, strip curtains, C&I whole building, and air cooled chillers. The savings figures for strip curtains and whole building measures in the TRC model matched exactly with the database. The SWE found it difficult to match savings for the other measures, though, because it was not clear how to group similar measures as they were named differently in the TRC model than in the program tracking database. Aside from the minor variances which can result from project reclassification, impact adjustment or simple rounding error, the savings figures and participant counts for non-residential programs from PECO's TRC model were reasonably close to the extract databases.

Table H-3 and Table H-4 compare the energy and demand savings in the TRC model with the PECO tracking data submissions at the measure level.

Table H-3: Measure Attributes from PECO TRC Model

Program	Measure	TRC Model Verified kWh	TRC Model Verified kW	TRC Model Meaure Life
Smart Equipment Incentives Program - C&I	LED Exit Signs	305,834	44	15
Smart Equipment Incentives Program - C&I	Strip Curtains	185,691	14	4
Smart Construction Incentives Program - C&I	CI Whole Building	1,952,394	409	15
Smart Equipment Incentives Program - GNP	Air Cooled Chillers	175,832	201	15

Table H-4: Measure Attributes from PECO Tracking Database

Program	Measure	Database Reported kWh	kWh Realization Rate	Database Verified kWh	Database Reported kW	kW Realization Rate	Database Verified kW	Database Meaure Life
Smart Equipment Incentives Program - C&I	LED Exit Signs	225,398	1.03	232,160	31	1.08	33	15
Smart Equipment Incentives Program - C&I	Strip Curtains	180,283	1.03	185,691	13	1.08	14	4
Smart Construction Incentives Program - C&I	CI Whole Building	1,883,389	1.03	1,939,891	215	1.9	408	15
Smart Equipment Incentives Program - GNP	Air Cooled Chillers	202,428	0.75	151,821	249	0.69	172	15

The SWE was able to verify the savings and other measure attributes at the program level for all measures. The savings calculations and realization rates were found to be transparent and applied correctly in the TRC model.

Table H-5 and Table H-6 compare the energy and demand savings in the TRC model with savings databases at the program level.

Table H-5: Verified Savings from TRC Model

Program	TRC Model kWh	TRC Model kW
Smart Equipment Incentives program - C&I	66,232,471	10,887
Smart Equipment Incentives program - GNP	48,062,539	5,840
Smart Construction Incentives	4,687,775	780

Table H-6: Verified Savings Reconstructed from Tracking Data and Realization Rates

Program	Database kWh	Database kW
Smart Equipment Incentives program - C&I	66,269,265	10,893
Smart Equipment Incentives program - GNP	48,086,878	5,843
Smart Construction Incentives	4,687,776	780

A measure life of 15 years was applied to measures such as commercial lighting, VFDs, and motors, which is consistent with the 2011 TRM Appendix A. For measures not specified in the TRM, such as commercial refrigeration measures, the TRC model assigns measure lives. The SWE examined several of these values and found them to be reasonable. Some of the other measures that the SWE verified include ground source heat pumps, night covers, strip curtains, anti-sweat heater controls, and door gaskets. PECO's TRC model clearly specified the source for the measure lives and incremental cost for all measures.

H.2.2 Residential Programs

PECO listed four programs under the non-residential umbrella: Smart Lighting Discounts, Smart Appliance Recycling, Smart Home Rebates, and the Low-Income Energy Efficiency Program. Each of these four programs achieved energy and demand savings during PY3. The SWE Team performed a spot check to verify that there are no differences in terms of energy and demand impacts, and incentive amounts, in PECO's TRC model with the figures listed in PECO's PY3 Annual Report and program tracking data. The SWE Team also checked the measure lives to ensure that they are consistent with Appendix A in the TRM as well as the measure cost information to ensure that the sources used are reasonable.

The SWE was able to verify the savings and other measure attributes at the program level for all measures. The savings calculations, realization rates, and NTG ratios were found to be transparent and applied correctly in the TRC model. The comparison between extract database and annual report is already described in the audit activities and findings sections of the SWE PY3 annual report. Aside from the minor variances which can result from project reclassification, impact adjustment or simple rounding error, the savings for residential programs from PECO's TRC model were reasonably close to the PY3 Annual Report and extract databases. In addition, the SWE found no consistency issues between the TRC model and the measure useful lives listed in the 2011 TRM.

H.3 PPL

H.3.1 Non-Residential Programs

PPL had six non-residential programs that produced energy and demand savings during PY3 (see Table 6-2). The SWE performed a spot check to verify that there are no differences between energy and demand impacts, incentive amounts, and participant count in PPL's TRC model, the PPL PY3 Annual Report, and the extract level databases. The SWE also checked the measure lives in the TRC models to ensure that they are consistent with the 2011 TRM Appendix A as well as the measure cost information to ensure that the sources used are reasonable.

The SWE checked five different program and sector combinations – Custom-GNP, Custom-LCI, Efficient Equipment-LCI, Renewable-GNP, and HVAC Tune-Up-SCI. PPL provided a series of databases capturing incremental measure-level activity to the SWE for review. The SWE found some variances in savings figures reported in the TRC model compared to savings figures in the extract databases.[106] PPL clarified that reported gross savings from the EEMIS tracking database may have been adjusted, where necessary, to reflect differences between the methods used to record and track savings and the methods in the TRM or to correct data capture errors. The adjusted ex ante gross savings were then verified through EM&V activities.

The SWE was able to verify that the savings attributes used in the TRC model calculations were close to the savings in the program tracking databases at the program level and well within the amount of variation expected due to adjustments, reclassification and rounding errors.

[106] Note that variances do not necessarily indicate inadequate QA/QC, incorrect reported savings, incorrect verified savings, or incorrect incentives. There are often valid differences between an EDC's tracking system (reported savings) and rebate forms, project files, and other supporting information. The EDC's program evaluator may have corrected the transaction via an *ex ante* adjustment or an *ex post* adjustment and, therefore, the adjusted reported/verified savings used in TRC model calculations are correct. In addition to this, reclassification of projects prior to annual reporting is expected as well.

Table H-7 and Table H-8 compare values contained in the TRC model to the savings databases.

Table H-7: Savings from TRC Model

Program	TRC Model Verified kWh	TRC Model Verified kW	TRC Model Incentive
Custom-GNP	48,180,284	5,726	N/A
Custom-LGCI	47,031,967	5,022	N/A
Equipment-LGCI	50,652,064	7,317	N/A
Renewable-GNP	2,380,048	655	N/A
HVAC-SMCI	820,153	595	N/A

Table H-8: Savings from Program Tracking Database

Program	Database kWh	Database kW	RR	Verified kWh	Verified kW
Custom-GNP	45,639,699	4,607	103.5%	47,237,088	4,768
Custom-LGCI	46,537,099	6,384	103.5%	48,165,898	6,607
Equipment-LGCI	52,711,134	7,754	95.3%	50,233,711	7,390
Renewable-GNP	3,017,403	783	80.9%	2,441,079	634
HVAC-SMCI	820,153	595	100.0%	820,153	595

The PPL TRC analysis is based on *ex post* verified savings as shown in Table H-7. Therefore, the database reported impacts were adjusted by an applicable realization rate to compare against TRC values as shown in Table H-8. The savings calculations, realization rates, and NTG ratios were found to be transparent and applied correctly in the TRC model.

A measure life of 15 years was applied to measures such as commercial lighting, VFDs, motors, and other custom projects, which is consistent with the TRM Appendix A. The TRC model additionally assigns measure lives for measures not specified in the TRM. The SWE team examined several of these values and found them to be reasonable. The SWE also found that PPL's TRC model doesn't specify the source for the measure lives for measures not included in the TRM and therefore requests that PPL provide some insight into how these values were determined.

H.3.2 Residential Programs

PPL listed five programs under the non-residential umbrella: Appliance Recycling, Energy Assessment & Weatherization, CFL Campaign, Efficient Equipment Incentive Program, and the Energy Efficiency Behavior & Education Program. All five programs achieved significant energy and demand savings during PY3. The SWE Team performed a spot check to verify that there are no differences in terms of energy and demand impacts, and incentive in PPL's TRC model with the figures listed in PPL's PY3 Annual Report and extract level databases. The SWE Team also checked the measure lives to ensure that they are consistent with Appendix A in the TRM as well as the measure cost information to ensure that the sources used are reasonable.

The SWE was able to verify the savings and other measure attributes at the program level for all measures. The comparison between extract database and annual report is already described in the audit activities and findings sections of the SWE PY3 annual report. The savings calculations, realization rates, and NTG ratios were found to be transparent and applied correctly in the TRC model. Aside from the minor variances which can result from project reclassification, impact adjustment or simple rounding error, the savings for residential programs from PECO's TRC model were reasonably close to the PY3 Annual Report and extract databases. *NOTE: Awaiting word from PPL on minor differences in TRC Model measure life versus 2011 TRM.*

H.4 FirstEnergy Companies (Met-Ed, Penelec, Penn Power)

H.4.1 Non-Residential Programs

Two of the FirstEnergy companies (Met-Ed and Penelec) each offered five non-residential energy efficiency programs (see Tables 7-2, 8-2) that produced energy and demand savings in PY3. Penn Power offered three programs that produced energy and demand savings in PY3 (see Table 9-2). The SWE performed a spot check to verify that there were no differences between energy and demand impacts, incentive amounts, and participant counts in FirstEnergy TRC models, the PY3 Annual Reports, and quarterly program tracking data extracts submitted to the SWE. The SWE also checked the measure lives in the TRC models to ensure that they are consistent with the TRM Appendix A as well as the measure cost information to ensure that the sources used are reasonable.

The SWE performed checks for the five programs, and was able to verify that the total gross reported savings and participant counts mentioned in the TRC model matched with the figures in the PY3 Annual Report and the program tracking database.

The SWE found it difficult, however, to match savings figures and participant counts listed in the TRC model with the extract databases for some programs, mainly due to the reclassification of the projects prior to PY3 annual reporting. Aside from the minor variances that resulted from project reclassification, impact adjustment, or simple rounding error, the savings figures and participant counts for non-residential programs from FirstEnergy's TRC models were very close to the extract databases. The comparison between extract database and annual report is already described in the audit activities and findings sections of this report (Section 7.2) and the savings calculations, realization rates, and NTG ratios were found to be transparent and applied correctly in the TRC model.

Table H-9 and Table H-10 below compare values contained in the Met-Ed TRC model to the Met-Ed PY3 Annual Report; Table H-11 and Table H-12 below compare values contained in the Penelec TRC model to the Penelec PY3 Annual Report; and Table H-13 and Table H-14 below compare values contained in the Penn Power TRC model to the Penn Power PY3 Annual Report.

Table H-9: TRC Model Program Attributes – Met-Ed

Program	No. of Participants	Reported MWh	Realization Rate	Verified MWh	Reported MW	Realization Rate	Verified MW
Small Commercial & Industrial EE	190	40,688	75%	30,623	8.53	55%	4.72
Large Commercial & Industrial EE	41	11,880	94%	11,142	1.47	98%	1.44
Streetlighting	44	776	100%	776	0.00	N/A	0.00
Non-Profit	7	87	114%	99	0.03	90%	0.03
Remaining Government/Non-Profit	110	5,392	81%	4,370	3.99	53%	2.11
TOTAL	**392**	**58,823**	-	**47,010**	**14.02**	-	**8.30**

Table H-10: Annual Report Program Attributes – Met-Ed

Program	No. of Participants	Reported MWh	Realization Rate	Verified MWh	Reported MW	Realization Rate	Verified MW
Small Commercial & Industrial EE	190	40,688	75%	30,623	8.53	55%	4.72
Large Commercial & Industrial EE	41	11,880	94%	11,142	1.47	98%	1.44
Streetlighting	44	776	100%	776	0.00	N/A	0.00
Non-Profit	7	87	114%	99	0.03	90%	0.03
Remaining Government/Non-Profit	110	5,392	81%	4,370	3.99	53%	2.11
TOTAL	**392**	**58,823**	-	**47,010**	**14.02**	-	**8.30**

Table H-11: TRC Model Program Attributes - Penelec

Program	No. of Participants	Reported MWh	Realization Rate	Verified MWh	Reported MW	Realization Rate	Verified MW
Small Commercial & Industrial EE	464	28,065	83%	23,410	5.28	76%	4.03
Large Commercial & Industrial EE	58	18,224	90%	16,486	3.79	63%	2.38
Streetlighting	58	423	97%	410	0.00	N/A	0.00
Non-Profit	26	643	135%	867	0.11	162%	0.18
Remaining Government/Non-Profit	340	18,000	90%	16,195	7.45	51%	3.79
TOTAL	**946**	**65,355**	-	**57,368**	**16.63**	-	**10.38**

Table H-12: Annual Report Program Attributes - Penelec

Program	No. of Participants	Reported MWh	Realization Rate	Verified MWh	Reported MW	Realization Rate	Verified MW
Small Commercial & Industrial EE	464	28,065	83%	23,410	5.28	76%	4.03
Large Commercial & Industrial EE	58	18,224	90%	16,486	3.79	63%	2.38
Streetlighting	58	423	97%	410	0.00	N/A	0.00
Non-Profit	26	643	135%	867	0.11	162%	0.18
Remaining Government/Non-Profit	340	18,000	90%	16,195	7.45	51%	3.79
TOTAL	**946**	**65,355**	-	**57,368**	**16.63**	-	**10.38**

Table H-13: TRC Model Program Attributes - Penn Power

Program	No. of Participants	Reported MWh	Realization Rate	Verified MWh	Reported MW	Realization Rate	Verified MW
Small Commercial & Industrial EE	41	15,913	76%	12,035	3.52	59%	2.09
Large Commercial & Industrial EE	7	634	139%	883	0.10	110%	0.11
Streetlighting	-	-	N/A	-	-	N/A	-
Non-Profit	-	-	N/A	-	-	N/A	-
Remaining Government/Non-Profit	29	3,495	88%	3,062	1.56	71%	1.10
TOTAL	**77**	**20,042**	**-**	**15,980**	**5.18**	**-**	**1.10**

Table H-14: Annual Report Program Attributes – Penn Power

Program	No. of Participants	Reported MWh	Realization Rate	Verified MWh	Reported MW	Realization Rate	Verified MW
Small Commercial & Industrial EE	41	15,913	76%	12,035	3.52	59%	2.09
Large Commercial & Industrial EE	7	634	139%	883	0.10	110%	0.11
Streetlighting	-	-	N/A	-	-	N/A	-
Non-Profit	-	-	N/A	-	-	N/A	-
Remaining Government/Non-Profit	29	3,495	88%	3,062	1.56	71%	1.10
TOTAL	**77**	**20,042**	**-**	**15,980**	**5.18**	**-**	**1.10**

H.4.2 Residential Programs

The three FirstEnergy EDCs, Met-Ed, Penelec and Penn Power, offer six non-residential energy efficiency programs under Act 129: Home Energy Audits & Outreach, Appliance Turn-In, EE HVAC, EE Products, New Construction, and WARM (Low-Income) Programs. The SWE Team performed a spot check to verify that there are no differences in terms of energy and demand impacts, and, incentive amounts in FirstEnergy TRC models with the figures listed in PY3 Annual Reports and quarterly program tracking data extracts submitted to the SWE. The SWE Team also checked the measure lives to ensure that they are consistent with Appendix A in the TRM as well as the measure cost information to ensure that the sources used are reasonable.

The SWE Team performed checks for all six programs. The SWE was able to verify that the total gross reported savings mentioned in the TRC model matched with the figures in the annual report and the program tracking database. The comparison between extract database and annual report is already described in the audit activities and findings sections of the SWE PY3 annual report. The savings calculations, realization rates, and NTG ratios were found to be transparent and applied correctly in the TRC model. In addition, the SWE found no consistency issues between the TRC model and the measure useful lives listed in the 2011 TRM.

H.5 West Penn Power

H.5.1 Non-Residential Programs

West Penn Power had three non-residential programs (C&I Equipment Program – Small, C&I Equipment – Large, and Government and Institutional) that produced energy and demand savings during PY3.

The SWE performed a spot check to verify that there are no differences between energy and demand impacts and participant counts in West Penn Power's TRC model, the PY3 Annual Report, and program tracking databases. The SWE also checked the measure lives in the TRC models to ensure that they are consistent with the 2011 TRM Appendix A as well as the measure cost information to ensure that the sources used are reasonable.

West Penn Power provided a series of spreadsheets to the SWE detailing project activity during PY3. The SWE was able to closely match energy and demand savings for all non-residential programs between the TRC model and the program tracking information. The energy and demand savings for the C&I Equipment – Large Program, the C&I Equipment Program – Small Program, and the Government and Institutional Program used in the TRC model are 148,271 MWh/yr and 31 MW respectively. The energy and demand savings for these programs in the database are 151,114 MWh/yr and 31 MW respectively.[107]

The SWE found that, prior to PY3 annual reporting, West Penn Power changed the names of some of its programs to fit the FirstEnergy programs TRC model and also reclassified some of the projects. During PY3, reclassifications occurred for governmental projects reported under the following sub-programs within the C&I Equipment Programs – Commercial HVAC Efficiency, Commercial Energy Efficiency, Custom Technology Applications, Custom Applications, and Commercial & Industrial Drives. A total of 40 participants, 5,009 MWh/yr, and 1.185 MW from these programs were reclassified to the Governmental and Institutional Program. The savings calculations, realization rates, and NTG ratios were found to be transparent and applied correctly in the TRC model.

A measure life of 15 years was applied to measures such as commercial lighting, VFDs, and motors, which is consistent with 2011 TRM Appendix A. The TRC model also assigns a measure life of 3 years to CFL measures installed as part of the C&I Equipment Program - Small and the Government and Institutional Program. The SWE feels that the underlying assumption in this measure life value is that CFL bulbs in these sectors will see more annual hours of use than in the residential sector, shortening the effective measure life.

[107] Please note that variance does not necessarily indicate inadequate QA/QC, incorrect reported savings, or incorrect verified savings. There are often valid differences between an EDC's tracking system (reported savings) and rebate forms, project files, and other supporting information. The EDC's program evaluator may have corrected the transaction via an *ex ante* adjustment or an *ex post* adjustment and, therefore, the adjusted reported/verified savings used in TRC calculations are correct.

Table H-15 and Table H-16 compare values contained in the TRC model to the PY3 Annual Report. These program impacts matched perfectly for each program.

Table H-15: Program Savings – West Penn TRC Model

Program	Reported MWh	Realization Rate	Verified MWh	Reported MW	Realization Rate	Verified MW
Commercial & Industrial Equipment Program - Small	59,193	110.9%	65,621	17.6	68.5%	12.1
Commercial & Industrial Equipment Program - Large	20,065	102.8%	20,636	3.4	104.7%	3.6
Governmental and Institutional Program	69,463	101.2%	70,306	10.2	95.4%	9.7

Table H-16: Program Savings – West Penn PY3 Annual Report

Program	Reported MWh	Realization Rate	Verified MWh	Reported MW	Realization Rate	Verified MW
Commercial & Industrial Equipment Program - Small	59,193	110.9%	65,621	17.6	68.5%	12.1
Commercial & Industrial Equipment Program - Large	20,065	102.8%	20,636	3.4	104.7%	3.6
Governmental and Institutional Program	69,463	101.2%	70,306	10.2	95.4%	9.7

H.5.2 Residential Programs

West Penn Power listed five programs under the residential umbrella: Home Performance, Appliance Turn-In, EE HVAC, EE Products, and Limited Income Energy Efficiency Program. Each of these three programs achieved energy and demand savings during PY3. The SWE Team performed a spot check to verify that there are no differences in terms of energy and demand impacts and participant counts in West Penn Power's TRC model with the figures listed in their PY3 Annual Report and program tracking databases. The SWE Team also checked the measure lives to ensure that they are consistent with Appendix A in the TRM as well as the measure cost information to ensure that the sources used are reasonable.

The SWE Team performed checks for all five programs. The SWE was able to verify that the total gross reported savings mentioned in the TRC model matched with the figures in the annual report and the program tracking database. The comparison between extract database and annual report is already described in the audit activities and findings sections of the SWE PY3 annual report. The savings calculations, realization rates, and NTG ratios were found to be transparent and applied correctly in the TRC model. In addition, the SWE found no consistency issues between the TRC model and the measure useful lives listed in the 2011 TRM.

Appendix I Glossary of Terms

ACCURACY: An indication of how close a value is to the true value of the quantity in question. The term could 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 efficiency 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.

BASELINE DATA: The measurements and facts describing facility operations and design during the baseline period. This will include 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 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 also used to describe 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 very 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 MODEL: Computer models based on physical engineering principals and/or standards used to estimate energy usage and/or savings. These models do not make use of billing or metered data, but usually incorporate site-specific data on customers and physical systems. Building Simulation Models usually require such site-specific data as square footage, weather, surface orientations, elevations, space volumes, construction materials, equipment use, lighting and building occupancy. Building simulation 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/losses. Examples of building simulation models include ADM2, BLAST and DOE-2.

CAPACITY: The amount of electric power for which a generating unit, generating station or other electrical apparatus is rated either 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 such factors 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 system load during the average 100 peak summer hours. This should properly be expressed so as 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 the 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. These steps may involve, for example, improved efficiency, avoidance of waste, and reduced consumption. Related activities include, for example, installing equipment (such as a computer to ensure efficient energy use), modifying equipment (such as making a boiler more efficient), adding insulation, and changing behavior patterns.

CONSTRUCT VALIDITY: The extent to which an operating variable/instrument accurately taps an underlying concept/hypothesis, properly measuring an abstract quality or idea.

CONTENT VALIDITY: The extent to which an operating measure taps all the separate sub-concepts of a complicated concept.

CONVERGENT VALIDITY: When two instruments/questions/measurement methods obtain similar results when measuring the same underlying construct with varying questions/approaches.

CORRELATION COEFFICIENT: A measure of the linear association between two variables, calculated as the square root of the R_2 obtained by regressing one variable on the other and signed to indicate whether the relationship is positive or negative.

CORRELATION TABLE (CORRELATION MATRIX): A table or matrix giving the correlation between all pairs of data sets. Row headings are the scores on one variable and column headings are the scores on the second variables and a cell shows how many times the score on that row was associated with the score in that column

COST-EFFECTIVENESS: An indicator of the relative performance or economic attractiveness of any energy efficiency investment or practice when compared to the costs of energy produced and delivered in the absence of such an investment. In the energy efficiency field, the present value of the estimated benefits produced by an energy efficiency program as compared to the estimated total program's 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 TEST.

CUMULATIVE PROGRAM INCEPTION TO DATE: Defined as the period since date of program implementation through the current reporting period (i.e., reporting period of this report).

CUSTOMER: Any person or entity responsible for payment of an electric and/or gas bill to 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 its provision of utility services.

CV: See COEFFICIENT OF VARIATION.

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 considered acceptable 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 kW (equals kWh/h) but can also refer to natural gas, usually as Btu/hr, kBtu/hr, therms/day or ccf/day.

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 BILLING: The electric capacity requirement for which a large user pays. It may be based on the customer's peak demand during the contract year, on a previous maximum or on an agreed minimum. Demand billing is measured in kilowatts.

DEMAND CHARGE: The sum to be paid by a large electricity consumer for its peak usage level.

DEMAND RESPONSIVENESS: Also sometimes referred to as load shifting. Activities or equipment that induce consumers to use energy at different (lower cost) times of day or to interrupt energy use for certain equipment temporarily, usually in direct response to a price signal. Examples include interruptible rates, doing laundry after 7 p.m., and air conditioner recycling programs.

DEMAND SAVINGS: The reduction in the demand from the pre-retrofit baseline to the post-retrofit demand, once independent variables (such as weather or occupancy) have been adjusted for. This term is usually applied to billing demand, to calculate cost savings or to peak demand, for equipment sizing purposes.

DEMAND SIDE MANAGEMENT (DSM): The methods used to manage energy demand including energy efficiency, load management, fuel substitution and load building. See LOAD MANAGEMENT.

DIRECT ENERGY SAVINGS (DIRECT PROGRAM ENERGY SAVINGS): The use of the words "direct savings" or "direct program savings" refers to the savings from programs that are responsible for the achievement of specific energy efficiency goals. Typically these are thought of as resource acquisition programs or programs that install or expedite the installation of energy-efficient equipment and which directly cause or help to cause energy efficiency to be achieved. Rebate, incentive or direct install programs provide direct energy savings.

DIRECT INSTALL or DIRECT INSTALLATION PROGRAMS: These types of programs 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: A distributed generation system involves small amounts of generation located on a utility's distribution system for the purpose of meeting local (substation level) peak loads and/or displacing the need to build additional (or upgrade) local distribution lines.

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 (such as 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.

EM&V: Evaluation, Measurement, Monitoring and Verification.

END-USE (MEASURES/GROUPS): Refers to a broad or sometimes narrower category that the program is concentrating efforts upon. Examples of end-uses include refrigeration, food service, HVAC, appliances, 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: Using less energy to perform the same function. Programs designed to use energy more efficiently - doing the same with less. For the purpose of this paper, energy efficiency programs are distinguished from DSM programs in that the latter are utility-sponsored and financed, while the former is a broader term not limited to any particular sponsor or funding source. "Energy conservation" is a term that 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 these terms interchangeably.

ENERGY EFFICIENCY IMPROVEMENT: Reduced energy use for a comparable level of service, resulting from the installation of an energy efficiency measure or the adoption of an energy efficiency practice. Level of service may be expressed in such ways as the volume of a refrigerator, temperature levels, and production output of a manufacturing facility or lighting level/square foot.

ENERGY EFFICIENCY MEASURE: Installation of 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 and/or demand (and, hence, energy and/or demand costs) at a comparable level of service.

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 OF EQUIPMENT: The percentage of gross energy input that is realized as useful energy output of a piece of equipment.

ENERGY EFFICIENCY PRACTICE: The use of high-efficiency products, services and practices or an energy using appliance or piece of equipment, to reduce energy usage 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: refrigerator replacement, light fixture replacement, cooling equipment upgrades.

ENERGY EFFICIENCY RATIO (EER): The ratio of output cooling in BTU per hour to input electrical power in watts at a given operating point. EER is generally calculated using a 95 degree Fahrenheit outside temperature and an inside temperature of 80 degrees at 50% relative humidity. The higher the unit's EER rating the, the more energy efficiency 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, such as the heating, ventilation and air conditioning (HVAC), lighting and water heating systems.

ENERGY SAVINGS: The reduction in use of energy from the pre-retrofit baseline to the post-retrofit energy use, once independent variables (such as weather or occupancy) have been adjusted for.

ENGINEERING APPROACHES: Methods using engineering algorithms or models to estimate energy and/or demand use.

ENGINEERING MODEL: 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, 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.

***EX ANTE* SAVINGS ESTIMATE**: Administrator-forecasted savings used for program and portfolio planning purposes as filed with the PA PUC, from the Latin for "beforehand."

***EX POST* EVALUATION ESTIMATED SAVINGS**: Savings estimates reported by the 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 is referring 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."

EXTERNAL VALIDITY: The extent to which the association between an independent variable and a dependent variable that is demonstrated within a research setting also holds true in the general environment.

FREE-DRIVER: A non-participant who adopted a particular efficiency measure or practice as a result of a utility program. See SPILLOVER EFFECTS for aggregate impacts.

FREE-RIDER: A program participant who would have implemented the program measure or practice in the absence of the program.

GROSS SAVINGS: The change in energy consumption and/or demand that results directly from program related actions taken by participants in an efficiency program, regardless of why they participated.

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 that it consumes in watt-hours.

HETEROSCEDASTICITY: Unequal error variance. In statistics, a sequence or a vector of random variables is heteroscedastic if the random variables in the sequence or vector may have different variances. This violates the regression assumption of constant variance (the variance of the errors is constant across observations or homoscedastic). Typically, residuals are plotted to assess this assumption. Standard estimation methods are inefficient when the errors are heteroscedastic. A common example is when variance is expected to be greater on a variable measurement for larger firms than for smaller firms.

HOMOSCEDASTIC (HOMOSCEDASTICITY): Constant error variance, an assumption of classical regression analysis. See also HETEROSCEDASTICITY.

IMPACT EVALUATION: Used to measure the program-specific induced changes in energy and/or demand usage (such kWh, kW and therms) and/or behavior attributed to energy efficiency and demand response programs.

IMPACT YEAR: Depending on the context, impact year means either (a) the twelve 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 and/or customer-specific information.

INDEPENDENT VARIABLES: The factors that affect the energy and demand used in a building but cannot be controlled (e.g., weather or occupancy).

INDIRECT ENERGY SAVINGS (INDIRECT PROGRAM ENERGY SAVINGS): The use of the words “indirect savings” or “indirect program savings” refers to programs that are typically information, education, marketing or outreach programs in which the program’s actions 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.

LINE LOSS FACTOR: Factor used to describe the energy lost due to heating of conductors caused by electrical resistance along the transmission and distribution lines of the electric grid.

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.

INTERNAL VALIDITY: The validity of (causal) inferences in scientific studies, usually based on experiments as experimental validity. Inferences are said to possess internal validity if a causal relation between two variables is properly demonstrated.

MARKET EFFECT EVALUATION: The evaluation of the change in the structure/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 an increase in the 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.

MEASUREMENT BOUNDARY: The boundary of the analysis for determining direct energy and/or demand savings.

METERING: Meeting is 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 specifically to separate data collection for one or more end-uses in a facility, such as lighting, air conditioning or refrigeration. Spot metering is an instantaneous measurement (rather than over time) to determine 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, e.g., 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).

MULTI-COLINEARITY: A statistical phenomenon in which two or more predictor variables in a multiple regression model are highly correlated. In this situation the coefficient estimates may change erratically in response to small changes in the model or the data. Multi-Colinearity does not reduce the predictive power or reliability of the model as a whole, at least within the sample data themselves; it only affects calculations regarding individual predictors.

NET SAVINGS: The total change in load that is attributable to an energy efficiency program. This change in load may include, implicitly or explicitly, the effects of 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, 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.

NORMALIZED ANNUAL CONSUMPTION (NAC) ANALYSIS: A regression-based method that analyzes monthly energy consumption data.

PARTIAL FREE-RIDER: A program participant who would have implemented, to some degree, the program measure or practice in the absence of the program (i.e., a participant may have purchased an ENERGY STAR® appliance in the absence of the program, but because of the program the participant purchases an appliance that is higher in efficiency).

PARTICIPANT: A consumer that received a service offered through the subject efficiency program, in a given program year. The term "service" is used in this definition to suggest that the service can be a wide variety of services, including financial rebates, technical assistance, product installations, training, energy efficiency information or 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 could 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, or a state residential energy efficiency code program.

PROGRAM YEAR TO DATE: Defined as the period between June 1st and May 31st of the current reporting period

PROGRAM YEAR THREE (PY3): Defined as the period between June 1, 2011 and May 31, 2012.

PROJECT: An activity or course of action involving one or multiple energy efficiency measures, at a single facility or site.

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) to specified independent variables (explanatory variables). The mathematical model of their relationship is the regression equation.

RELIABILITY: Refers to the likelihood that the 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.

RIGOR: The level of expected confidence and precision. The higher the level of rigor, the more confident one is that the results of the evaluation are both accurate and precise.

SEASONAL ENERGY EFFICIENCY RATIO: Rating of a unit is 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 the unit's SEER rating, the more energy efficiency it is.

SPILLOVER: Reductions in energy consumption and/or demand caused by the presence of the energy efficiency program, beyond the program-related gross savings of the participants. There can be participant and/or nonparticipant spillover.

STATISTICALLY ADJUSTED ENGINEERING (SAE) MODELS: A category of statistical analysis models that incorporate the engineering estimate of savings as a dependent variable.

STIPULATED VALUES: See "deemed savings."

SYMMETRIC ADDITIVE ADJUSTMENT: A mathematical approach used incorporate pre-event usage trends into the baseline usage estimates for demand response customers.

TECHNICAL RESOURCE MANUAL: Standards for measuring and verifying applicable DSM/EE measures used by EDCs to meet the Act 129 consumption and peak demand reduction targets.

TOTAL RESOURCE COST TEST: The TRC test analyzes the costs and benefits of the energy efficiency and conservation plans.

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.

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: 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 SAVINGS: Savings that have undergone rigorous evaluation, measurement, and verification to ensure their accuracy within a prescribed level of confidence and precision.