

**Final Annual Report
to the
Pennsylvania Public Utility Commission**

**For the Period
June 2012 through May 2013
Program Year 4**

For Pennsylvania Act 129 of 2008
Energy Efficiency and Conservation Plan

Prepared by ADM Associates, Tetra Tech, NMR Group, and West Penn Power Company

For

West Penn Power Company
Docket No. M-2009-2093218

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Acronyms

C&I	Commercial and Industrial
CATI	Computer-Aided Telephone Interview
CFL	Compact Fluorescent Lamp
CPITD	Cumulative Program/Portfolio Inception to Date
CPITD-Q	Cumulative Program/Portfolio Inception through Current Quarter
CSP	Conservation Service Provider or Curtailment Service Provider
CVR	Conservation Voltage Reduction
CVRf	Conservation Voltage Reduction factor
DLC	Direct Load Control
DR	Demand Response
EDC	Electric Distribution Company
EE&C	Energy Efficiency and Conservation
EM&V	Evaluation, Measurement, and Verification
GNI	Government, Non-Profit, Institutional
HVAC	Heating, Ventilating, and Air Conditioning
IQ	Incremental Quarter
kW	Kilowatt
kWh	Kilowatt-hour
LED	Light Emitting Diode
LEEP	Low-Income Energy Efficiency Program
LIURP	Low-Income Usage Reduction Program
M&V	Measurement and Verification
MW	Megawatt
MWh	Megawatt-hour
NTG	Net-to-Gross
PA PUC	Pennsylvania Public Utility Commission
PY1	Program Year 2009, from June 1, 2009 to May 31, 2010
PY2	Program Year 2010, from June 1, 2010 to May 31, 2011
PY3	Program Year 2011, from June 1, 2011 to May 31, 2012
PY4	Program Year 2012, from June 1, 2012 to May 31, 2013
PYX QX	Program Year X, Quarter X
PYTD	Program Year to Date
SEER	Seasonal Energy Efficiency Rating
SWE	Statewide Evaluator
T&R	Tracking & Reporting
TRC	Total Resource Cost
TRM	Technical Reference Manual

Report Definitions

Note: Definitions provided in this section are limited to terms critical to understanding values presented in this report. For other definitions, please refer to the Act 129 glossary.

REPORTING PERIODS

Cumulative Program Inception to Date (CPITD)

Refers to the period of time since the start of the Act 129 programs. CPITD is calculated by totaling all program year results, including the current program year to date results. For example, CPITD results for PY4 Q3 is the sum of PY1, PY2, PY3, PY4 Q1, PY4 Q2, and PY4 Q3 results.

Incremental Quarter (IQ)

Refers to the current reporting quarter only. Activities occurring during previous quarters are not included. For example, IQ results for PY4 Q3 will only include results that occurred during PY4 Q3 and not PY4 Q2.

Program Year to Date (PYTD)

Refers to the current reporting program year only. Activities occurring during previous program years are not included. For example, PYTD results for PY4 Q3 will only include results that occurred during PY4 Q1, PY4 Q2, and PY4 Q3. It will not include results from PY1, PY2 and PY3.

SAVINGS TYPES

Preliminary

Qualifier used in all reports except the final annual report to signify that evaluations are still in progress and that results have not been finalized. Most often used with “realization rate” or “verified gross savings”.

Reported Gross

Refers to results of the program or portfolio determined by the program administrator (e.g., the EDC or the program implementer). Also known as *ex-ante*, or “before the fact” (using the annual evaluation activities as the reference point).

Verified Gross

Refers to results of the program or portfolio determined by the evaluation activities. Also known as *ex-post*, or “after the fact” (using the annual evaluation activities as the reference point).

TRC COMPONENTS¹

Administration Costs

Includes the administrative CSP (rebate processing), tracking and reporting system (“T&R” or tracking system), and general administration and clerical costs.

EDC Costs

Per the 2011 Total Resource Cost Test Order, the Total EDC Costs refer to EDC incurred expenditures only.

Management Costs

Includes the EDC program management, CSP program management, general management oversight and major accounts.

Participant Costs

Per the 2011 Total Resource Cost Test Order, the net participant costs are the costs for the end use customer.

Total TRC Costs

Total TRC Costs includes EDC Evaluation Costs, Total EDC Costs and Participant Costs.

Total TRC Benefits

Based upon verified gross kWh and kW savings. Benefits include: avoided supply costs, including the reduction in costs of electric energy, generation, transmission, and distribution capacity, and natural gas valued at marginal cost for periods when there is a load reduction.

¹ All TRC definitions are subject to the 2011 Total Resource Cost Test Order.

1 Overview of Portfolio

Pennsylvania Act 129 of 2008 signed on October 15, 2008 mandated energy savings and coincident peak demand reduction goals for the largest electric distribution companies (EDCs) in Pennsylvania. Each EDC submitted energy efficiency and conservation (EE&C) plans (Plans)—which were approved by the Pennsylvania Public Utility Commission (PA PUC)—pursuant to these goals. This report documents the progress and effectiveness of the EE&C accomplishments for West Penn Power Company (West Penn Power or Company) in the 4th quarter of Program Year 4 (PY4), defined as March 1, 2013 through May 31, 2013, Program Year 4 accomplishments, as well as the cumulative accomplishments of the programs since inception in Program Year 1 (PY1).

ADM Associates has evaluated the programs including measurement and verification of the savings. The final verified savings for PY4 and the cumulative verified savings of the programs since inception in Program Year 1 (PY1) are included in this final annual report.

This report is organized into two major sections. The first section provides an overview of activities the Company has undertaken in accordance with the Plan. This includes summary information and portfolio level details regarding the progress towards the Act 129 compliance goals, energy and demand impacts, net-to-gross ratios, finances, and cost-effectiveness. The following sections include program specific details, including program updates, impact evaluation findings, and process evaluation findings.

1.1 Summary of Progress toward Compliance Targets

Energy Savings

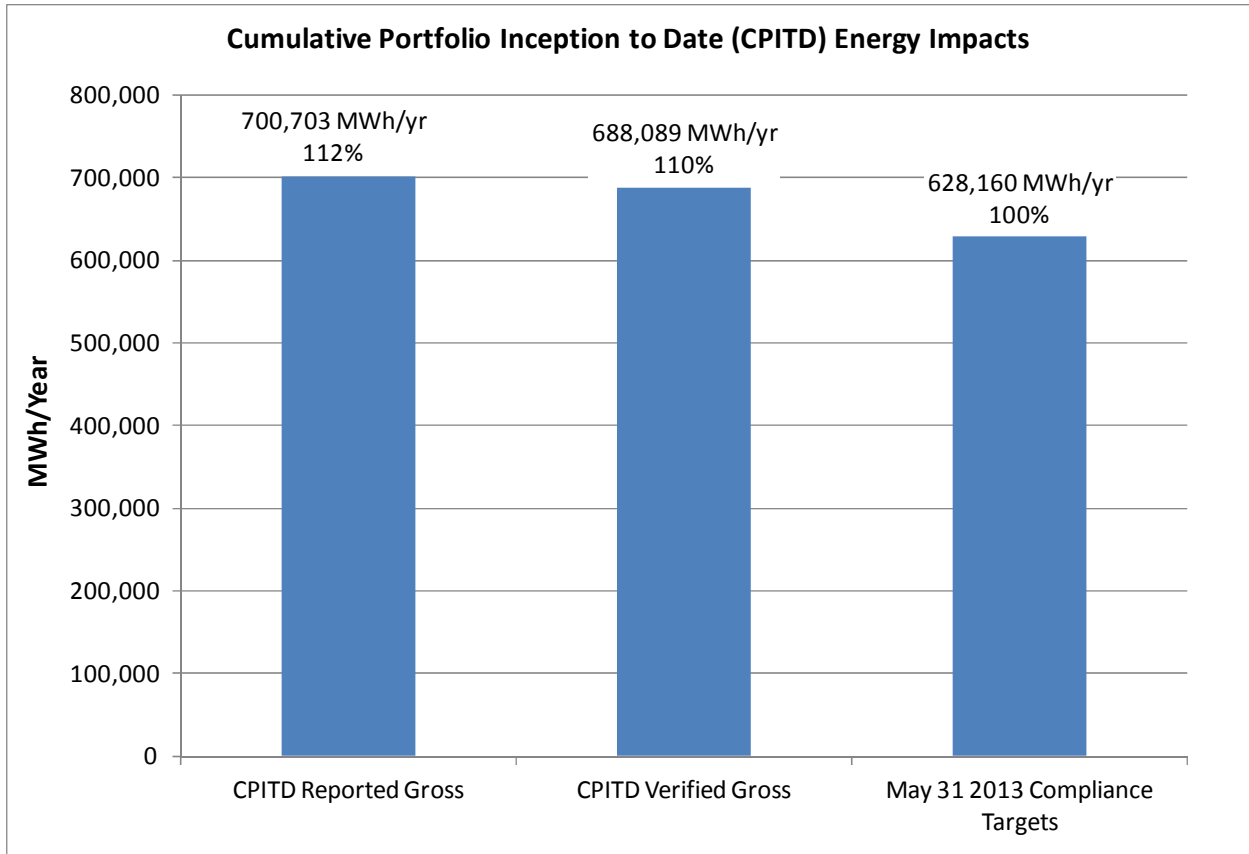
The energy savings² compliance target for West Penn Power was 628,160 MWh/yr which had to be achieved by May 31, 2013 per Act 129. Based on CPITD verified gross energy savings³, West Penn Power

² Herein, energy savings refers to annualized energy savings and is measured in kWh/year or MWh/year. Energy savings are reported at the meter.

³ See the “Report Definitions” section for an explanation of how CPITD verified gross savings are calculated.

has achieved 110 percent of the energy savings compliance target. These energy savings are shown in Figure 1-1. The PUC will determine compliance using CPITD verified gross energy savings.

Figure 1-1: Portfolio CPITD Energy Savings



Line Loss Adjustments

Table 1-1 shows the line loss adjustment factor that was used to gross up demand savings from the meter level to the system level. This factor reflects the weighted average hourly marginal loss value (i.e. the change in MW losses vs. the change in MW of load) modeled during the top 100 hours, where weights are reflected by the hourly load reductions for energy efficiency and demand response programs. This represents the weighted average of marginal distribution and transmission system losses across the top 100 hours for West Penn Power.

Table 1-1: Line Loss Factor

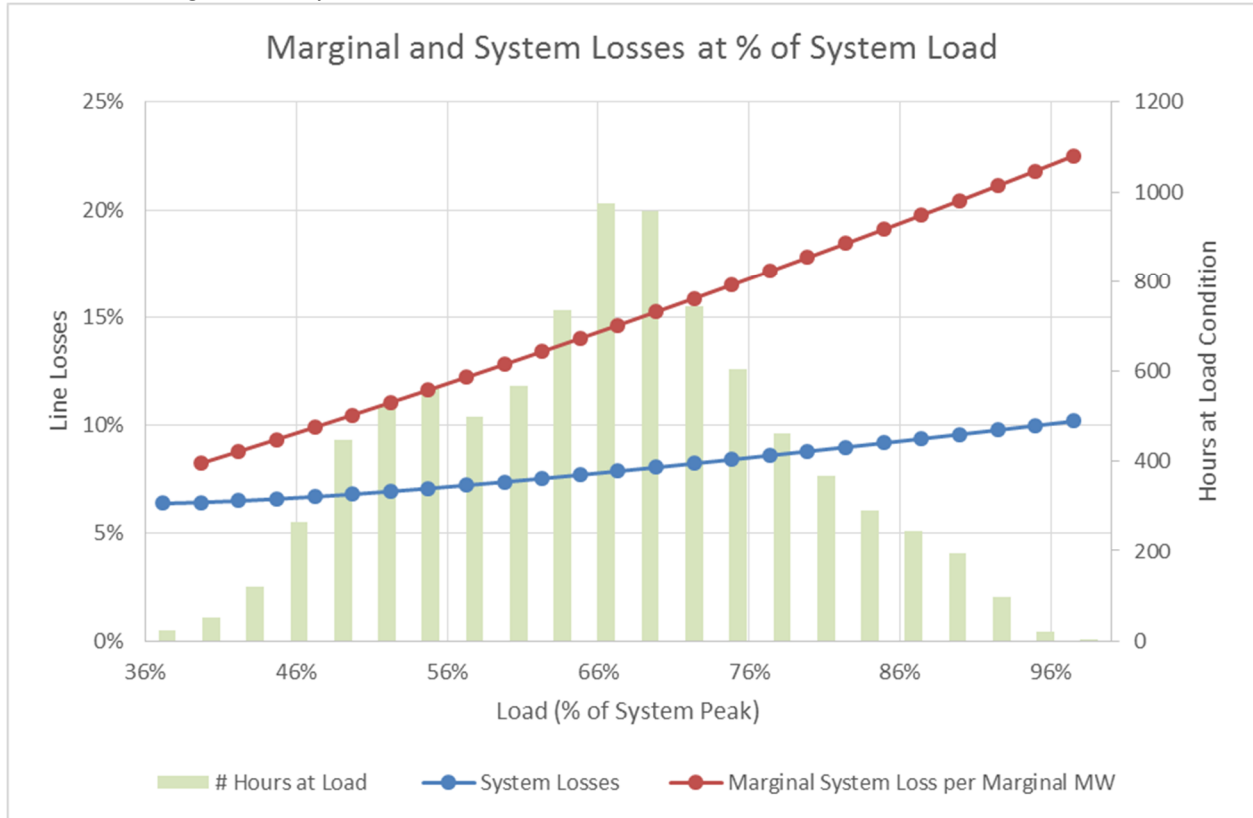
Application	Line Loss Factor
Utilized for all EE and DR Programs	20.0%

This line loss factor recognizes the fact that Transmission and Distribution systems experience exponential gains in line losses as system loading increases⁴ due to increased thermal resistivity of system conductors and transformers, as was experienced during the top 100 summer hours of 2012. System reconstructed loads during the top 100 hours in 2012 were significantly greater than annual system average loads. Exhibit 1 below illustrates system and marginal line losses for West Penn Power at various system loading conditions. “# Hours at Load” (shown in bars) reflects the distribution of 8760 annual hours at different loading conditions. Recognizing that the Demand Reduction compliance period is measured during the Top 100 Hours, the Line Loss Factor in Table 1-1 appropriately reflects the average marginal line losses occurring during maximum system loading conditions (i.e., the upper right hand portion of the marginal loss line in Exhibit 1 below).

West Penn Power’s saving analysis incorporates line losses modeled at peak system load conditions, reflecting West Penn Power’s sector sales reported via the FERC Form 1 and sector loss factors as defined in West Penn Power’s Tariff. Hourly losses were modeled for each of the top 100 hours used to reconstruct system loads (i.e., reflecting add-backs as described in §4 of the 2012 TRM) and to compute the energy efficiency and demand response demand savings.

⁴ *Valuing the Contribution of Energy Efficiency to Avoided Marginal Line Losses and Reserve Requirements*. Principal authors Jim Lazar and Xavier Baldwin Aug. 2011.

Exhibit 1 – Marginal and System Losses



Peak Demand Reduction during the Top 100 Hours

The system peak demand reduction⁵ compliance target for West Penn Power was 157 MW per Act 129 which had to be achieved by May 31, 2013. When assessing performance against this target, the Company utilized specific evaluation results to measure the demand impacts of CFLs in addition to TRM protocols. Specifically, the Company’s evaluator has adjusted the coincidence factor and included waste heat interactive effects to more accurately depict the demand reductions from residential CFLs during the Company’s Top 100 Hours.

As requested by the SWE and TUS Staff, the Company’s performance results are shown utilizing the 2012 TRM, hereafter referred to as “TRM Top 100 Hours MW Achieved” or “TRM”. However, as has been previously communicated to the SWE and TUS Staff through Joint Utility comments⁶, the 2012 TRM

⁵ Herein, demand reduction refers to the EDC’s system peak demand reduction in the EDC’s top 100 hours of highest demand, as defined by the PA PUC and is measured in kW or MW.

⁶ Joint EDC Comments on Residential Coincidence Factor, March 12, 2013, p. 3, Items 2a-c.

contains an error in the demand coincidence factor for Residential CFLs⁷. As this error *significantly* understates the impact of these widely adopted measures during peak periods, it was corrected in the 2014 TRM⁸. As such, and consistent with Section 1.8 of the 2012 TRM which allows for the correction of results for discovered errors, the Company has calculated an additional set of TRM impacts that corrects the Residential CFL coincidence factor to reflect the intended value of 8.8%. These results are hereafter referred to as “TRM Corrected Top 100 Hours MW Achieved” or “TRM Corrected”.

Finally, the Company has included an additional set of evaluation results that include specific deviations from the 2012 TRM protocols to more accurately assess the impacts of Residential Lighting during the Company’s Top 100 Hours. The Company believes these more precise evaluation results, hereafter referred to as “*Evaluated Top 100 hours MW Achieved*” or “*Evaluated*” best demonstrates compliance with ACT 129’s unique Demand Reduction target. The evaluation results adjust the TRM deemed values and protocols as follows:

- 1) An alternative methodology to assess the Coincidence Factor (“CF”) of residential CFLs that uses residential CFL load shapes and the actual top 100 hours for West Penn Power to establish the actual contributions of residential lighting to peak load reductions during the summer of 2012. As articulated in Section 1.1 of the 2012 TRM: *“The algorithms and methodologies set forth in this document must be used to determine EDC reported gross savings and evaluation measurement and verification (EM&V) verified savings, unless an alternative measurement approach or custom measure protocols is submitted and approved for use”*. Consistent with this guidance, the Company submits an alternative methodology in order to more accurately assess its peak load impacts during the top 100 hours. As described in Appendix A, use of load shapes and actual hours associated with the Company’s top 100 hours more accurately comports with the steps for assessment of top 100 hour impacts as delineated in Section 4 of the TRM. The resulting coincidence factor is 11.8%.
- 2) Include interactive lighting impacts (i.e. interactive effect). As recognized in revisions to Residential lighting protocols in the 2014 TRM, accurately estimating demand reduction impacts of Residential CFLs requires consideration of the air conditioning load that is avoided by the use of more efficient lighting technology in homes. This adjustment is particularly important to recognize during summer peak periods. The 2012 TRM recognizes this impact in Non-Residential settings, and the 2014 Draft TRM recognizes these impacts in both Residential and Non-Residential settings. The Company’s

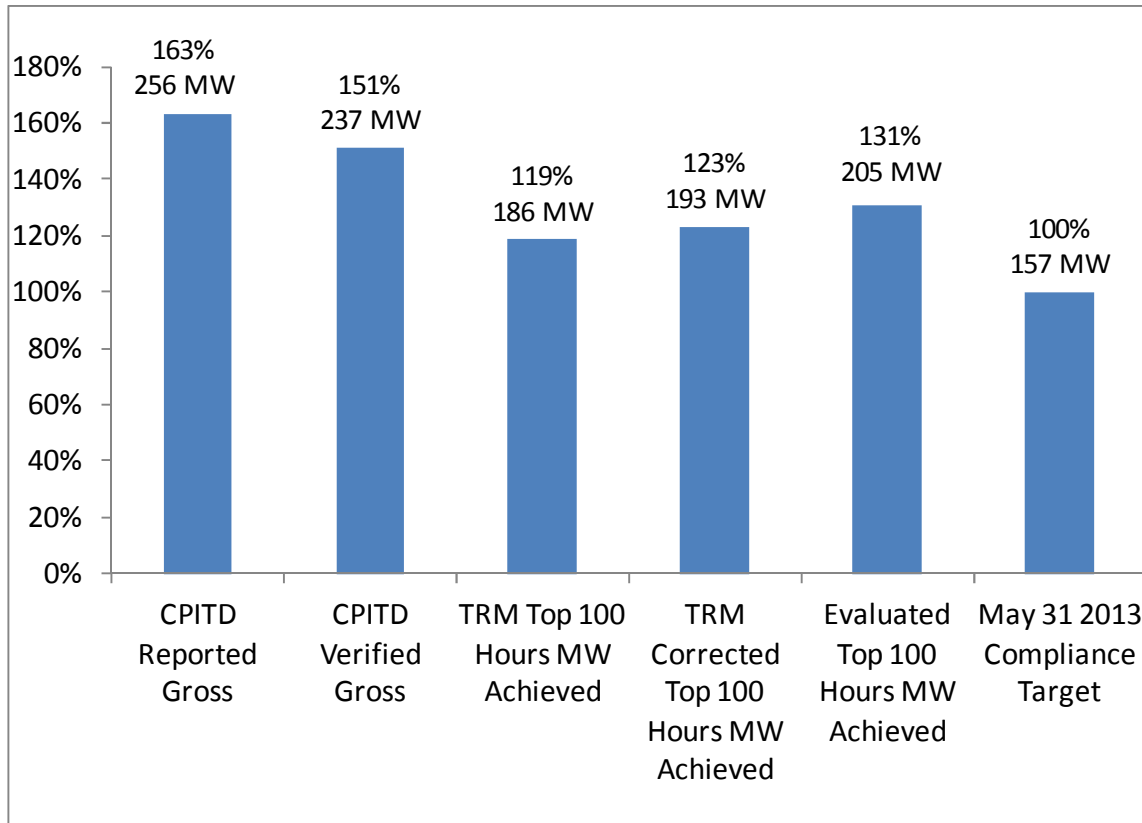
⁷ The 5.0% coincidence factor listed in Table 2-42: ENERGY STAR Lighting – References, pp. 108-109, is an error in the 2012 TRM. The Company believes the correct value as pulled from the intended source document is 8.8% as shown in *RLW Analytics, “Energy Efficiency Measures/Programs Reference Document for the ISO Forward Capacity Market (FCM)”*, prepared for the New England State Program Working Group (SPWG), Spring 2007, p. IV. FirstEnergy further believes that the 8.8% value is also not fully appropriate for Top 100 compliance targets because it is calculated in the PJM peak window (2 PM to 6 PM), while the Top 100 hours tend to include hours that are outside this window with higher lighting utilization.

⁸ As adopted on December 19, 2013, the Pennsylvania *Technical Reference Manual*, revised June 2014, establishes the Coincidence Factor for Residential Energy Star Lighting as 9.1%, Table 2 73: *ENERGY STAR Lighting – References*, p. 151

evaluator has performed Company specific data collection and modeling to estimate those impacts during the top 100 hours.⁹

Based on the adjustments discussed in this Section and further described in Appendix A, West Penn Power has achieved 131% of the demand reduction compliance target during the Top 100 hours of 2012 based only on installations in place and providing demand reductions during those hours, identified as “Evaluated Top 100 Hours MW Achieved” in Figure 1-2 (119% of the target using “TRM” results, and 123% using “TRM Corrected” results). Including demand reductions initiated for Act 129 programs occurring outside the top 100 hours, West Penn Power achieved 151% of the demand reduction compliance target based on CPITD gross demand reduction¹⁰ achieved through Quarter 4 (CPITD-Q), as shown in Figure 1-2.

Figure 1-2. Portfolio CPITD Peak Demand Reduction



⁹ See Appendix A for further detail related to this adjustment.

¹⁰ See the “Report Definitions” section for an explanation of how CPITD verified gross savings are calculated. As referred to in this Figure, “TRM,” “TRM Corrected,” and “Evaluated” results are consistent with the terminology previously discussed in Section 1 of this Report.

Low Income Sector

Act 129 mandates that the number of measures offered to the low-income sector be proportionate to the low-income sector's share of total energy usage.¹¹ There are 10 measures available to the low-income sector and 42 measures available in total across all customer sectors¹². The measures offered to the low-income sector therefore comprise 23.8 percent of the total measures offered. This exceeds the fraction of the electric consumption of the utility's low-income households divided by the total electricity consumption in the West Penn Power territory (9.7 percent). These values are shown in Table 1-2.

Table 1-2: Low-Income Sector Compliance Metrics

	Low-Income Sector	All Sectors	% Low-Income
# of Measures Offered	10	42	23.8%
Electric Consumption (MWh/yr)	1,951,180	20,079,830	9.7%

The CPITD reported gross energy savings for low-income sector programs (excluding low-income participation in non-low-income programs) is 19,194 MWh/yr; this is 2.7 percent of the CPITD total portfolio reported gross energy savings.

Including low-income customer participation in non-low-income programs, the CPITD reported gross energy savings achieved is 42,560 MWh/yr; this is 6.1percent of the CPITD total portfolio reported gross energy savings.

The CPITD verified gross energy savings achieved for low-income programs (excluding low-income participation in non-low-income programs) is 18,371 MWh/yr; this is 2.6 percent of the CPITD total portfolio verified gross energy savings.¹³

¹¹ Act 129 includes a provision requiring electric distribution companies 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." 66 Pa.C.S. §2806.1(b)(i)(G). The legislation contains no provisions regarding targets for participation, or energy or demand savings.

¹² To keep calculations tractable, measures are grouped into homogeneous categories. For example, the "WARM Plus" low-income program offers more than 100 distinct measures, but it is counted as one of the seven broad measures available solely to low-income customers. Likewise, there may be scores of variants of linear fluorescent lamps rebated by the Efficient Equipment programs, but they are also categorized in the same group.

¹³ See the "Report Definitions" section for an explanation of how CPITD verified gross savings are calculated.

Including low-income customer participation in non-low-income programs, the CPITD reported verified energy savings achieved is 64,121 MWh/yr; this is 9.1 percent of the CPITD total portfolio reported gross energy savings.^{14 15}

Government, Nonprofit and Institutional (GNI) sector

Act 129 mandates that a minimum of 10% of the required energy and demand targets be obtained from units of federal, state and local governments, including municipalities, school districts, institutions of higher education and nonprofit entities. Herein, this group is referred to as the government, nonprofit and institutional (GNI) sector.

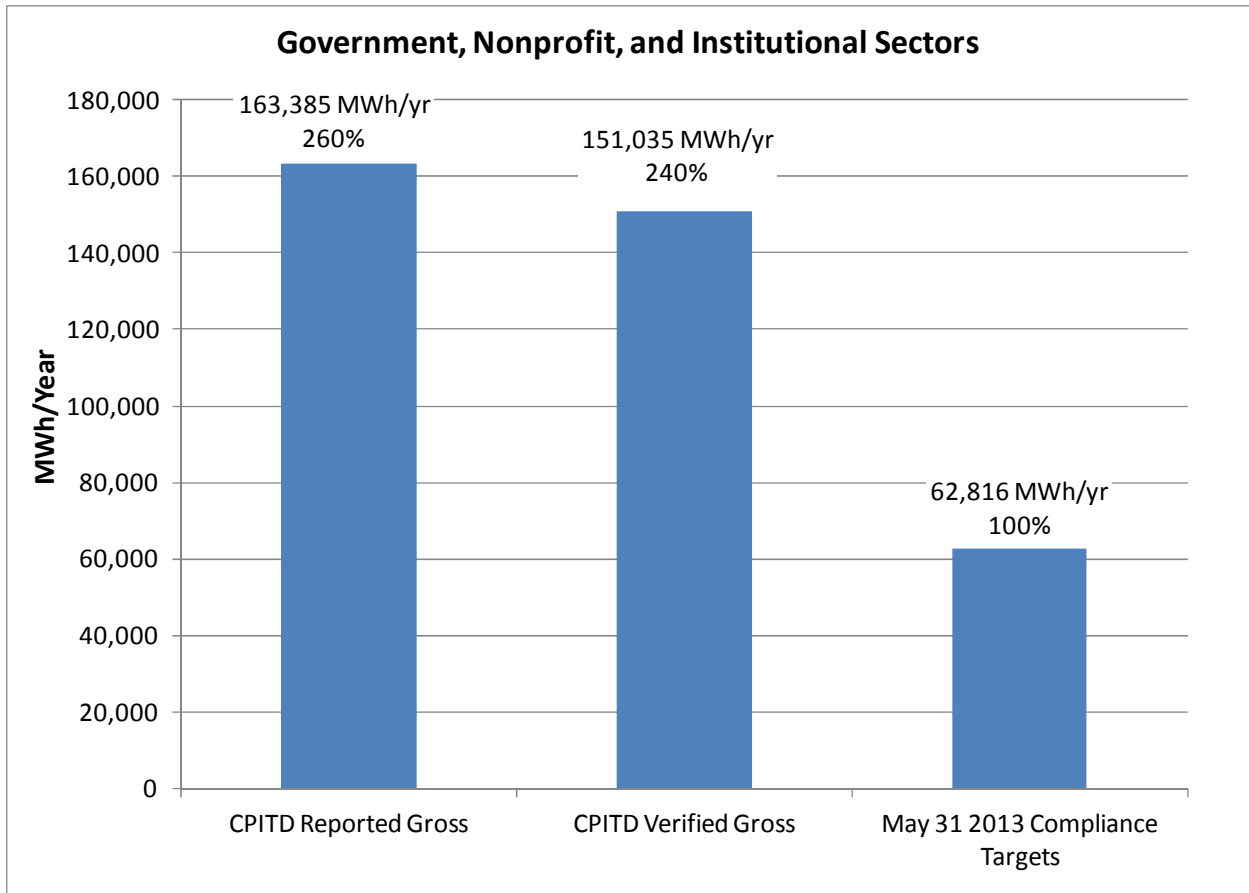
The energy savings compliance target for the GNI sector for West Penn Power is 63 GWh/yr, which must be obtained by May 31, 2013. Based on CPITD verified gross energy savings¹⁶, West Penn Power achieved 240 percent of the target. These values are shown in Figure 1-3.

¹⁴ The Energy Savings achieved in the low-income sector starting with the PY4Q2 report are calculated according to the procedure in the PY3 Annual report (page 14). This is a shift from the previous calculation procedure that was used for the PY4Q1 report, and the new methodology results in smaller claimed impacts, thus the adjustment from the PY4Q1 report.

¹⁵ The estimated cost of low-income savings from non-low-income programs is \$5,004,501.

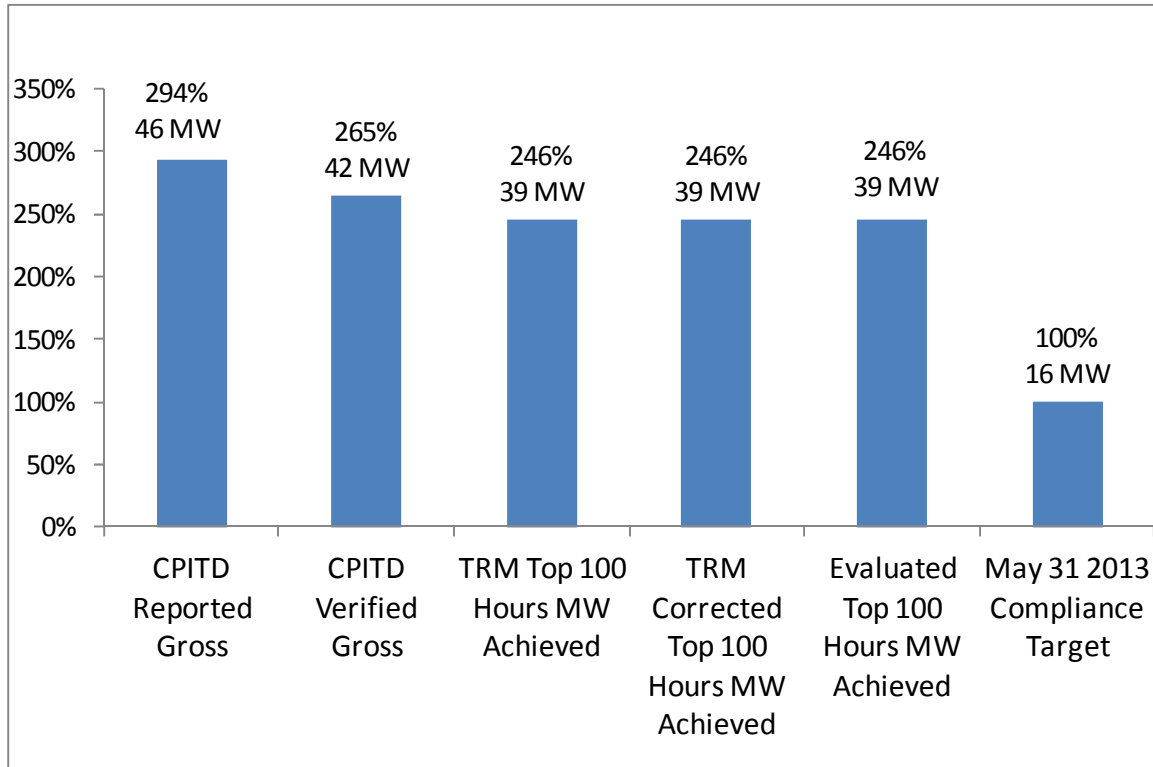
¹⁶ See the "Report Definitions" section for an explanation of how CPITD verified gross savings are calculated.

Figure 1-3: GNI CPITD Energy Savings



The peak demand compliance target for the GNI sector for West Penn Power is 16 MW. Based on CPITD verified gross demand reduction¹⁷, West Penn Power achieved 246% percent of the target, identified as "Evaluated Top 100 Hours MW Achieved" (246% of the target using "TRM" results, and 246% using "TRM Corrected" results). These values are shown in **Figure 1-4**.

Figure 1-4: GNI CPITD Peak Demand Reduction



Phase II Carry Over

According to the Phase II Implementation Order, West Penn Power is allowed by the PUC to "carry over" MWh savings into Phase II of Act 129. Table 1-3 below shows how many MWh of savings from PY4 West Penn Power will be carrying over into Phase II.

¹⁷ See the "Report Definitions" section for an explanation of how CPITD verified gross savings are calculated. As referred to in this Figure, "TRM," "TRM Corrected," and "Evaluated" results are consistent with the terminology previously discussed in Section 1 of this Report.

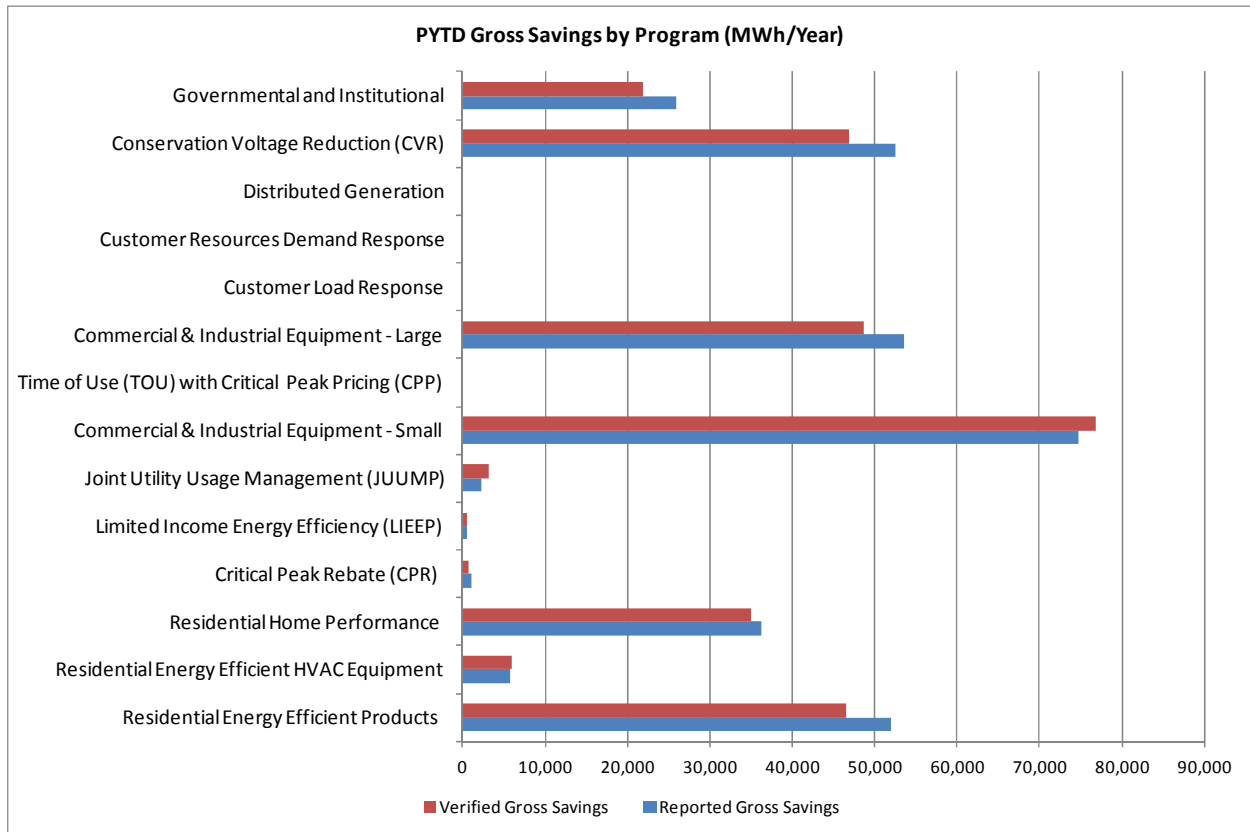
Table 1-3: Savings from PY4 Carried into Phase II

CPITD Verified Savings (MWh/Yr)	CPITD Unverified Savings (MWh/Yr)	Savings Carried into Phase 2 (MWh/Yr)
688,089	0	59,929

1.2 Summary of Energy Impacts

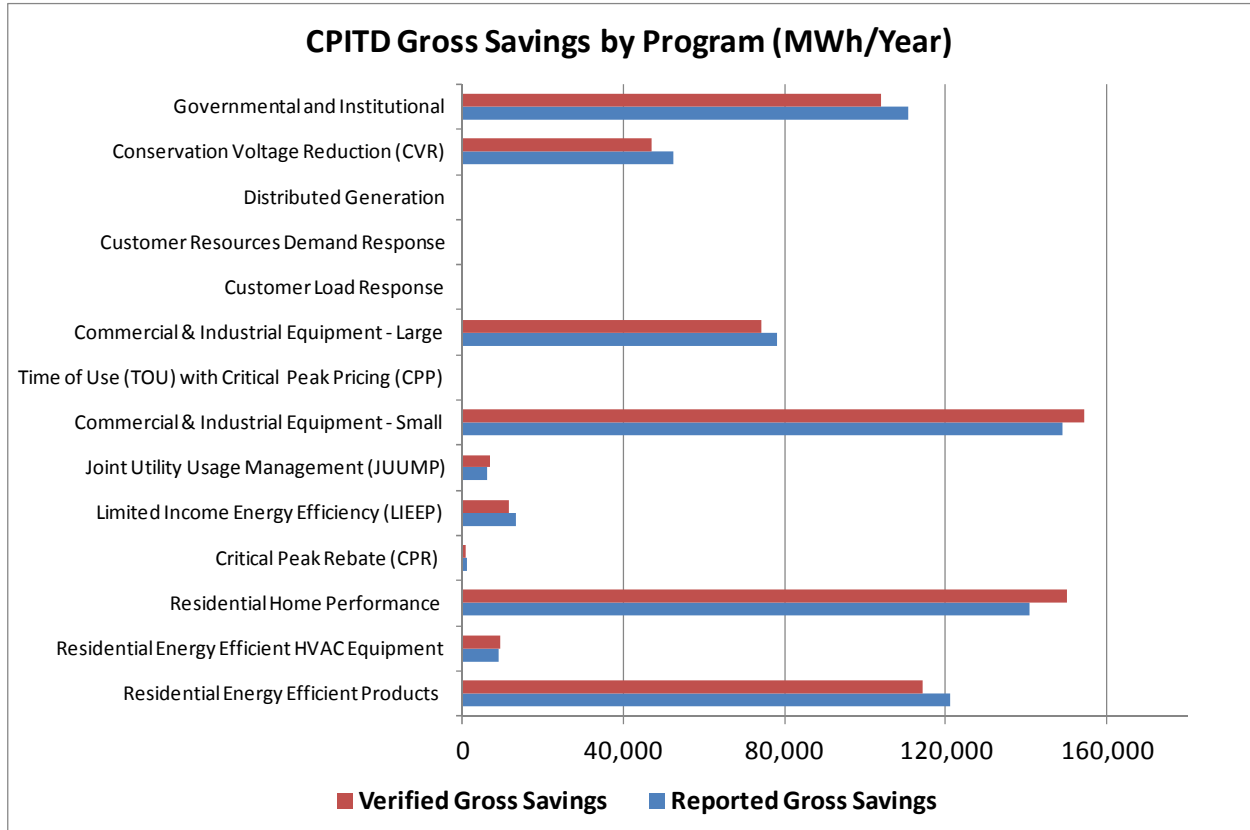
A summary of the reported and verified energy savings by program for Program Year 4 is presented in Figure 1-5.

Figure 1-5: PYTD Gross Energy Savings by Program



A summary of the cumulative reported and verified energy savings by program is presented in Figure 1-6.

Figure 1-6: CPITD Gross Energy Savings by Program



A summary of energy impacts by program through the PY4 Q4 is presented in Table 1-4 and Table 1-5.

Table 1-4: Reported Participation and Gross Energy Savings by Program

Program	Participants			Reported Gross Energy Savings (MWh/Year)		
	IQ	PYTD	CPITD	IQ	PYTD	CPITD
Residential Appliance Turn-In	895	5,087	11,235	1,612	9,254	18,650
Residential Energy Efficient Products	119,625	293,874	617,932	21,817	52,040	121,029
Residential Energy Efficient HVAC Equipment	4,138	13,401	16,843	1,233	5,741	8,968
Residential Home Performance	186,733	197,324	561,637	8,970	36,297	141,043
Critical Peak Rebate (CPR)	0	23,974	23,974	0	1,060	1,060
Limited Income Energy Efficiency (LIEEP)	0	630	10,702	0	522	13,149
Joint Utility Usage Management (JUUMP)	0	4,398	8,711	0	2,362	6,045
Commercial & Industrial Equipment - Small	307	10,278	37,842	23,212	74,791	149,194
Time of Use (TOU) with Critical Peak Pricing (CPP)	0	0	0	0	0	0
Commercial & Industrial Equipment - Large	43	149	201	19,483	53,619	78,180
Customer Load Response	0	0	0	0	0	0
Customer Resources Demand Response	0	155	155	0	0	0
Distributed Generation	0	0	0	0	0	0
Conservation Voltage Reduction (CVR)	0	0	0	0	52,492	52,492
Governmental and Institutional	95	420	1,485	17,731	25,943	110,893
TOTAL PORTFOLIO	311,836	549,690	1,290,717	94,057	314,122	700,703
NOTES:						

Table 1-5: Verified Gross Energy Savings by Program

Program	PYTD Reported Gross Energy	PYTD Energy Realization Rate	PYTD Verified Gross Energy	CPITD Verified Gross Energy

	Savings (MWh/Year)		Savings (MWh/Year)	PYTD Achieved Precision	Savings (MWh/Year)	CPITD Achieved Precision
Residential Appliance Turn-In	9,254	81%	7,470	9%	15,255	5%
Residential Energy Efficient Products	52,040	90%	46,641	9%	114,344	5%
Residential Energy Efficient HVAC Equipment	5,741	103%	5,917	6%	9,396	3%
Residential Home Performance	36,297	96%	34,979	18%	150,130	12%
Critical Peak Rebate (CPR)	1,060	74%	783	5%	783	5%
Limited Income Energy Efficiency (LIEEP)	522	117%	610	10%	11,578	10%
Joint Utility Usage Management (JUUMP)	2,362	135%	3,178	14%	6,793	14%
Commercial & Industrial Equipment - Small	74,791	103%	76,848	10%	154,530	7%
Time of Use (TOU) with Critical Peak Pricing (CPP)	0	n/a	0		0	
Commercial & Industrial Equipment - Large	53,619	91%	48,613	11%	74,245	8%
Customer Load Response	0	n/a	0		0	
Customer Resources Demand Response	0	n/a	0		0	
Distributed Generation	0	n/a	0		0	
Conservation Voltage Reduction (CVR)	52,492	89%	46,980	16%	46,980	16%
Governmental and Institutional	25,943	84%	21,832	13%	104,055	13%
TOTAL PORTFOLIO	314,122	94%	293,851	5.6%	688,089	4.6%

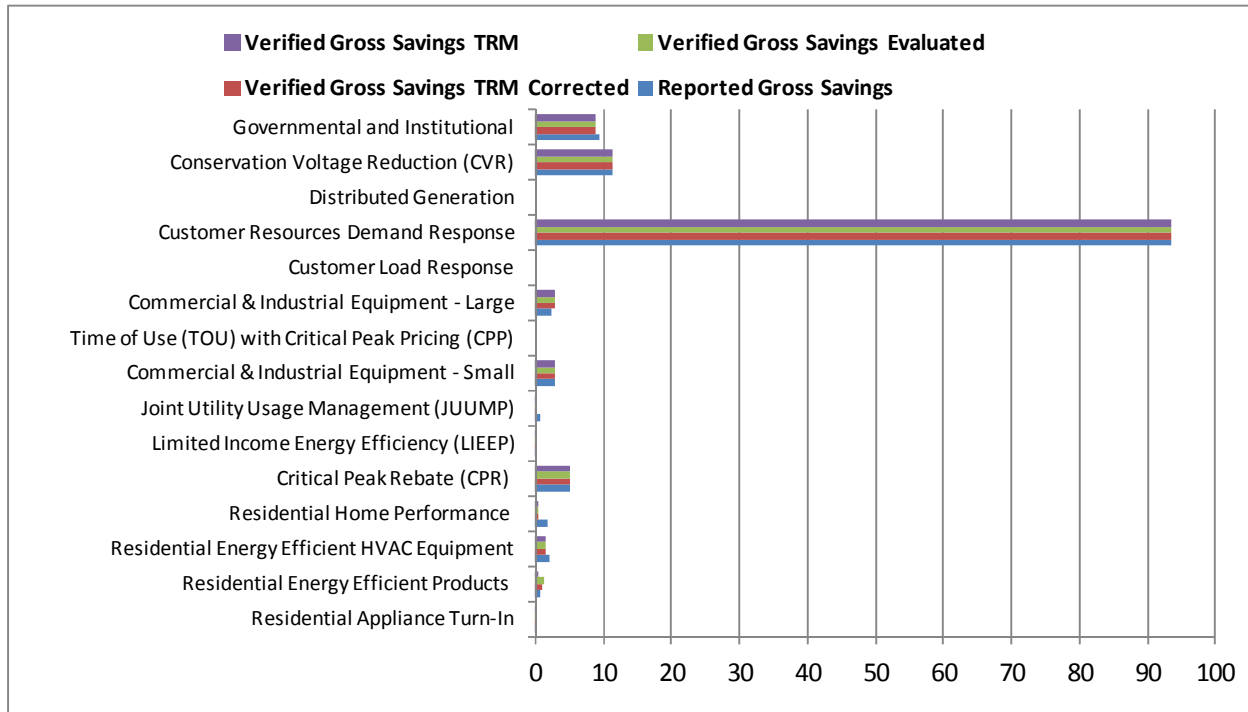
1.3 Summary of Fuel Switching Impacts

West Penn Power has not rebated any overt gas to electric fuel switching measures in its Plan. In certain programs where comparable gas appliances are available, there are rebates available for electric heat pumps or electric water heaters. For these programs, all participants are asked if gas is available at their homes or businesses. ADM surveyed customers that received rebates for electric heat pumps and electric water heaters. Out of 60 surveyed program participants, 47 reported that they did not have gas service available at their homes. Seven of the ten customers that did have gas service available replaced preexisting electric heat pumps or electric water heaters. The remaining three customers switched from gas to heat pump water heaters, but did not cite the West Penn Power rebate as the primary factor in the decision to switch to electric water heating. One customer reported that the electric heat pump water heater is more environmentally friendly, while the other two customers cited that heat pump water heaters are cheaper to run.

1.4 Summary of Demand Impacts

A summary of the reported and verified demand reduction by program within the top 100 hours for the program year is presented in Figure 1-7¹⁸.

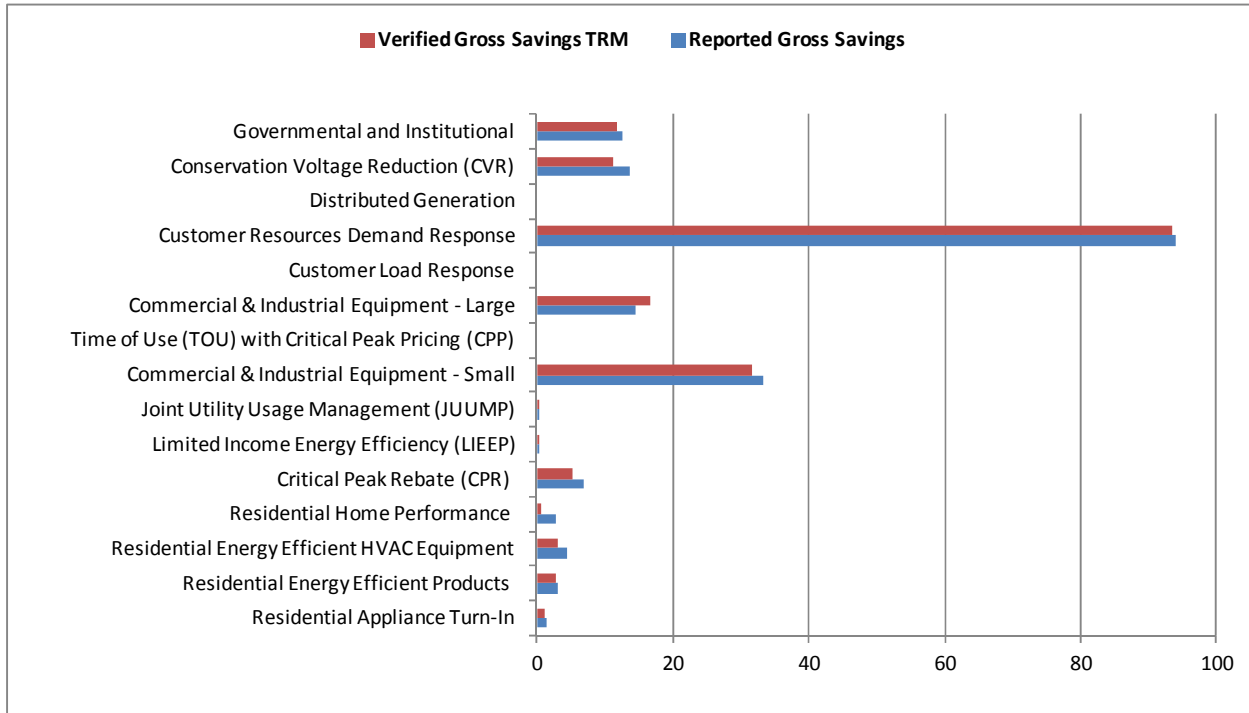
Figure 1-7: PYTD Reported Demand Reduction by Program (Top 100 Hours)



¹⁸ See the "Report Definitions" section for an explanation of how CPITD verified gross savings are calculated. As referred to in this Figure, "TRM," "TRM Corrected," and "Evaluated" results are consistent with the terminology previously discussed in Section 1 of this Report..

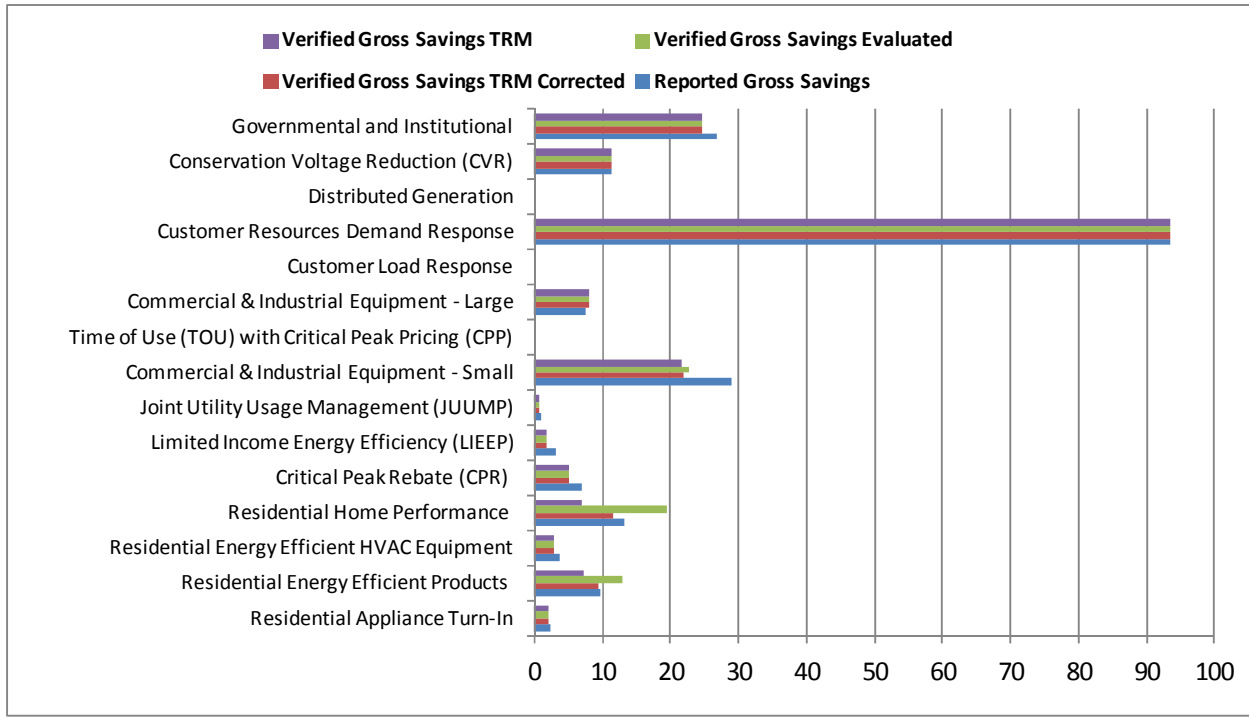
A summary of the reported and verified demand reductions by program including all MW savings for the program year is presented in Figure 1-8. The impacts below include the line loss factors presented in Table 1-1.

Figure 1-8: PYTD Reported Demand Reduction by Program (All MW Savings)



A summary of the cumulative reported and verified demand reduction by program, using the loss factors presented in Table 1-1, within the top 100 hours is presented in Figure 1-9¹⁹.

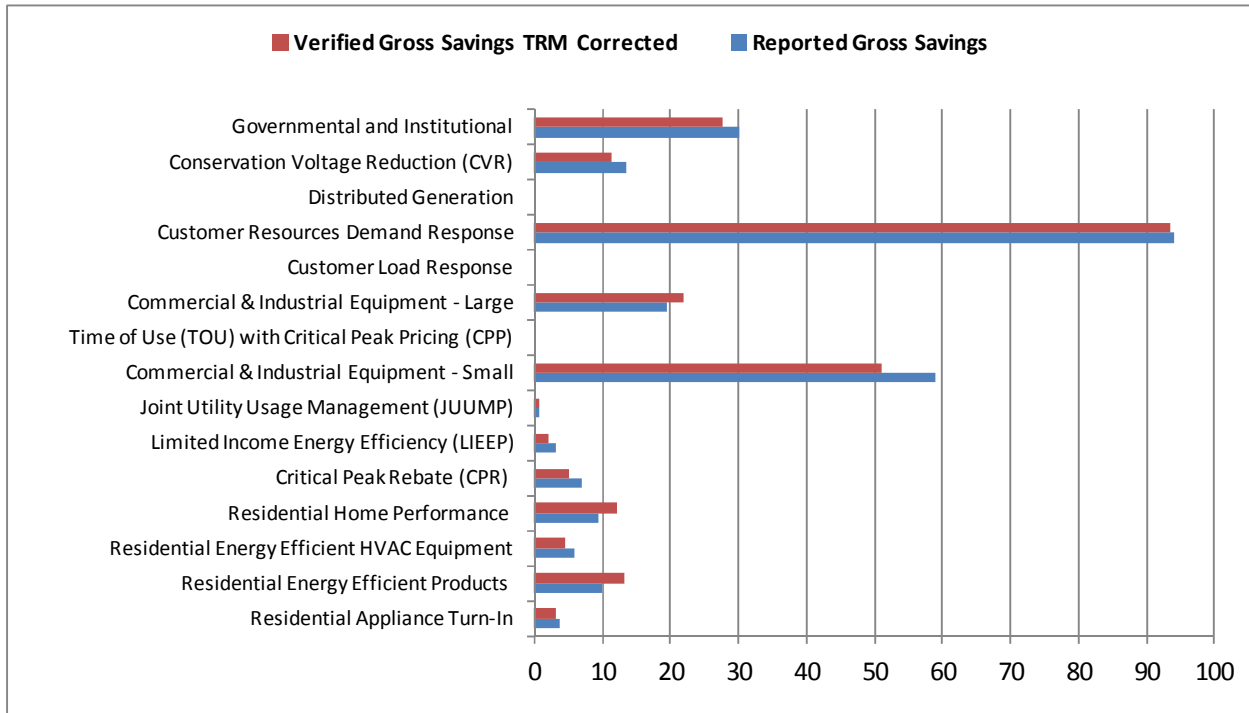
Figure 1-9: CPITD Reported Demand Reduction by Program (Top 100 Hours)



¹⁹ See the “Report Definitions” section for an explanation of how CPITD verified gross savings are calculated. As referred to in this Figure, “TRM,” “TRM Corrected,” and “Evaluated” results are consistent with the terminology previously discussed in Section 1 of this Report..

A summary of the cumulative reported and verified demand reduction by program, using the loss factors as presented in Table 1-1, including all MW savings for the program year is presented in Figure 1-10.

Figure 1-10: CPITD Reported Demand Reduction by Program (All MW Savings)



A summary of demand reduction impacts by program through PY4 Q4 is presented in Table 1-6, Table 1-7 and Table 1-8.

Table 1-6: EDC Reported Participation and Gross Demand Reduction by Program

Program	Participants			Reported Gross Demand Reduction (MW)		
	IQ	PYTD	CPITD	IQ	PYTD	CPITD
Residential Appliance Turn-In	895	5,087	11,235	0.27	1.55	3.59
Residential Energy Efficient Products	119,625	293,874	617,932	1.33	3.17	10.00
Residential Energy Efficient HVAC Equipment	4,138	13,401	16,843	1.41	4.53	5.97
Residential Home Performance	186,733	197,324	561,637	1.34	2.74	9.34
Critical Peak Rebate (CPR)	0	23,974	23,974	0.00	7.03	7.03
Limited Income Energy Efficiency (LIEEP)	0	630	10,702	0.00	0.07	3.19
Joint Utility Usage Management (JUUMP)	0	4,398	8,711	0.00	0.46	0.58
Commercial & Industrial Equipment - Small	307	10,278	37,842	23.92	33.27	58.82
Time of Use (TOU) with Critical Peak Pricing (CPP)	0	0	0	0.00	0.00	0.00
Commercial & Industrial Equipment - Large	43	149	201	9.37	14.46	19.50
Customer Load Response	0	0	0	0.00	0.00	0.00
Customer Resources Demand Response	0	155	155	0.00	94.01	94.01
Distributed Generation	0	0	0	0.00	0.00	0.00
Conservation Voltage Reduction (CVR)	0	0	0	0.00	13.59	13.59
Governmental and Institutional	95	420	1,485	11.64	12.75	30.03
TOTAL PORTFOLIO	311,836	549,690	1,290,717	49.28	187.62	255.64

Table 1-7: PYTD Verified Gross Demand Reductions in the Top 100 Hours by Program²⁰

Program	PYTD Reported Gross Demand Savings (MW)	PYTD Demand Realization Rate	PYTD Verified Gross Demand Savings (MW)	PYTD Achieved Precision	CPITD Verified Gross Demand Savings (MW) TRM	CPITD Verified Gross Demand Savings (MW) TRM Corrected	CPITD Verified Gross Demand Savings (MW) Evaluated	CPITD Achieved Precision
Residential Appliance Turn-In	0.25	83%	0.21	0.11	2.01	2.01	2.01	0.08
Residential Energy Efficient Products	0.59	140%	0.83	0.07	7.25	9.40	12.91	0.05
Residential Energy Efficient HVAC Equipment	2.15	70%	1.51	0.05	2.83	2.83	2.83	0.05
Residential Home Performance	1.89	25%	0.48	0.13	6.82	11.67	19.58	0.09
Critical Peak Rebate (CPR)	5.16	100%	5.16	0.05	5.16	5.16	5.16	0.05
Limited Income Energy Efficiency (LIEEP)	0.03	114%	0.04	0.10	1.91	1.91	1.91	0.07
Joint Utility Usage Management (JUUMP)	0.77	9%	0.07	0.14	0.71	0.71	0.71	0.10
Commercial & Industrial Equipment - Small	2.99	95%	2.86	0.16	21.69	22.05	22.62	0.11
Time of Use (TOU) with Critical Peak Pricing (CPP)	0.00	n/a	0.00	n/a	0.00	0.00	0.00	n/a
Commercial & Industrial Equipment - Large	2.44	116%	2.83	0.15	8.10	8.10	8.10	0.11
Customer Load Response	0.00	n/a	0.00	n/a	0.00	0.00	0.00	n/a
Customer Resources Demand Response	93.60	100%	93.60	0.11	93.60	93.60	93.60	0.11
Distributed Generation	0.00	n/a	0.00	n/a	0.00	0.00	0.00	n/a
Conservation Voltage Reduction (CVR)	11.38	100%	11.38	0.16	11.38	11.38	11.38	0.16
Governmental and Institutional	9.52	93%	8.90	0.17	24.61	24.61	24.61	0.12
TOTAL PORTFOLIO	130.8	98%	127.8	8%^[1]	186.1	193.4	205.4	6%^[2]
	[1] At the 90% confidence level [2] At the 90% confidence level							

²⁰ As referred to in this Figure, “TRM,” “TRM Corrected,” and “Evaluated” results are consistent with the terminology previously discussed in Section 1 of this Report.

Table 1-8: PYTD Total Verified Gross Demand Reductions by Program

Program	PYTD Reported Gross Demand Savings (MW)	PYTD Demand Realization Rate	PYTD Verified Gross Demand Savings (MW)	PYTD Achieved Precision	CPITD Verified Gross Demand Savings (MW/Year)	CPITD Achieved Precision
Residential Appliance Turn-In	1.55	83%	1.28	0.11	3.08	8%
Residential Energy Efficient Products	3.17	90%	2.85	0.07	9.56	5%
Residential Energy Efficient HVAC Equipment	4.53	70%	3.17	0.05	4.49	5%
Residential Home Performance	2.74	24%	0.67	0.13	7.02	9%
Critical Peak Rebate (CPR)	7.03	73%	5.16	0.05	5.16	5%
Limited Income Energy Efficiency (LIEEP)	0.07	114%	0.08	0.10	1.95	7%
Joint Utility Usage Management (JUUMP)	0.46	9%	0.04	0.14	0.69	10%
Commercial & Industrial Equipment - Small	33.27	95%	31.77	0.16	50.60	11%
Time of Use (TOU) with Critical Peak Pricing (CPP)	0.00		0.00	0.00	0.00	0%
Commercial & Industrial Equipment - Large	14.46	116%	16.72	0.15	22.00	11%
Customer Load Response	0.00		0.00	0.00	0.00	0%
Customer Resources Demand Response	94.01	100%	93.60	0.11	93.60	11%
Distributed Generation	0.00		0.00	0.00	0.00	0%
Conservation Voltage Reduction (CVR)	13.59	84%	11.38	0.16	11.38	16%
Governmental and Institutional	12.751	93%	11.92	0.17	27.64	12%
TOTAL PORTFOLIO	188	95%	178.6	7%^[1]	237.2	5%^[2]
[1] At the 90% confidence level						
[2] At the 90% confidence level						

1.5 Summary of PY4 Net to Gross Ratios

Per the 2011 TRC Order, EDCs are required to conduct Net-to-Gross (NTG) research. NTG ratios are not applied to gross savings and are not used for compliance purposes, but are used for future program planning purposes. Table 1-9 presents a summary of observed NTG ratios by program based on research for PY4.

Table 1-9: PY4 NTG Ratios by Program

Program Name	NTG Ratio PY4 ²¹	NTG Categories Included ²²
Residential Home Performance	89.6%	free ridership, participant spillover
Residential Appliance Turn-in	65.5%	free ridership
Residential Energy Efficiency HVAC	58.9%	free ridership, participant spillover
Residential Energy Efficient Products	48.2%	free ridership, participant spillover
Limited Income Energy Efficiency Program (LIEEP)	Study not conducted	n/a
Joint Utility Usage Management Program (JUUMP)	Study not conducted	n/a
Commercial/Industrial Small Sector Equipment	97.9%	free ridership, participant spillover
Commercial/Industrial Large Sector Performance Contracting/Equipment ²³	97.9%	free ridership, participant spillover
Commercial/Industrial Large Sector Demand Response	Study conducted by the PA Act 129 Statewide evaluator ²⁴	
Residential Critical Peak Rebate Demand Response Program	Study conducted by the PA Act 129 Statewide evaluator ²⁵	
Government and Institutional	65.5%	free ridership, participant spillover

²¹ NTG studies were conducted once for each program in Phase I (unless otherwise noted) in PY3. Studies were not conducted for programs that have minimal contribution to total portfolio impacts.

²² For example, free ridership, non-participant spillover, participant spillover.

²³ Net-to-gross research was conducted for combined Commercial/Industrial and Government/Non-profit Equipment programs/sectors. Caution is recommended when interpreting by sector.

²⁴ See "ACT 129 DEMAND RESPONSE STUDY, Final Report", May 16, 2013.
<http://www.puc.pa.gov/pdocs/1230512.docx>

²⁵ See "ACT 129 DEMAND RESPONSE STUDY, Final Report", May 16, 2013.
<http://www.puc.pa.gov/pdocs/1230512.docx>

1.6 Summary of Portfolio Finances and Cost-Effectiveness

A breakdown of the portfolio finances is presented in Table 1-10.²⁶

Table 1-10: Summary of Portfolio Finances

	IQ (\$1,000)	PYTD (\$1,000)	CPITD (\$1,000)
EDC Incentives to Participants	\$ 8,171	\$ 22,323	\$ 45,799
EDC Incentives to Trade Allies			
Subtotal EDC Incentive Costs	\$ 8,171	\$ 22,323	\$ 45,799
Design & Development			\$ 1,652
Administration ^[1]	\$ 991	\$ 2,014	\$ 5,793
Management ^[2]			
Marketing ^[3]	\$ 1,100	\$ 2,233	\$ 7,338
Technical Assistance	\$ 2,637	\$ 7,387	\$ 20,286
Subtotal EDC Implementation	\$ 4,728	\$ 11,634	\$ 35,069
EDC Evaluation Costs	\$ 729	\$ 1,089	\$ 2,692
SWE Audit Costs	\$ 226	\$ 536	\$ 2,180
Total EDC Costs^[4]	\$ 13,854	\$ 35,582	\$ 85,740
Participant Costs^[5]	\$ 258	\$ 93,431	\$ 139,110
Total TRC Costs^[6]	\$ 5,715	\$ 107,338	\$ 183,605
Total Lifetime Energy Benefits		\$ 189,295	\$ 350,535
Total Lifetime Capacity Benefits		\$ 54,941	\$ 65,403
Total TRC Benefits^[7]	\$ -	\$ 244,237	\$ 415,939
TRC Ratio^[8]	0.00	2.28	2.27

NOTES

Per PUC direction, TRC inputs and calculations are required in the Annual Report only and should comply with the 2011 Total Resource Cost Test Order approved July 28, 2011. Please see the "Report Definitions" section of this report for more details.

[1] Includes the administrative CSP (rebate processing), tracking system, and general administration and clerical cost.

[2] Includes EDC program management, CSP program management, general management oversight, and major accounts.

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

[4] Per the 2011 Total Resource Cost Test Order, the Total EDC Costs refer to EDC incurred expenses only.

[5] Per the 2011 Total Resource Cost Test Order, the net Participant Costs are the costs for the end-use customer.

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

[7] Total TRC Benefits equals the sum of Total Lifetime Energy Benefits and Total Lifetime Capacity Benefits. Based upon verified gross kWh and kW savings. Benefits include: avoided supply costs, including the reduction in costs of electric energy, generation, transmission, and distribution capacity, and natural gas valued at marginal cost for periods when there is a load reduction.

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

²⁶ Reflects the Company's portfolio accounting as of October 31, 2013 and is subject to true up or revision.

1.7 Summary of Cost-Effectiveness by Program

TRC ratios are calculated by comparing the total TRC benefits and the total TRC costs. Table 1-11 shows the TRC ratios by program and other factors used in the TRC ratio calculation.

Table 1-11: PYTD TRC Ratios by Program

Program	TRC Benefits (\$1000)	TRC Costs (\$1000)	TRC Ratio	Discount Rate	Line Loss Factor
Residential Appliance Turn-In	\$ 5,200	\$ 784	6.64	7.92%	11.0%
Residential Energy Efficient Products	\$ 25,063	\$ 6,818	3.68	7.92%	11.0%
Residential Energy Efficient HVAC Equipment	\$ 5,859	\$ 5,174	1.13	7.92%	11.0%
Residential Home Performance	\$ 5,031	\$ 1,490	3.38	7.92%	11.0%
Critical Peak Rebate (CPR)	\$ 450	\$ 699	0.64	7.92%	11.0%
Limited Income Energy Efficiency (LIEEP)	\$ 374	\$ 535	0.70	7.92%	11.0%
Joint Utility Usage Management (JUUMP)	\$ 3,401	\$ 3,674	0.93	7.92%	11.0%
Commercial & Industrial Equipment - Small	\$ 73,192	\$ 44,378	1.65	7.92%	11.0%
Time of Use (TOU) with Critical Peak Pricing (CPP)	\$ 0	\$ 54	0.00	7.92%	11.0%
Commercial & Industrial Equipment - Large	\$ 45,214	\$ 11,589	3.90	7.92%	11.0%
Customer Load Response	\$ 0	\$ 33	0.00	7.92%	11.0%
Customer Resources Demand Response	\$ 6,211	\$ 5,695	1.09	7.92%	11.0%
Distributed Generation	\$ 0	\$ 0	0.00	7.92%	11.0%
Conservation Voltage Reduction (CVR)	\$ 47,678	\$ 821	58.08	7.92%	11.0%
Governmental and Institutional	\$ 26,565	\$ 25,595	1.04	7.92%	11.0%

2 Residential Critical Peak Rebate Program

The West Penn Power residential demand response or Critical Peak Rebate (CPR) program was a voluntary program marketed as the Energy Savers Reward Program. This program encouraged customers to lower their demand during peak load hours by offering a rebate based on actual demand reduction. CPR could be competitively neutral to allow customers to continue to pay the same generation charge as on utility provided default service or from an electric generation supplier. CPR required the installation of a smart meter to measure the customer’s demand during peak hours. Participants received information to assist them in controlling their demand and their electric bills.

2.1 Program Updates

This program was only offered to Residential customers from June 1, 2012 through September 30, 2012.

2.2 Impact Evaluation Gross Savings

The impact evaluation for the CPR program consists of weather sensitive, auto-regressive model. Each customer’s usage is predicted for the hour in question using a regression model specific to that household. The regression model takes into account the past hour’s weather (temperature humidity index, and binary cloudy variable), and the usage in the prior 12 hours for that customer. Each customer’s baseline is then aggregated to arrive at a representative number for each demand response group (DR group). There are eight distinct DR groups. Customers are grouped into DR groups on the basis of whether they sign up for morning or afternoon event, whether they intend on reducing AC usage to curtail load or not, and whether the customers have in-home technologies to assist in the demand response process or not. The DR groups, along with population and sample sizes are listed in Table 2-2.

Table 2-1: CPITD Reported Results by Quarter²⁷

Reporting Period	Participants	Reported Gross Energy Savings (MWh/yr)	Retail Level Reported Gross Demand Reduction (MW)	Generator Level Top 100 Reported Gross Demand Reduction (MW)	TRM Top 100 Verified Gross Demand Reduction (MW)	TRM Corrected Top 100 Verified Gross Demand Reduction (MW)	Evaluated Top 100 Verified Gross Demand Reduction (MW)	Incentives (\$1000)
PY4 Q1	23,573	1,060	5.86	7.03	5.16	5.16	5.16	361

²⁷ For purposes of this report, all top 100 hour impacts are reported in PY4Q1.

PY4 Q2	0	0	0.00	0.00	0.00	0.00	0.00	152
PY4 Q3	0	0	0.00	0.00	0.00	0.00	0.00	0
PY4 Q4	0	0	0.00	0.00	0.00	0.00	0.00	0
PY4 Total	23,573	1,060	5.86	7.03	5.16	5.16	5.16	513
CPITD Total	23,573	1,060	5.86	7.03	5.16	5.16	5.16	1,011

Table 2-2: Sampling Strategy for PY4

Stratum	Strata Boundaries	Population Size	Assumed Coefficient of Variation (C _v) or Proportion in Sample Design	Target Levels of Confidence & Precision	Target Sample Size	Achieved Sample Size	Evaluation Activity
DR11	Day with Air	6,214	0.72	90/0.15	55	55	Interval Meter Analysis
DR12	Day Without Air	1,006	0.65	90/0.15	15	15	Interval Meter Analysis
DR13	Evening with Air	3,613	0.61	90/0.15	32	32	Interval Meter Analysis
DR14	Evening without Air	537	0.61	90/0.15	15	15	Interval Meter Analysis
DR15	Day with Air with technology	7,470	0.72	90/0.15	66	66	Interval Meter Analysis
DR16	Day without Air With Technology	368	0.59	90/0.15	15	15	Interval Meter Analysis
DR17	Evening with Air with Technology	4,199	0.59	90/0.15	37	37	Interval Meter Analysis
DR18	Evening without Air with Technology	166	0.78	90/0.15	15	15	Interval Meter Analysis
Program Total		23,573		90/0.15	250	250	

Table 2-3: PY4 Summary of Evaluation Results for Energy

Stratum	Reported Gross Energy Savings	Energy Realization Rate	Observed Coefficient of Variation (C_v) or Proportion	Relative Precision	Verified Gross Energy Savings	Unverified Gross Energy Savings
DR11	242	57%	0.5	10%	137	
DR12	30	213%	0.5	19%	64	
DR13	197	70%	0.5	13%	138	
DR14	16	311%	0.5	19%	49	
DR15	303	51%	0.5	9%	155	
DR16	10	332%	0.5	19%	33	
DR17	258	68%	0.5	12%	174	
DR18	5	663%	0.5	19%	33	
Program Total	1,060	74%	0.4	5%	783	

The table below for demand reduction includes PYTD reported and verified demand reductions at the customer meter level for all impact evaluation sampling strata, and verified CPITD top 100-hour demand reductions at the generator level for the entire program.

Table 2-4: PY4 Summary of Evaluation Results for Demand

Stratum	Reported Gross Demand Reduction	Demand Realization Rate	Observed Coefficient of Variation (Cv) or Proportion	Relative Precision	PYTD TRM Verified Gross Demand Reduction (MW) (Retail)	CPITD TRM Top 100 Verified Gross Demand Reduction (MW) (Generator)	CPITD TRM Corrected Top 100 Verified Gross Demand Reduction (MW) (Generator)	CPITD Evaluated Top 100 Verified Gross Demand Reduction (MW) (Generator)
DR11	1.46	57%	0.5	10%	0.83			
DR12	0.18	213%	0.5	19%	0.37			
DR13	0.97	70%	0.5	13%	0.68			
DR14	0.08	311%	0.5	19%	0.24			
DR15	1.89	51%	0.5	9%	0.97			
DR16	0.06	332%	0.5	19%	0.21			
DR17	1.22	68%	0.5	12%	0.82			
DR18	0.02	663%	0.5	19%	0.12			
Program Total	5.86	72%	0.4	5%	4.24	5.16	5.16	5.16

2.3 Impact Evaluation Net Savings

The structure of this program makes a free-rider non-existent. An individual who would have normally used less energy during the event period will be accounted for through the baseline and allocated 0 savings. Thus, the Net to Gross ratio is 1.

2.4 Process Evaluation

Methodology

The evaluation team conducted process evaluations after the first summer 2012 called event to inform program communications with participants and program operations for the remainder of the program offering in Program Year 4.

The key researchable issues for the first event study were identified through program documentation review and interviews with program staff. They included:

- Understanding. Assess participants' understanding of the program and how the program works.
- Difficulty. Assess the level of difficulty with key program components.
- Actions to reduce usage. Document actions taken by participants to reduce electricity usage during the first energy savings period (event) and identify actions participants plan to take during future energy savings periods (events).
- Operational improvement. Identify opportunities for operational improvements and communications with participants.
- The key researchable issues for the post program study were identified through the first event research study (assess if identified issues were effectively addressed) and interviews with program staff. These included:
 - Motivation, understanding, and satisfaction. Understand customer motivation to participate in the program and assess participant understanding of and satisfaction with the program.
 - Home Energy Analyzer Tool. Assess the use of the Home Energy Analyzer tool by participants to gauge home energy usage and reductions during savings events.
 - Dropout motivation. Determine the reasons why people dropped out of the program and what could be done to retain participants.
 - Actions to reduce usage. Assess participant recall of actions to take and document actions taken by participants to reduce electricity usage during the energy savings periods 2012.
 - Operational improvement for future. Identify opportunities for future operational improvements.
 - Future participation. Determine the likelihood of future participation in a similar program.
 - First event study "compare and contrast". Compare survey responses of the first event survey to the post-summer survey to identify trends or changes in the customer acceptance of the program.

Tetra Tech designed and implemented a phone survey as the data collection method. The data sets were stratified by participants and dropouts as well as by program group (Daytime with Air, Daytime without Air, Evening with Air, and Evening without Air) and randomly sampled within each stratum. For both the

first event study and post program study, 100 surveys were completed for an 8.1 and 8.2 percent relative precision with 90 percent confidence, respectively, at the program level.

Key Findings – First Event Study

- Customers like communications via email and cell phone.
- There is an opportunity to increase customer participation in the Home Energy Analyzer tool and this may increase customer engagement throughout the program.
- Most customers found the various components of the program easy to understand.
- Customers do not necessarily take all of the actions that they recall as mentioned in information packet regarding ways to reduce energy usage.
- Per customers' responses about additional actions they plan to take during the next event, additional savings could be seen - 33 participants plan to take additional actions.
- Only 38 percent of respondents who report having a programmable thermostat on their air conditioning have programmed it to increase the temperature setting when not at home.
- Key Findings – Post Program Study
- The financial incentive is a motivator for customer participation, but not the only reason some customers participate - participants also mentioned reasons such as concern for the environment.
- Program components are easy to understand and satisfaction with program components and the program overall was high.
- Use of the Home Energy Analyzer tool was not widespread among program participants.
- Recall of the WPP communicated actions to take during events increased over the summer; however, nearly 30 percent of first event respondents and 18 percent of post-summer respondents could not recall any of the recommended actions.
- Increasing the temperature on AC, turning off lights, delaying laundry, and turning off appliances were the most recalled actions and the actions most frequently taken during events.
- Customers dropped out of the program for a myriad of reasons. Top reasons for dropping out included too many phone calls, too many event days, and payment was not worth the effort. For some customers, there is nothing that the program could do differently to retain them as participants; for others, a better understanding of the program may help retain them.
- More than 50 percent of participants have programmable thermostats and, of those that do, 37 percent program them to increase the temperature when not at home during the summer (the first event study result was 38 percent). The percentage rises to 46 percent programmed for those participating in the "Evening with Air Conditioning" time period.
- Almost three quarters of participants are very likely to participate in a similar program in the future.

Table 2-5: Status Report for Process Evaluations

<p>Recommendations</p>	<p>EDC Status Report for Process Evaluations (Implemented, Being Considered, Rejected AND Explanation of Action Taken by EDC)</p>
<p>Residential Demand Response Program “Energy Saver Rewards”</p>	
<p>Provide customers with reminders about what they can do to save energy during savings events.</p>	<p>Implemented in Phase I.</p>
<p>Provide customers with reminders about the Home Energy Analyzer tool.</p>	<p>Implemented in Phase I.</p>
<p>Provide customers with near-immediate feedback on energy savings after an event.</p>	<p>Implemented in Phase I.</p>
<p>Consider allowing customers to receive communication via email and phone enabled methods, such as a phone app or a text message.</p>	<p>Implemented in Phase I.</p>
<p>Consider conducting a study with non-participants in the CPR program in which a test group receives additional information during peak demand periods to reduce usage. Expanding the study to include a group of participants in the Home Energy Reports program may also provide useful information.</p>	<p>Program ended - will be considered as appropriate for Phase III.</p>

2.5 Financial Reporting

All program expenses were within approved budgets, and TRC results were within reasonable ranges. A breakdown of the program finances is presented in Table 2-6

Table 2-6: Summary of Residential Critical Peak Rebate Program Finances

	IQ (\$1,000)	PYTD (\$1,000)	CPITD (\$1,000)
EDC Incentives to Participants		\$ 513	\$ 513
EDC Incentives to Trade Allies			
Subtotal EDC Incentive Costs		\$ 513	\$ 513
Design & Development			\$ 6
Administration ^[1]	\$ 5	\$ 113	\$ 185
Management ^[2]			
Marketing ^[3]	\$ 0	\$ 1	\$ 180
Technical Assistance	\$ 12	\$ 12	\$ 44
Subtotal EDC Implementation Costs	\$ 17	\$ 126	\$ 415
EDC Evaluation Costs	\$ 33	\$ 59	\$ 84
SWE Audit Costs			
Total EDC Costs^[4]	\$ 50	\$ 699	\$ 1,012
Participant Costs^[5]		\$ 513	\$ 513
Total TRC Costs^[6]	\$ 50	\$ 699	\$ 1,012
Total Lifetime Energy Benefits		\$ 103	\$ 103
Total Lifetime Capacity Benefits		\$ 347	\$ 347
Total TRC Benefits^[7]	n/a	\$ 450	\$ 450
TRC Ratio^[8]	n/a	0.64	0.44

NOTES

Per PUC direction, TRC inputs and calculations are required in the Annual Report only and should comply with the 2011 Total Resource Cost Test Order approved July 28, 2011. Please see the "Report Definitions" section of this report for more details.

[1] Includes the administrative CSP (rebate processing), tracking system, and general administration and clerical cost.

[2] Includes EDC program management, CSP program management, general management oversight, and major accounts.

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

[4] Per the 2011 Total Resource Cost Test Order, the Total EDC Costs refer to EDC incurred expenses only .

[5] Per the 2011 Total Resource Cost Test Order, the net Participant Costs are the costs for the end-use customer.

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

[7] Total TRC Benefits equals the sum of Total Lifetime Energy Benefits and Total Lifetime Capacity Benefits. Based upon verified gross kWh and kW savings. Benefits include: avoided supply costs, including the reduction in costs of electric energy, generation, transmission, and distribution capacity, and natural gas valued at marginal cost for periods when there is a load reduction.

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

3 Residential Home Performance Program

The purpose of the Home Performance Program is to: 1) identify energy savings opportunities; 2) install basic low-cost measures; and 3) make customers aware of other energy efficient programs offered by West Penn Power. Households will be able to identify energy saving opportunities through three types of home energy audits.

1. **Online Audit** – This program is a self-administered on-line audit that analyzes historic energy use, and calculates energy savings based on customer responses to a series of questions. Customers without internet access can complete the audit over the phone with a company representative. Customers who complete the on-line audit are eligible to receive an energy conservation kit once the audit is complete and submitted. There is no incremental cost to customers to complete the on-line audit.
2. **Walk Through audit** – This program is an on-site audit administered by a trained professional auditor. Customers pay a fee of \$50 for the walk-through on-site audit and receive direct-installed low-cost energy savings measures selected by the trained auditor based on the needs of the home.
3. **Whole House Comprehensive audit** – This program provides comprehensive diagnostic assessments of households followed by direct installation of selected low-cost measures plus incentives for implementation of measures addressing building shell, appliances and other energy-consuming features. Customers are eligible to receive up to \$300 in rebates for participating in a two-part (test in/test out) comprehensive energy audit and up to \$900 in rebates calculated on performance-based kWh savings achieved by installing energy-saving improvements.
4. **Behavior Mod** - The Behavior Modification and Education portion of this program is focused on ways customers can implement no-cost or low-cost measures and behaviors that offer opportunities to reduce energy consumption or demand. This component will be implemented in PY4.
5. **Opt In Kits** - The Home Performance Program includes the distribution of CFLs through several CFL promotional channels, including Opt-in, Smart Meter, Online Analyzer, School Kits, and a UPMC mailing. The UPMC mailing also included lime lights and smart strips, although these represent less than 2 percent of reported savings within the program.

3.1 Program Updates

Of the three components of this program, the Whole House Comprehensive audit components did not change during PY4. Beginning in PY4, the Company also offered phone-based audits to customers who had not completed an online audit. Customers who completed the phone-based audit were also eligible for an energy conservation kit and educational information that included tips on how to save energy in their home. For the Walk Thru audit program; the \$50 participation fee was waived by the CSP from January through May 2013 in an effort to boost participation.

3.2 Impact Evaluation Gross Savings

This program has three components: Online audits with mailings of conservation kits, walk-through audits with direct installation of low-cost measures, and comprehensive whole-house retrofits. In PY4, the conservation kits accounted for essentially all (well over 99%) of the program level energy savings. The majority of the savings from the whole house audit projects were attributable to CFLs, Low-flow showerheads, and pipe insulation.

Gross Impact Analysis for the Energy Conservation Kit Contents

Two separate energy conservation kits were sent to customers depending on their hot water fuel source. The kit provided to customers with electric water heating consists of CFLs, LED night lights, aerators and aerator adapters, a furnace whistle, a “smart” power strip, and a low flow showerhead. The kit provided to customers with non-electric water heating consists of CFLs, specialty dimmable CFLs, LED night lights, a furnace whistle, and a “smart” power strip.

In evaluating the gross impact analysis for the energy conservation kits in PY4, four items must be determined:

1. The average energy savings and demand reduction for the kit elements that are installed;
2. The number and type of kits mailed to customers during PY4,
3. The installation rate for the various kit elements
4. The delivery rate, or percentage of reported kits sent to customers that were not received by customers, either because of shipping problems, customer moving, or other such scenarios.

The first item has been determined through application of the partially deemed savings protocols in the 2012 TRM. The most significant adjustment in this process concerns the baseline change for 23W to 26W CFLs. Reported savings were calculated with a 100W lamp as the baseline for such lamps, and the gross verified savings reported herein are calculated with a 72W baseline in accordance with the 2012 TRM. All else held constant, this lowered the realization rate by approximately 9%.

Upon reviewing reported measure-level savings, ADM discovered that these savings included demand reductions for furnace whistles, while the 2012 TRM does not recognize demand reductions. Since most installed furnace whistles – particularly in West Penn Power territory, are installed in homes with central cooling, one would expect nonzero demand reductions from this measure. As such, the realization rate for demand reduction was lower than the realization rate for energy savings. Although the 2014 proposed TRM does recognize demand reductions for this measure, the gross verified impacts are calculated in accordance with the 2012 TRM and zero demand reductions are credited to this measure. Since most of the conservation kits were shipped after the top 100 hours, the resulting underestimation in demand reductions is minimal.

The second item, the total number and type of kits mailed to customers in PY4, is determined by reviewing the program T&R system. Specifically, the T&R system is checked to ensure that duplicate shipments to

the same physical address are not double counted and that all kits being claimed for PY4 are eligible based on delivery dates.

The third item, installation rates, are determined through online surveys, except for CFLs which are given “deemed” installation rates of 0.84 (later multiplied by the kit receipt rate as determined through surveys), consistent with the TRM.

For a particular site in a sample, the installation rate for each kit element takes on a binary value of 1, if the element is installed in accordance to the principles that define that element as an energy efficiency measure, and 0 otherwise. In particular, faucet aerators and low flow showerheads are only counted as “installed” if they are installed in a home that has electric water heating. Smart power strips are counted as “installed” if: (1) there are appliances plugged into the “controlled” sockets that are turned on and off by the smart strip; and (2) an appliance that is not uniformly on is installed in the “master” socket. ADM uses EDC specific ISRs to calculate the verified savings for the kits.

The final item, the delivery rate is determined through the online survey instrument and through follow up interviews. Online survey respondents are asked to indicate whether they received the conservation kit that was mailed to them. For the small percentage of respondents who indicated that they did not receive the kits, follow up email or telephone interviews were conducted at a later date to determine if the customer had misunderstood the question in the online survey. The reported in-service rates reflect the kit non-receipt rate as they are calculated as the ratio of the number of items installed to the number of items claimed to be delivered by West Penn Power.

The online survey instrument that was used to verify that the shipped energy conservation kits were installed asks a series of questions that determine how many of each item was installed and where each item was installed. The accuracy of the online survey instrument was verified in prior program years through supplementary on-site data collection activities of a nested sample of the online survey respondents. The results of this analysis indicate that the variance in savings attributable to this program is primarily a result of installation rates. This variance is best captured in the online survey instrument, as it allows for a large sample size not easily obtained through on-site data collection. Furthermore, the online survey seems particularly appropriate because the majority of program participants completed the audit process online (as opposed to the telephone and walk-through methods). The more anonymous nature of online survey method is through to less likely introduce bias in the estimates of installation rates.

Gross Impact Analysis for the Walk-Through and Comprehensive Audits

The items that are installed during the walk-through visits include a variable quantity of conservation kit items and other low-cost measures to be determined or judged as appropriate by the auditor. Apart from air sealing, all of the energy efficiency measures distributed in the walk-through audits have energy savings protocols that are in the 2012 PA TRM. A relatively small number of homes received comprehensive measures that include air sealing, duct sealing, window upgrades, and insulation. These homes accounted for about 50 MWh of savings for West Penn Power in PY4. The program implementer

calculates energy savings with a whole-house simulation that is informed with site-specific data and measurements such as pre-measure and post-measure air leakage rates measured with a blower door test. ADM has reviewed this process with the implementer in PY4 and finds the data acquisition and calculation process to be appropriate. Approximately 75% of the impacts associated with the in-house audits are attributable to measures such as CFLs, low-flow showerheads and faucet aerators, and hot water pipe insulation. The T&R system reported the measures with adequate resolution to enable a calculation review for the census of participants. ADM verified that the proper TRM algorithms were used for these measures. In addition to the savings calculation review, ADM conducted a small number of verification surveys to verify that the reported conservation measures are in service.

3.2.1 Program Sampling

The two program components - online and walk-through/comprehensive audits - are treated as separate sub-programs, each with distinct populations, samples, and realization rates. A sample point in the context of this program is “a program participant.” For the online/telephone audits component, this is equivalent to “one energy conservation kit.” For the walk-through audit component, it is equivalent to saying “one home.”

Online Audits

The sampling approach for the online audit program component is random sampling. Stratification by kit type was done to ensure that appropriate realization rates are determined for the two individual kit types.

Overall, there are two tiers of sampling involved.

1. A census of the energy and demand savings calculations in the program tracking data are reviewed to ensure that the energy savings and demand reductions are being claimed according to the protocols in the PA TRM, with reasonable assumptions for installation rates.
2. The sample size for online surveys was sufficiently large to determine gross impact with $\pm 15\%$ relative precision at the 85% confidence level. This large sample size (see Table 1-9) is motivated by the fact that the various kit components have different installation rates and only a large sample can accurately capture a true estimate of the installation rate. This is the main advantage of an online survey instrument as compared to on-site data collection for this program.

Walk-Through Audits

There were very few walk-through audits completed in PY4 as well as in previous years due to the program fee of \$50. Though the on-site audits account for approximately 0.5% of program impacts, M&V efforts involved conducting calculation reviews with a small number of verification interviews. The sampling approach for the walk-through audit program component is random sampling. For the purely prescriptive, low-cost measures such as CFLs, smart power strips, showerheads, aerators, and DHW pipe insulation, a census of the energy and demand savings calculations in the T&R system supporting reported savings for the program are reviewed to ensure that the energy savings and demand reductions are claimed according to the protocols in the PA TRM.

Table 3-1: CPITD Reported Results by Quarter²⁸

Reporting Period	Participants	Reported Gross Energy Savings (MWh/yr)	Retail Level Reported Gross Demand Reduction (MW)	Generator Level Top 100 Reported Gross Demand Reduction (MW)	TRM Top 100 Verified Gross Demand Reduction (MW)	TRM Corrected Top 100 Verified Gross Demand Reduction (MW)	Evaluated Top 100 Verified Gross Demand Reduction (MW)	Incentives (\$1000)
PY4 Q1	189,738	9,656	0.36	1.89	0.46	0.48	0.51	\$ 169
PY4 Q2	187,277	8,906	0.04	0.00	0.00	0.00	0.00	\$ 117
PY4 Q3	186,773	8,765	0.04	0.00	0.00	0.00	0.00	\$ 110
PY4 Q4	187,243	8,970	0.04	0.00	0.00	0.00	0.00	\$ 871
PY4 Total	197,324	36,297	0.36	1.89	0.46	0.48	0.51	\$ 1,267
CPITD Total	569,810	141,043	7.78	8.49	6.82	11.67	19.58	\$ 6,740

Table 3-2: Sampling Strategy for PY4

Stratum	Strata Boundaries	Population Size	Assumed Coefficient of Variation (C _v) or Proportion in Sample Design	Target Levels of Confidence & Precision	Target Sample Size	Achieved Sample Size	Evaluation Activity
Home Energy Reports	n/a	184,569	n/a	15%	180,000 treatment, 25,000 control	184,569 treatment, 26,376 control	billing analysis
Conservation Kits	all	12,663	0.5	15%	50	97	Online Surveys
In-Home Audits	all	92	n/a	50%	census	census	Calculation Review.
Program Total		197,324		15%	50	97	197,324

²⁸ For purposes of this report, all top 100 hour impacts are reported in PY4Q1.

Table 3-3: PY4 Summary of Evaluation Results for Energy

Stratum	Reported Gross Energy Savings	Energy Realization Rate	Observed Coefficient of Variation (C _v) or Proportion	Relative Precision*	Verified Gross Energy Savings	Unverified Gross Energy Savings
Home Energy Reports	31,148	100%	n/a	21%	31,148	
Conservation Kits	5,071	74%	< 0.5	4%	3,754	
In-Home Audits	78	98%	< 0.5	10%	77	
Program Total	36,297	96%		18%	34,979	

*The sampling precision is essentially zero for the Home Energy Reports program component. The reported 21% precision is the *measurement uncertainty* in the billing analysis results.

The table below for demand reduction includes PYTD reported and verified demand reductions at the customer meter level for all impact evaluation sampling strata, and verified CPITD top 100-hour demand reductions at the generator level for the entire program. Please note, as discussed in Section 1 and Appendix A of this Report, the CPITD Top 100 demand reduction values in this table are shown using values that represent: 1) calculations published in the 2012 Pennsylvania TRM (“TRM”); 2) calculations that include a correction to the Residential CFL coincidence factor (“TRM Corrected”); and, 3) calculations that incorporate alternative measurement approaches from the 2012 TRM to more accurately assess the peak load impacts from residential lighting during the Company’s Top 100 Hours (“Evaluated”).

Table 3-4: PY4 Summary of Evaluation Results for Demand (Top 100 Hours) Stratum

Stratum	Reported Gross Demand Reduction	Demand Realization Rate	Observed Coefficient of Variation (C _v) or Proportion	Relative Precision	PYTD TRM Verified Gross Demand Reduction (MW) (Retail)	CPITD TRM Top 100 Verified Gross Demand Reduction (MW) (Generator)	CPITD TRM Corrected Top 100 Verified Gross Demand Reduction (MW) (Generator)	CPITD Evaluated Top 100 Verified Gross Demand Reduction (MW) (Generator)
Home Energy Reports	2.09	17%	n/a	21%	0.36			
Conservation Kits	0.19	154%	0.34	7%	0.19			
In-Home Audits	0.00	161%	0.50	10%	0.01			
Program Total	2.28	24%		13%	0.56	6.82	11.67	19.58

3.3 Impact Evaluation Net Savings

The evaluation team employed the self-report approach (SRA) to estimate free-ridership and spillover effects for the Whole House Comprehensive Audit component of the WPP Home Performance program. The Online Audit kits and Outreach (opt-in kit), Walk-Through Audit, and Behavioral Modification components were not evaluated for free ridership and spillover.²⁹ The participant 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 participant 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. The evaluation team completed 58 surveys for a 6.1 percent relative precision with 90 percent confidence (for free-ridership assessment) at the program level.³⁰

Free-ridership was evaluated at the measure category level for each participant surveyed. Participants were sampled for up to two of the following measure categories received/rebated through the program: 1) test-out improvements; 2) CFLs; 3) smart strips; 4) hot water equipment; and, 5) LED nightlights. A free-ridership rate was calculated for each measure category for each participant. Individual scores were then weighted to account for disproportionate sampling, nonresponse, and differential energy savings.

Spillover was evaluated at the participant level. 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.

The net-to-gross research shows that the program has influenced the majority of program gross savings. The overall program free-ridership was estimated to be 18.1 percent, and spillover 7.7 percent for a net-to-gross ratio of 89.6 percent.

Based on this net-to-gross research and the relatively low participation rate and sample sizes across the measures, the evaluation team did not recommend program design changes.

²⁹ The Online Audit and Outreach and Walk Through Audit components were evaluated for the other FirstEnergy Pennsylvania companies in PY3. Net-to-gross research was not conducted for the Behavioral Modification component due to the design of the program; this program is set up as a random control trial (RCT) with treatment and control groups— an approach that inherently controls for free-ridership and participant spillover. To the extent that the control group is affected by the program, nonparticipant SO is not addressed; however, this effect is likely to be small.

³⁰ Based on 103 completed surveys at the measure category level; participants were surveyed for up to two measure categories.

3.4 Process Evaluation

The evaluation team conducted process evaluations for the Whole House Audit, and Behavioral Modification (Home Energy Reports) components of the WPP Home Performance program. These were separate evaluation efforts due to the very different design and implementation of each component; therefore, the studies' methodologies and results are reported separately below.

Whole House Comprehensive Audit

Evaluation Methodology

The limited process evaluation effort for the Whole House Comprehensive Audit component consisted of participant surveys conducted in conjunction with net-to-gross research surveys. Key researchable issues were identified based on the evaluator's experience assessing other residential home energy audits and outreach programs and through interviews with program staff. These issues included:

- **Program marketing.** Participants were asked how they heard about the program and preferred methods for receiving information from FirstEnergy about energy efficiency.
- **Participant satisfaction.** Participants were asked a number of satisfaction questions with regards to equipment received, interactions with program staff, rebate amounts and application process, and with the program overall.
- **Funneling to other FirstEnergy programs.** Participants were asked about their awareness of and participation in other FirstEnergy energy efficiency programs, along with the influence their participation in the Home Energy Audit and Outreach program had on their participation in other FirstEnergy programs.

The sampling frame for the participant survey was the population of Program Year 4 program participants. The evaluation team removed accounts previously contacted by ADM for Program Year 4 evaluation activities from the eligible survey sample frame to avoid double-contacting individual participants for multiple evaluation activities. A census was used for the Comprehensive Audit.

Key Findings

- Participant satisfaction is high and almost three out of every four participants surveyed have recommended the program to others.
- Direct mail marketing efforts were most effective at generating awareness and interest in the program and participants generally prefer to receive information about programs via direct mail and/or email.

Table 3-5: Status Report for Process Evaluations

Recommendations	EDC Status Report for Process Evaluations (Implemented, Being Considered, Rejected AND Explanation of Action Taken by EDC)
Residential Home Energy Audits and Outreach	
Continue marketing and outreach efforts via direct mail and consider marketing through email.	Implemented

Behavioral Modification (Home Energy Reports)

Evaluation Methodology

The evaluation team completed quantitative telephone interviews with 162 customers who were included in the treatment group and 152 customers in the control group in PY4 (for overall 4.6 percent relative precision with 90 percent confidence). The survey focused on the following issues:

- **Customer engagement with the program.** The Residential Behavior Modification program is an auto-enroll program with which customers have not necessarily expressed interest or actively enrolled. An objective of the survey was to assess whether customers are aware of the program and read the HERs that were delivered to their homes. Other measures of engagement included reported usefulness of the information, perceived relevance of the energy-saving tips, and use of on-line tools associated with the program.
- **Barriers to engaging the program.** The survey measured how readership of the HERs changes over time and why. Customers’ reactions to the HERs, including open-ended questions eliciting more information, and reasons for not pursuing additional information through the program are examined to identify barriers for the program.
- **Evidence of behavioral change.** While the impact of the program on household energy use resulting from the changes in behavior is the focus of separate evaluation activities using different methods, the telephone survey provides preliminary information on customer behavior. Do customers take steps to reduce their energy use as a result of the HERs? Are there measurable differences in energy-saving activities between treatment and control groups?

Key Findings

- Awareness of the program and readership of the HERs is high with almost 90 percent of households recalling that they received the reports and all but 2 percent at least scan or look at certain parts of the reports.
- Engagement with the program remains stable, or tends to improve, over time - households that read the report at the start continued to read the report throughout the program and the change in readership was more likely to have increased than decreased based on retrospective self-reports.
- Information provided in the HERs is viewed as useful with over 80 percent of households finding the HERs at least somewhat useful and just under one-quarter describing the HERs are “very useful.”
- Households more often find comparisons of their own energy-use over time to be useful (over 80 percent) than comparisons with their neighbors (about 60 percent). Households express low confidence in the validity and accuracy of the neighbor comparison—a central motivational component of the program. Among six types of information regularly reported in the HERs, the neighbor comparisons receive the lowest usefulness ratings.
- While readership of the paper HERs is high, very few households engage on-line resources promoted by the program.
- Evidence that the HERs shape behavior is mixed. About one-half of households report that they have taken steps to reduce their energy use as a result of the HERs, but comparisons of energy-saving behaviors among households randomly assigned to the treatment and control groups yield few significant differences.

Table 3-6: Status Report for Process Evaluations

<p style="text-align: center;">Recommendations</p>	<p style="text-align: center;">EDC Status Report for Process Evaluations (Implemented, Being Considered, Rejected AND Explanation of Action Taken by EDC)</p>
<p style="text-align: center;">Residential Behavioral Modification (HERs)</p>	
<p>Increase confidence in the HERs by addressing misperceptions and perceived inaccuracies, particularly with how neighbors are explained (through meaningful illustrations of households that may or may not be included in its comparison group, for example).</p>	<p>Being Considered</p>
<p>Emphasize <i>over-time</i> comparisons rather than <i>neighbor</i> comparisons.</p>	<p>Being Considered</p>
<p>Encourage the use of on-line tools cautiously and clearly outline an added value for customers. For example, present a compelling case for on-line use that addresses common complaints about the paper HERs (e.g., cost-efficiencies, more accurate neighbor comparisons or customized energy-saving tips).</p>	<p>Being Considered</p>
<p>Motivate energy-saving behavior by telling a success story—outline how a typical household that has low to moderate efficiency can take specific and practical steps to improve their energy efficiency. Link this story to tracking information available in the HER or on-line to help customers understand how they can use this information as tools for themselves.</p>	<p>Being Considered</p>

3.5 Financial Reporting

All program expenses were within approved budgets, and TRC results were within reasonable ranges. A breakdown of the program finances is presented in Table 3-7.

Table 3-7: Summary of Residential Home Performance Program Finances

	IQ (\$1,000)	PYTD (\$1,000)	CPITD (\$1,000)
EDC Incentives to Participants	\$ 738	\$ 1,267	\$ 6,740
EDC Incentives to Trade Allies			
Subtotal EDC Incentive Costs	\$ 738	\$ 1,267	\$ 6,740
Design & Development			\$ 135
Administration ^[1]	\$ 152	\$ 291	\$ 398
Management ^[2]			
Marketing ^[3]	\$ 276	\$ 583	\$ 1,322
Technical Assistance	\$ 120	\$ (847)	\$ 4,565
Subtotal EDC Implementation Costs	\$ 547	\$ 27	\$ 6,420
EDC Evaluation Costs	\$ 83	\$ 103	\$ 229
SWE Audit Costs			
Total EDC Costs^[4]	\$ 1,368	\$ 1,397	\$ 13,390
Participant Costs^[5]		\$ 1,361	\$ 7,105
Total TRC Costs^[6]	\$ 630	\$ 1,490	\$ 13,754
Total Lifetime Energy Benefits		\$ 4,909	\$ 46,527
Total Lifetime Capacity Benefits		\$ 121	\$ 932
Total TRC Benefits^[7]		\$ 5,031	\$ 47,460
TRC Ratio^[8]	0.00	3.38	3.45

NOTES

Per PUC direction, TRC inputs and calculations are required in the Annual Report only and should comply with the 2011 Total Resource Cost Test Order approved July 28, 2011. Please see the "Report Definitions" section of this report for more details.

[1] Includes the administrative CSP (rebate processing), tracking system, and general administration and clerical cost.

[2] Includes EDC program management, CSP program management, general management oversight, and major accounts.

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

[4] Per the 2011 Total Resource Cost Test Order, the Total EDC Costs refer to EDC incurred expenses only.

[5] Per the 2011 Total Resource Cost Test Order, the net Participant Costs are the costs for the end-use customer.

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

[7] Total TRC Benefits equals the sum of Total Lifetime Energy Benefits and Total Lifetime Capacity Benefits. Based upon verified gross kWh and kW savings. Benefits include: avoided supply costs, including the reduction in costs of electric energy, generation, transmission, and distribution capacity, and natural gas valued at marginal cost for periods when there is a load reduction.

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

4 Residential Appliance Turn-In Program

Residential customers are eligible for a cash incentive and disposal of up to two large older inefficient appliances (refrigerators or freezers); and two Room Air Conditioners (RAC) per household per calendar year. All units must be working and meet established size requirements.

4.1 Program Updates

No changes to this program during PY4.

4.2 Impact Evaluation Gross Savings

The M&V values for this program are based on the energy savings resulting from a customer taking a working refrigerator, freezer or RAC out of service. The savings from refrigerator recycling are stipulated in the TRM, and the protocol for computing savings from RAC recycling are stipulated in an interim TRM protocol. While RAC energy savings are dependent on location and are mapped using the participant's zip code, RAC demand savings are not location dependent. In PY4, the deemed energy impacts for refrigerators and freezers are as follows:

Measure Description	Unit Annual Energy Savings	Unit Annual Demand Reduction
Refrigerator/Freezer Recycling without replacement	1659 kWh	0.2057 kW
Refrigerator/Freezer Recycling with replacement with Energy Star	1205 kWh	0.1494 kW
Refrigerator/Freezer Recycling with replacement with non Energy Star ³¹	1091 kWh	0.1350 kW
RAC	Varies by Zip Code	0.6395 kW

Verifying the savings from this program requires telephone verification, with the final sample encompassing a range of participants entering the program at various times throughout the year. The verification survey was designed to identify whether a refrigerator or freezer was recycled without replacement or if it was replaced with a standard or Energy Star unit. The survey also verifies that the room AC, refrigerator, or freezer was operational at the time of retirement. A final step is necessary to avoid double-counting of savings in the case that a refrigerator is replaced with an Energy Star unit and rebated under the Efficient Products program. ADM conducted a database lookup to identify customers

³¹ This entry is from the 2012 TRM.

that recycled a refrigerator or freezer, and also received rebates for EnergyStar refrigerators or freezers during the same program year. The savings associated with the EnergyStar refrigerators or freezers were then subtracted from the gross verified savings for the program.

For refrigerators and freezers, the reported savings were calculated only for the “recycling without replacement” scenario. The gross verified impacts were calculated according to the process discussed above, which results in lower savings for refrigerators and freezers that are recycled with replacement. The realization rate for the program is attributable almost entirely to this difference.

4.2.1 Program Sampling

The sampling approach for this program is a simple random sample. Sample sizes target 90% confidence level and 10% precision.

Table 4-1: CPITD Reported Results by Quarter³²

Reporting Period	Participants	Reported Gross Energy Savings (MWh/yr)	Retail Level Reported Gross Demand Reduction (MW)	Generator Level Top 100 Reported Gross Demand Reduction (MW)	TRM Top 100 Verified Gross Demand Reduction (MW)	TRM Corrected Top 100 Verified Gross Demand Reduction (MW)	Evaluated Top 100 Verified Gross Demand Reduction (MW)	Incentives (\$1000)
PY4 Q1	1,622	2,977	0.41	0.25	0.21	0.21	0.21	\$ 66
PY4 Q2	1,637	2,979	0.42					\$ 63
PY4 Q3	934	1,687	0.24					\$ 67
PY4 Q4	895	1,612	0.23					\$ 51
PY4 Total	5,087	9,254	1.29	0.25	0.21	0.21	0.21	\$ 247
CPITD Total	11,108	18,660	2.99	2.29	2.01	2.01	2.01	\$ 697

³² For purposes of this report, all top 100 hour impacts are reported in PY4Q1.

Table 4-2: Sampling Strategy for PY4

Stratum	Strata Boundaries	Population Size	Assumed Coefficient of Variation (C _v) or Proportion in Sample Design	Target Levels of Confidence & Precision	Target Sample Size	Achieved Sample Size	Evaluation Activity
Refrigerators/Freezers	n/a	5542	0.5	15%	23	64	Verification Survey
				5%	census	census	Cross check to EE Products
Room ACs	n/a	250	0.5	20%	5	2	Verification Survey
				5%	census	census	Calculation Review
Program Total		5,792		15%	28	66	

Table 4-3: PY4 Summary of Evaluation Results for Energy

Stratum	Reported Gross Energy Savings	Energy Realization Rate	Observed Coefficient of Variation (C _v) or Proportion	Relative Precision	Verified Gross Energy Savings	Unverified Gross Energy Savings
Refrigerators/Freezers	9,194	81%	CV<<0.5	9%	7,410	
Room ACs	60	100%	CV<<0.5	51%	60	
Program Total	9,254	81%		9%	7,470	

The table below for demand reduction includes PYTD reported and verified demand reductions at the customer meter level for all impact evaluation sampling strata, and verified CPITD top 100-hour demand reductions at the generator level for the entire program.

Table 4-4: PY4 Summary of Evaluation Results for Demand (Top 100 Hours)Stratum

Stratum	Reported Gross Demand Reduction	Demand Realization Rate	Observed Coefficient of Variation (Cv) or Proportion	Relative Precision	PYTD TRM Verified Gross Demand Reduction (MW) (Retail)	CPITD TRM Top 100 Verified Gross Demand Reduction (MW) (Generator)	CPITD TRM Corrected Top 100 Verified Gross Demand Reduction (MW) (Generator)	CPITD Evaluated Top 100 Verified Gross Demand Reduction (MW) (Generator)
Refrigerators/Freezers	1.14	80%	CV<<0.5	9%	0.92			
Room ACs	0.15	100%	CV<<0.5	51%	0.15			
Program Total	1.29	83%		11%	1.07	2.01	2.01	2.01

4.3 Impact Evaluation Net Savings

The evaluation team employed the self-report approach (SRA) to estimate free-ridership. The participant 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. The effort was stratified by end-use, or measures, within the Appliance Turn-in program: refrigerators, freezers, and room air conditioners. A total of 201 surveys were completed at the measure level for a 5.6 percent relative precision with 90 percent confidence (for free-ridership assessment) at the program level.

Data was also collected to assess unlike spillover for this program; however, as the program design and implementation is not structured to induce additional non-program savings through energy education, spillover was not quantified for this program. Based on review of the survey data, any potential spillover effects would have been minimal; previous net-to-gross studies of appliance recycling programs have shown spillover attributed to this program to be around one to two percent.

The West Penn Power overall Appliance Turn-in free-ridership result was 38.5 percent for a net-to-gross of 61.5 percent. This is the weighted average based on kWh savings of the individual end-use measure free-ridership rates of 38.4 percent for refrigerators, 36.9 percent for freezers, and 52.6 percent for room air conditioners.

Based on this net-to-gross research, the evaluation team did not recommend program design changes.

4.4 Process Evaluation

Evaluation Methodology

The process evaluation effort consisted of participant surveys conducted with customers who participated in the program in Program Year 3. Key researchable issues were identified based on the evaluator's experience assessing other residential appliance recycling programs and through interviews with program staff. These issues included:

- **Program marketing.** Participants were asked how they heard about the program and preferred methods for receiving information from West Penn Power about energy efficiency.
- **Participant satisfaction.** Participants were asked a number of satisfaction questions in regards to equipment received, interactions with program staff, rebate amounts and application process, and with the program overall.
- **Condition of the turned-in equipment.** Participants were asked if the equipment turned in through the program was in working condition at the time of removal.
- **Disposal and replacement of equipment turned in through the program.** Participants were asked about what would have been done with the equipment if not for the program and if the equipment had been replaced.

A random sample was drawn at the customer level, ensuring the measure mix for each replicate is similar to that of the overall sample frame. During the analysis phase, weight ratios were applied to the data so that the analyses are reflective of the population.

Key Findings

- Bill inserts were the most effective marketing tool in generating awareness of and interest in the program.
- West Penn Power customers are willing to participate in the program with a lower incentive amount, or no incentive at all. This finding suggests that the free pick-up and recycling of the appliance is more important than the incentive to many customers.
- In the absence of the program, most surveyed participants would still have disposed of their appliance.
- A small portion of the recycled appliances were not operational at the time of program participation.
- Recycled appliances were often replaced with ENERGY STAR® rated appliances and removed from older homes.

Table 4-5: Status Report for Process Evaluations

Recommendations	EDC Status Report for Process Evaluations (Implemented, Being Considered, Rejected AND Explanation of Action Taken by EDC)
Residential Appliance Turn-in Program	
Consider adopting enhanced cross-marketing strategies.	Being considered in Phase II.
Emphasize environmental issues and convenience factors in program marketing materials.	Implemented.
Consider lowering incentives for recycled appliances.	Rejected - program results indicate that the higher rebate level was required to support participation goals.
Continue to target recycling primary appliances, as well as secondary appliances that will not be replaced.	Implemented.

4.5 Financial Reporting

All program expenses were within approved budgets, and TRC results were within reasonable ranges. A breakdown of the program finances is presented in Table 4-6.

Table 4-6: Summary of Residential Appliance Turn-In Program Finances

	IQ (\$1,000)	PYTD (\$1,000)	CPITD (\$1,000)
EDC Incentives to	\$ 51	\$ 247	\$ 697
EDC Incentives to Trade			
Subtotal EDC Incentive	\$ 51	\$ 247	\$ 697
Design & Development			
Administration ^[1]	\$ 3	\$ 13	\$ 163
Management ^[2]			
Marketing ^[3]	\$ 14	\$ 93	\$ 924
Technical Assistance	\$ 45	\$ 369	\$ 1,387
Subtotal EDC	\$ 63	\$ 475	\$ 2,474
EDC Evaluation Costs	\$ 50	\$ 61	\$ 145
SWE Audit Costs			
Total EDC Costs^[4]	\$ 163	\$ 784	\$ 3,316
Participant Costs^[5]	\$ 51	\$ 247	\$ 697
Total TRC Costs^[6]	\$ 163	\$ 784	\$ 3,316
Total Lifetime Energy		\$ 4,680	\$ 7,935
Total Lifetime Capacity		\$ 520	\$ 782
Total TRC Benefits^[7]		\$ 5,200	\$ 8,717
TRC Ratio^[8]	n/a	6.64	2.63

NOTES

Per PUC direction, TRC inputs and calculations are required in the Annual Report only and should comply with the 2011 Total Resource Cost Test Order approved July 28, 2011. Please see the "Report Definitions" section of this report for more details.

[1] Includes the administrative CSP (rebate processing), tracking system, and general administration and clerical cost.

[2] Includes EDC program management, CSP program management, general management oversight, and major accounts.

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

[4] Per the 2011 Total Resource Cost Test Order, the Total EDC Costs refer to EDC incurred expenses only.

[5] Per the 2011 Total Resource Cost Test Order, the net Participant Costs are the costs for the end-use customer.

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

[7] Total TRC Benefits equals the sum of Total Lifetime Energy Benefits and Total Lifetime Capacity Benefits. Based upon verified gross kWh and kW savings. Benefits include: avoided supply costs, including the reduction in costs of electric energy, generation, transmission, and distribution capacity, and natural gas valued at marginal cost for periods when there is a load reduction.

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

5 Residential Energy Efficient HVAC Program

This program provides incentives supporting implementation of contractor-installed HVAC or other eligible systems in existing or new residential buildings. The program promotes the sale of high-efficiency, ENERGY STAR® compliant equipment through installation contractors selling to residential customers who are replacing existing home HVAC equipment and provides incentives to customers who replace existing or standard HVAC equipment in residential applications with qualifying energy-efficient heating and cooling systems.

Additionally, the program also provides incentives for maintenance (tune-ups) of existing CAC or heat pump equipment and offers an additional incentive toward replacement of furnace fans meeting ENERGY STAR efficiency guidelines.

5.1 Program Updates

No changes to this program during PY4.

5.2 Impact Evaluation Gross Savings

Gross Impact Analysis

The evaluation effort is conducted using separate methodologies for rebated HVAC equipment such as heat pumps, CACs and solar water heaters, and for HVAC maintenance. Details of the methodologies are described in the subsections below. A calculation review is part of all methodologies ensuring that the energy savings and demand reductions for each measure are calculated according to the appropriate protocols in the PA TRM.

Gross Impact for CACs and Heat Pumps

Savings associated with these HVAC equipment types are estimated using a partially deemed approach, with the kWh reduction determined using deemed hours of operation of the equipment determined by which reference city the installed location is closest to and nameplate information from the equipment regarding unit capacities and efficiencies.

For all new HVAC systems, the baseline efficiencies are stipulated in the PA TRM and are in accordance with Federal codes and standards.

The 'nameplate' data (e.g. capacity, SEER, EER, COP, HSPF) that provides the basis for deemed savings calculation will be verified through a combination of three activities:

1. A review of the T&R system to identify claimed nameplate data,
2. Participant surveys to confirm measure installation or service completion, and to obtain customer-specific parameters needed by the TRM protocols.

3. A review of program application materials including contractor and retailer invoices, rebate applications, and AHRI certificates.

The first activity, reviewing the T&R system, consists of several elements. First the tracking data are checked for duplicate entries, program eligibility based on date, and proper use of PA TRM protocols for calculating savings. As with previous years, the reported savings values are computed using “average” capacity, efficiency, and equivalent full load hour assumptions rather than characteristics specific to each unit/application. In the context of this program, proper use of PA TRM protocols for calculating savings requires data fields listing the ‘nameplate’ data for each unit. These data, as well as the AHRI certificate number for new equipment applications, are captured and stored in the tracking system. However, these are not reported for the census of sites in the T&R database. As such, a sufficiently large sample of program applications was checked on a one-by-one basis in the online database to determine actual capacities and efficiencies. The AHRI database was then cross-checked to ensure that the capacities and efficiencies listed in the online database were accurate. The zip-code “lookup” in the 2012 TRM was used to identify the closest reference city and therefore the most appropriate deemed hours of operation.

Participant surveys were conducted to verify installation and operation of equipment and confirmation of HVAC maintenance services for a random sample of program participants. The surveys also collected additional parameters that are required by the PA TRM for ductless mini-split systems. For these systems, the TRM requires the location of installation within the house and the type of HVAC system that was replaced, if any.

The proper PA TRM protocols for savings calculations were then applied to this sample of program participants, and the results were compared with the claimed savings from the T&R system to develop a realization rate.

The third activity, reviewing program application materials, is performed in an effort to verify that program application materials, on-site data, AHRI database specifications, and information found in the online program database are all in agreement.

Final verified savings are a product of the “installation verification rate,” and the per-unit savings adjusted for any discrepancies found through review of the online database, application materials, and survey data collection activities. The variance between claimed and verified savings comes as a result of using proper capacities, efficiencies, and deemed hours of operation rather than assumed averages.

Gross Impact for HVAC Tune Ups

The verification for AC tune-ups includes two components. First, it must be verified that a tune-up actually occurred as claimed in the T&R system.

This was accomplished by surveying program participants via telephone to confirm that they had received a tune-up during PY4. Program application materials, including invoices for services provided and a list of maintenance measures provided were also reviewed for a sample of tune-up participants.

Secondly, to properly utilize the PA TRM protocols for savings calculations, the capacities and efficiencies of the units being serviced needs to be known. The capacities of the units in question are inferred through the model numbers. This information is not always available, but most of the sampled application forms or invoices did include model numbers or capacities. The 2012 TRM recognizes impacts during the heating season for tune-ups performed on heat pumps. As such, the fraction of heat pumps is also determined from the sampled application packets. Proper deemed hours of operation were also determined using the zip-code “lookup” mentioned above.

The PA TRM deemed savings calculations were applied using the capacities, efficiencies, and deemed hours of operation as described above. The resulting savings estimates were then compared to the claimed savings values from the T&R system to develop a “preliminary desk review realization rate.” Final verified savings are a product of this preliminary realization rate and the verification rate determined through the participant telephone interviews.

Evaluation Findings

The program’s telephone surveys confirmed that 100% of sampled participants received an AC tune-up. Variances between the gross reported and gross verified savings, as shown in the tables below, were attributable to the application of PA TRM protocols to gross reported savings that were estimated based on ‘typical’ capacities, efficiencies, and heating, cooling hours.

5.2.1 Program Sampling

The two program components – new equipment rebates and AC tune-ups - are treated as separate programs, each with distinct populations, samples, and realization rates. A sample point in the context of this program is “a participating unit.” For new equipment, this is equivalent to one CAC, ASHP, or GSHP, or single or multi-zone mini-split system. For the AC tune-up component, it is equivalent to “one serviced CAC or ASHP.”

There are three sampling activities associated with this component of the program. The first is sampling from the T&R system to identify unit characteristics from the online program database, the second is sampling for application and invoice reviews, and the third is for telephone verification surveys. The confidence and precision for each stratum are based upon the combined sample sizes for telephone verification surveys, although the evaluation is also informed with specifics such as heating and cooling capacities as obtained from HVAC tune-up application materials.

The first sampling activity was to select new equipment participants from the T&R system to identify relevant unit capacities and efficiencies from the online program database. The characteristics of these

sample points were also verified using the AHRI database. To ensure accuracy at the measure level (i.e., CACs, ASHPs and GSHPs), each measure was treated as a separate population, from which a simple random sample was drawn. The sample size was then determined such that the results would exceed $\pm 10\%$ relative precision at the 90% confidence level at the measure level. Because ADM has amassed a large number of AHRI rating information over the last four evaluation cycles, over 1,000 of the 2,491 rebated HVAC units were matched to corresponding data from the AHRI database.

The invoice and application review focused on the Tune-ups because TRM algorithm inputs such as unit capacity and type (heat pump or CAC) are only available through a review of application materials and invoices. The target sample size for this activity was 40 units.

A stratified random sampling approach was used for participant surveys, with a goal of achieving 40 sample points for tune-ups, 25 sample points for ductless mini-splits, and 10 more sample points randomly selected from other measures.

Table 5-1: CPITD Reported Results by Quarter³³

Reporting Period	Participants	Reported Gross Energy Savings (MWh/yr)	Retail Level Reported Gross Demand Reduction (MW)	Generator Level Top 100 Reported Gross Demand Reduction (MW)	TRM Top 100 Verified Gross Demand Reduction (MW)	TRM Corrected Top 100 Verified Gross Demand Reduction (MW)	Evaluated Top 100 Verified Gross Demand Reduction (MW)	Incentives (\$1000)
PY4 Q1	5,033	1,319	1.38	2.15	1.51	1.51	1.51	\$ 332
PY4 Q2	2,854	1,028	0.80					\$ 150
PY4 Q3	1,376	1,184	0.42					\$ 285
PY4 Q4	4,138	2,210	1.18					\$ 511
PY4 Total	13,401	5,742	3.78	2.15	1.51	1.51	1.51	\$ 1,278
CPITD Total	16,874	8,977	4.98	3.59	2.83	2.83	2.83	\$ 1,908

³³ For purposes of this report, all top 100 hour impacts are reported in PY4Q1.

Table 5-2: Sampling Strategy for PY4

Stratum	Strata Boundaries	Population Size	Assumed Coefficient of Variation (C_v) or Proportion in Sample Design	Target Levels of Confidence & Precision	Target Sample Size	Achieved Sample Size	Evaluation Activity
HVAC Equipment	Qualitative Strata: GSHP, ASHP, CAC	1,720	2.0	15%	369	270	AHRI Lookups, TRM calculation review
HVAC Equipment	All	256	0.5	25%	8	10	Inspection of Invoices
HVAC Tune-Ups	a	11,425	0.5	20%	13	23	Verification Surveys, TRM calculations
HVAC Tune-Ups	n/a		0.5	15%	23	37	Inspection of Invoices
Solar Water Heaters	n/a	0	0.5	30%	0	0	Calculation Review
Program Total		13,401		15%	442	377	

Table 5-3: PY4 Summary of Evaluation Results for Energy

Stratum	Reported Gross Energy Savings	Energy Realization Rate	Observed Coefficient of Variation (C_v) or Proportion	Relative Precision	Verified Gross Energy Savings	Unverified Gross Energy Savings
HVAC Equipment	2,427	117%	1.38	12%	2,836	
Mini-Splits	463	82%	0.64	19%	382	
HVAC Tune-Ups	2,851	95%	0.24	6%	2,699	
Solar Water Heaters	0	n/a	0.5	30%	0	
Program Total	5,742	103%		6%	5,917	

The table below for demand reduction includes PYTD reported and verified demand reductions at the customer meter level for all impact evaluation sampling strata, and verified CPITD top 100-hour demand reductions at the generator level for the entire program.

Table 5-4: PY4 Summary of Evaluation Results for Demand

Stratum	Reported Gross Demand Reduction	Demand Realization Rate	Observed Coefficient of Variation (Cv) or Proportion	Relative Precision	PYTD TRM Verified Gross Demand Reduction (MW) (Retail)	CPITD TRM Top 100 Verified Gross Demand Reduction (MW) (Generator)	CPITD TRM Corrected Top 100 Verified Gross Demand Reduction (MW) (Generator)	CPITD Evaluated Top 100 Verified Gross Demand Reduction (MW) (Generator)
HVAC Equipment	0.56	73%	1.38	12%	0.41			
Mini-Splits	0.10	61%	0.64	19%	0.06			
HVAC Tune-Ups	3.11	70%	0.64	6%	2.17			
Solar Water Heaters	0.00	n/a	0.24	30%	0.00			
Program Total	3.77	70%	0.50	5%	2.64	2.83	2.83	2.83

5.3 Impact Evaluation Net Savings

The evaluation team employed the self-report approach (SRA) to estimate free-ridership and spillover effects. The participant survey included a series of questions to quantitatively assess the program’s influence on the installation of energy-saving equipment received or rebated through the program. In addition, the participant 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. The evaluation team completed 116 participant surveys at the measure level for a 7.4 percent relative precision with 90 percent confidence (for free-ridership assessment) for the program.

Free-ridership was evaluated at the equipment level (heat pump and central air conditioner³⁴) for each participant surveyed. Individual scores were weighted to account for disproportionate sampling, nonresponse, and differential energy savings. The free-ridership estimation algorithm assessed the program influence on timing, efficiency, and quantity purchased with adjustments to account for various channels through which the program may have influenced the participant: the influence of participation in other West Penn Power programs; the influence of the program rebate; and, the influence of the contractor.

“Unlike participant spillover” was evaluated at the customer level and 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.

The West Penn Power program NTG research indicates estimates of 42.6 percent free-ridership and 0.3 percent spillover for a net-to-gross ratio of 57.7 percent. The free-ridership estimates for heat pumps and central air conditioners were 43.0 and 38.2 percent, respectively.

No recommendations for measure-level modifications were made based on this research.

5.4 Process Evaluation

Evaluation Methodology

Tetra Tech conducted interviews with program staff, participants, and contractors. Tetra Tech designed the program participant process evaluation survey to evaluate the general experiences with the program and to verify program impact indicators based on participant perceptions. Records were randomly sampled for each measure type from the Program Year 3 rebate population. Key researchable issues included:

- **Program marketing.** Participants were asked how they heard about the program and preferred methods for receiving information from West Penn Power about energy efficiency.
- **Participant satisfaction.** Participants were asked a number of satisfaction questions in regards to equipment received, interactions with program staff, rebate amounts and application process, and with the program overall.
- **Funneling to other FirstEnergy programs.** Participants were asked about their awareness of and participation in other West Penn Power energy efficiency programs, along with the influence their

³⁴ Solar water heaters were excluded from the research effort due to low participation in PY3. Tune-ups were excluded as experience shows that it is difficult to estimate net-to-gross of tune-up offerings based on customer self-report as this service is highly contractor driven and contractor interviews were not included in this effort. An assessment of Net to Gross for Tune Ups was conducted for West Penn Power in PY4

participation in the Residential HVAC program had on their participation in other West Penn Power programs.

Key Findings

- Contractors and retailers were the most effective marketing tool to generate awareness and interest in the program in Program Year 3.
- Participants report that contractors and retailers discuss ways to save energy and maintain high-efficiency equipment during their visit.
- Participant satisfaction is high with overall satisfaction rated at 9.2 (1 to 10 scale).
- Respondents report tuning up their equipment frequently, even those without annual maintenance contracts
- Survey results suggest that the HVAC program has funneled some customers to other FirstEnergy programs.
- Contractors report challenges to selling high efficiency equipment and the primary contributing factor stated is that the current group of rebates (i.e., from utilities, manufacturers, as well as the federal tax credit) does not sufficiently reduce the incremental costs of moving from a 13 SEER to a 14.5+ SEER central air conditioner or heat pump.

Table 5-5: Status Report for Process Evaluations

Recommendations	EDC Status Report for Process Evaluations (Implemented, Being Considered, Rejected AND Explanation of Action Taken by EDC)
Residential Energy Efficiency HVAC	
Watch participation trends for equipment installations, and consider modifications to program design elements in light of reduced Federal tax credits.	Being considered for Phase II.
Target tune-up participants who do not have pre-existing maintenance contracts in order to maximize program savings, or offer an enhanced tune-up not currently offered as standard practice.	Rejected due to practical challenges of data availability.
Market the program through an aggressive multi-tiered approach: contractor marketing, cross-marketing between programs, program leave-behind materials, etc..	Implemented.

Refine the application process to ensure it is both streamlined and user-friendly and consider online applications.	Implemented as appropriate. Online applications are not available.
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5.5 Financial Reporting

All program expenses were within approved budgets, and TRC results were within reasonable ranges. A breakdown of the program finances is presented in Table 5-6.

Table 5-6: Summary of Residential Energy Efficient HVAC Program Finances

	IQ (\$1,000)	PYTD (\$1,000)	CPITD (\$1,000)
EDC Incentives to Participants	\$ 509	\$ 1,278	\$ 1,908
EDC Incentives to Trade Allies			
Subtotal EDC Incentive Costs	\$ 509	\$ 1,278	\$ 1,908
Design & Development			
Administration ^[1]	\$ (239)	\$ (211)	\$ 54
Management ^[2]			
Marketing ^[3]	\$ (94)	\$ 101	\$ 301
Technical Assistance	\$ (58)	\$ (68)	\$ 211
Subtotal EDC Implementation Costs	\$ (391)	\$ (179)	\$ 566
EDC Evaluation Costs	\$ 23	\$ 36	\$ 152
SWE Audit Costs			
Total EDC Costs^[4]	\$ 141	\$ 1,135	\$ 2,626
Participant Costs^[5]		\$ 5,317	\$ 6,334
Total TRC Costs^[6]	\$ (368)	\$ 5,174	\$ 7,052
Total Lifetime Energy Benefits		\$ 4,496	\$ 6,504
Total Lifetime Capacity Benefits		\$ 1,363	\$ 1,690
Total TRC Benefits^[7]	N/A	\$ 5,859	\$ 8,194
TRC Ratio^[8]	N/A	1.13	1.16

NOTES

Per PUC direction, TRC inputs and calculations are required in the Annual Report only and should comply with the 2011 Total Resource Cost Test Order approved July 28, 2011. Please see the "Report Definitions" section of this report for more details.

[1] Includes the administrative CSP (rebate processing), tracking system, and general administration and clerical cost.

[2] Includes EDC program management, CSP program management, general management oversight, and major accounts.

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

[4] Per the 2011 Total Resource Cost Test Order, the Total EDC Costs refer to EDC incurred expenses only.

[5] Per the 2011 Total Resource Cost Test Order, the net Participant Costs are the costs for the end-use customer.

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

[7] Total TRC Benefits equals the sum of Total Lifetime Energy Benefits and Total Lifetime Capacity Benefits. Based upon verified gross kWh and kW savings. Benefits include: avoided supply costs, including the reduction in costs of electric energy, generation, transmission, and distribution capacity, and natural gas valued at marginal cost for periods when there is a load reduction.

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

6 Residential Energy Efficient Products Program

This program provides financial incentives to customers and support to retailers that sell energy-efficient products such as ENERGY STAR® qualified appliances or CFLs. The program includes promotional support, point-of-sale materials, training, promotional events and “up-stream product buy-down” rebates to retailers, distributors or manufacturers for select appliances. The program also includes existing catalog sales channel, and support for community-based initiatives, or other distribution channels that can reliably document effective distribution of energy-efficient products.

6.1 Program Updates

There were no changes to this program during PY4.

6.2 Impact Evaluation Gross Savings

Gross Impact Analysis

The evaluation effort is conducted using separate methodologies for CFLs and for other appliances, with the details of the methodologies described in the subsections below.

Gross Impact for CFLs

Savings associated with the CFL component are estimated using a deemed approach, with the energy savings and demand reductions taken as deemed in accordance with the TRM.

As with previous years, there were two separate activities within the CFL component of this program in PY4: upstream discounts and giveaway events. The impact evaluation for both activities within the CFL program component includes the following verification elements:

- Review of shipment invoices, including types and quantities of CFLs distributed to participating retailers. These shipment invoices are matched to the T&R system to confirm proper counts and bulbs types claimed.
- Review of the T&R system to assure there are no duplicate entries and that all bulbs were eligible for being counted in PY4 based on invoice dates.
- Review of CSP energy savings and demand reduction calculations.
 - A review of the assumptions regarding the wattages of the baseline incandescent bulbs presumed to be supplanted by CFLs is particularly important.

Gross Impact for Appliances

Gross kWh savings for appliances sold through the Residential Energy Efficient Products program are estimated using a deemed approach for measures included in the statewide TRM.

The impact evaluation for the appliance program component will include the following components:

- Verification of proper installation through on-site visits; and
- Review of CSP energy savings and demand reduction calculations
 - Calculations are reviewed to ensure that they are done according to the PA TRM or PA Interim TRM.
 - For three particular measures – room air conditioners, dehumidifiers, and clothes washers – the PA TRM requires a partially deemed approach. That is, certain characteristics of the appliance or the household in which the appliance is used affect the calculations.

For measures with partially deemed TRM protocols, the T&R system calculated impacts with one savings scenario rather than with specific scenarios that occur in measure implementation. For example, the energy savings and demand calculations for room air conditioners used Harrisburg as the reference city in all cases. This was corrected by using a zip-code “lookup” to identify the closest reference city to the household in which the unit was used for each case. Additionally, the savings for dehumidifiers assumed that all of the rebated units had a capacity between 25 and 35 pint per day. This resulted in an understatement of energy savings attributable to dehumidifiers, as many of the units had capacities greater than that range (and accordingly greater deemed savings). While the T&R system for the program did not have a data field listing the capacities of each dehumidifier rebated, these parameters *are* captured and recorded in the CSP tracking database, though in a format that precludes determination of these parameters for the census of the population. Accordingly, ADM sampled a sufficiently large number of rebated dehumidifiers to check the distribution of capacities. Deemed energy savings and demand reductions from the PA TRM were applied to this sample of dehumidifiers and compared to the claimed savings in the T&R system. The resulting realization rate was applied to the population of dehumidifiers rebated through the program. Finally, the T&R system energy savings calculations for clothes washers assumed that all units were operating in households with electric water heating. However, survey data collection activities revealed that this was not necessarily the case. For the sample of clothes washers verified by participant surveys, information regarding the households’ water heating fuel source was documented and used to properly assign energy savings according to the PA TRM. These energy savings were compared to the T&R system’s claims and used to develop a realization rate that was applied to the population of clothes washers rebated through the program.

The preceding discussion illustrates the fact that the majority of the variance between claimed savings and verified savings was the result of adjustments to reflect actual vs. “typical” savings values, or baseline adjustments to reported savings, which were corrected during the “desk review” phase of verification. The only exception, which was revealed with participant surveys was the presence of non-electric water heating and its effect on verified savings for clothes washers.

Determination of Cross Sector Sales

Surveys were utilized to establish “cross-sector sales” whereby CFLs purchased in stores with support of the Residential program were installed in non-residential businesses, and conversely, CFL kits distributed to small Commercial & Industrial customers were installed in residential applications. In previous program years, ADM decremented both energy savings and demand reduction impacts for CFLs that are distributed for use in the non-residential sector but were installed in residential settings. In PY4, ADM administered broad, “random digit dial” telephone surveys to assess the cross-over from residential to non-residential. A total of 827 complete responses were collected from respondents who reported to have purchased CFLs at retailers that participate in the Company’s upstream buy-down programs. Out of a total 11,745 CFLs reported to have been purchased, 579 were reported to be installed in non-residential settings. Based on this, the evaluation utilizes a conservative crossover rate from residential to non-residential use of 4.9%. The PA TRM protocols are used to evaluate impacts for CFLs that migrate to the non-residential sector. The calculation inputs are summarized in the table below.

Table 6-1. Parameters used for crossover CFL demand impact calculations.

Building Type	Percent of Reported "Crossover" CFLs	CF	Likelihood that it's in a cooled space ¹	Cooling Interactive Factor	Effective Cooling Interactive Factor
Hospitals	17%	0.84	90%	34%	30.6%
Industrial Manufacturing	2%	0.77	90%	34%	30.6%
Lodging – Guest Rooms	7%	0.84	80%	34%	27.2%
Light Manufacturing	4%	0.77	90%	34%	30.6%
Manufacturing – Light Industrial	1%	0.63	90%	34%	30.6%
Nursing Home	9%	0.77	90%	34%	30.6%
Restaurant – Sit-Down	2%	0.77	90%	34%	30.6%
Retail – Large	1%	0.88	90%	34%	30.6%
Other	56%	0.33 ²	60%	34%	20.4%
Weighted Average		0.54	79%	25%	27%
<p>1. These likelihoods are estimations based on EM&V experience from Phase I</p> <p>2. The coincidence factor for facility types listed as “other” is taken from metering conducted by ADM to evaluate the CF of CFLs distribute to small commercial customers in PY3.</p>					

Cross sector sales have the effect of increasing demand reductions for the Small Commercial and Industrial Efficient Equipment program, and lowering the demand reductions as reported for the Efficient Products program (by 4.9% to account for CFLs are not installed in the residential sector). Consistent with these results, the Company has moved funds between Sectors and Programs to account for these findings. Although additional energy savings are also expected from CFL crossover, West Penn Power is taking a

conservative approach and not reporting any adjustments to energy savings for either program at this time.

Peak Demand Coincidence Factor and Cooling Interactive Factor

As discussed in Section 1.1 and Appendix A, the 2012 PA TRM protocols for the non-residential sector recognize additional demand reductions associated with space cooling that result for lighting wattage reductions within conditioned space. The cooling interactive factor for demand is 34%, which means that for every 1 Watt of coincident peak reductions from lighting within conditioned space, an additional 0.34 Watt savings results from avoided air conditioner usage. The proposed 2014 TRM protocols recognize this basic fact for CFLs installed in cooled space in the residential sector as well. As discussed in detail in Appendix A, West Penn Power is:

1. including a cooling interactive factor to demand reductions from residential CFLs to more accurately depict the demand reductions for residential CFLs; and,
2. including an adjustment to the calculation of CFL coincidence factor based on the metering study that is also the source for the CFL hours of use in the 2013 TRM and proposed 2014 TRM.

The incremental impacts from these two considerations are included in the demand reduction tables in Section 1 as “Evaluated Top 100 MW Achieved”. Please refer to Appendix A for further details on these two protocol adjustments.

6.2.1 Program Sampling

For the upstream and giveaway CFL program component, a sample of shipment invoices along with the calculations in the T&R system were reviewed to ensure that the energy savings and demand reductions are claimed according to the protocols in the PA TRM. Minor discrepancies were found regarding baseline wattage assumptions and there were some rounding errors but overall there was very little variance between claimed and verified savings for all lamps except in cases where the baseline lamp wattage has been updated from 100W to 72W in the 2012 TRM.

The sampling approach for the appliance rebate program component is stratified random sampling with the stratification defined such that measures with common reasons for realization rates (e.g. lack of electric water heater or dryer for clothes washers) are grouped together. A sample point in the context of the appliance rebate component of this program is defined as “one appliance.” A large sample (census when possible) of the energy and demand savings calculations in the program tracking data are reviewed to ensure that the energy savings and demand reductions are claimed according to the protocols in the PA TRM, as described in the previous section.

Two sampling activities were required for the appliance component of the program:

1. A sample of rebated dehumidifiers from the T&R system was examined in the online program database to identify each unit’s capacity in pints per day. This was a simple random sample that achieved $\pm 4\%$ precision at the 90% confidence level.

2. The sample size for survey verifications is sufficient to determine gross impact with $\pm 15\%$ relative precision at the 85% confidence level. The sampling technique for verification was stratified random sampling with clothes washers comprising one stratum, and all other appliances composing a separate stratum. This stratification was chosen because of the variance in savings for clothes washers with electric and non-electric water heating sources.

Table 6-2. CPITD Reported Results by Quarter³⁵

Reporting Period	Participants	Reported Gross Energy Savings (MWh/yr)	Retail Level Reported Gross Demand Reduction (MW)	Generator Level Top 100 Reported Gross Demand Reduction (MW)	TRM Top 100 Verified Gross Demand Reduction (MW)	TRM Corrected Top 100 Verified Gross Demand Reduction (MW)	Evaluated Top 100 Verified Gross Demand Reduction (MW)	Incentives (\$1000)
PY4 Q1	53,532	9,515	0.48	0.59	0.53	0.83	1.31	\$ (19)
PY4 Q2	49,671	8,264	0.43	0.00	0.00	0.00	0.00	\$ 348
PY4 Q3	69,984	12,433	0.63	0.00	0.00	0.00	0.00	\$ 289
PY4 Q4	120,687	21,828	1.11	0.00	0.00	0.00	0.00	\$ 605
PY4 Total	293,874	52,040	2.64	0.59	0.53	0.83	1.31	\$1,222
CPITD Total	619,830	121,040	8.44	7.43	7.25	9.40	12.91	\$ 5,010

Table 6-3: Sampling Strategy for PY4

Stratum	Population Size	Assumed Coefficient of Variation (C _v) or Proportion in Sample Design	Target Levels of Confidence & Precision	Achieved Sample Size	Evaluation Activity
Upstream Lighting	247,804	0.25	15%	Census on TRM calculations + 7 invoices for verification	Census on TRM calculations + 7 invoices for verification
CFL Giveaway	30,161	0.25	20%		census
Clothes Washers	3,666	0.5	20%	40	40
Dehumidifiers	1,665	0.5	20%	10	418 calculation reviews, 3 verification surveys
LED Holiday Lights	4,050	0.5	20%	census	census

³⁵ For purposes of this report, all top 100 hour impacts are reported in PY4Q1.

All Other	9,356	0.5	20%	25	42
Program Total	296,702		15%	75	80

Table 6-4: PY4 Summary of Evaluation Results for Energy

Stratum	Reported Gross Energy Savings	Energy Realization Rate	Observed Coefficient of Variation (C_v) or Proportion	Relative Precision	Verified Gross Energy Savings	Unverified Gross Energy Savings
Upstream Lighting	43,392	89%	CV <<0.5	10%	38,674	
CFL Giveaway	5,334	99%	CV <<0.5	20%	5,294	
Clothes Washers	946	50%	CV <<0.5	20%	476	
Dehumidifiers	460	77%	CV <<0.5	20%	355	
LED Holiday Lights	43	101%	n/a	20%	43	
All Other	1,866	96%	CV <<0.5	20%	1,799	
Program Total	52,040	90%		9%	46,641	

The table below for demand reduction includes PYTD reported and verified demand reductions at the customer meter level for all impact evaluation sampling strata, and verified CPITD top 100-hour demand reductions at the generator level for the entire program. Please note, as discussed in Section 1 and Appendix A of this Report, the CPITD Top 100 demand reduction values in this table are shown using values that represent: 1) calculations published in the 2012 Pennsylvania TRM (“TRM”); 2) calculations that include a correction to the Residential CFL coincidence factor (“TRM Corrected”); and, 3) calculations that incorporate alternative measurement approaches from the 2012 TRM to more accurately assess the peak load impacts from residential lighting during the Company’s Top 100 Hours (“Evaluated”).

Table 6-5: PY4 Summary of Evaluation Results for Demand

Stratum	Reported Gross Demand Reduction	Demand Realization Rate	Observed Coefficient of Variation (Cv) or Proportion	Relative Precision	PYTD TRM Verified Gross Demand Reduction (MW) (Retail)	CPITD TRM Top 100 Verified Gross Demand Reduction (MW) (Generator)	CPITD TRM Corrected Top 100 Verified Gross Demand Reduction (MW) (Generator)	CPITD Evaluated Top 100 Verified Gross Demand Reduction (MW) (Generator)
Upstream Lighting	2.01	88%	CV <<0.5	10%	1.77			
CFL Giveaway	0.26	92%	CV <<0.5	20%	0.24			
Clothes Washers	0.05	100%	CV <<0.5	20%	0.05			
Dehumidifiers	0.02	98%	CV <<0.5	20%	0.02			
LED Holiday Lights	0.00	n/a	n/a	20%	0.00			
All Other	0.29	102%	CV <<0.5	20%	0.30			
Program Total	2.64	90%		7%	2.38	7.25	9.40	12.91

6.3 Impact Evaluation Net Savings

The evaluation team employed the self-report approach (SRA) to estimate free-ridership and spillover effects. The participant 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 participant 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.

The participant population file was sampled by measure category with the sample strategy focused on measures with the greatest contribution to the program savings and, therefore, excluded those measures with lower relative participation and/or contribution to the program in terms of total savings (water heaters, room air conditioners, smart strips, and torchieres) with the exception of LED holiday lights as these were a measure of interest. The evaluation team completed 131 surveys at the measure level for a 7.1 percent relative precision with 90 percent confidence (for free-ridership assessment). Data were weighted during analysis to represent the population of interest (customers).

Free-ridership was evaluated at the measure category level for each participant surveyed. A free-ridership algorithm assessed the program influence on timing, efficiency, and quantity purchased and the rate was calculated for each measure category for each participant. Individual scores were then weighted to account for disproportionate sampling, nonresponse, and differential energy savings.

"Unlike spillover" was evaluated at the customer level, and is 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.

The West Penn Power program NTG research indicates estimates of 56.5 percent free-ridership and 7.0 percent spillover for a net-to-gross ratio of 50.5 percent. Individual measure free-ridership estimates were: 57.4 for washers; 56.8 for refrigerators/freezers; 60.5 for dehumidifiers; and 33.8 percent for LED lighting.³⁶

The evaluation team does not recommend program design changes.

6.4 Process Evaluation

Evaluation Methodology

The process evaluation effort consisted of participant surveys in conjunction with the net-to-gross research effort. Key researchable issues were identified based on the evaluator's experience assessing other efficient products programs and through interviews with program staff. These issues included:

³⁶ Caution for small sample size for dehumidifiers (n=18) and LED lighting (n=21).

- **Program marketing.** Participants were asked how they heard about the program and preferred methods for receiving information from West Penn Power about energy efficiency.
- **Participant satisfaction.** Participants were asked a number of satisfaction questions in regards to equipment received, interactions with program staff, rebate amounts and application process, and with the program overall.

Key Findings

- Retailers were the most effective marketing tool to generate awareness and interest in the program in Program Year 4 and many retailers are discussing ways to save energy and maintain high-efficiency equipment with program participants.
- Participant satisfaction is high with an average overall rating of 9.1
- Survey results suggest that the Energy Efficient Products program has funneled some customers to other West Penn Power programs and the overall rating of the influence of the Energy Efficient Products program in their participation in other West Penn Power programs was 6.0 out of 10.0 with 52 percent at seven or higher, indicating that the Energy Efficient Products program has influenced participation in other West Penn Power programs.

Table 6-6: Status Report for Process Evaluations

Recommendations	EDC Status Report for Process Evaluations (Implemented, Being Considered, Rejected AND Explanation of Action Taken by EDC)
Residential Energy Efficient Products	
There were no recommendations based on this research.	

6.5 Financial Reporting

All program expenses were within approved budgets, and TRC results were within reasonable ranges. A breakdown of the program finances is presented in Table 6-7.

Table 6-7: Summary of Residential Energy Efficient Products Program Finances

	IQ (\$1,000)	PYTD (\$1,000)	CPITD (\$1,000)
EDC Incentives to Participants	\$ 605	\$ 1,223	\$ 5,010
EDC Incentives to Trade Allies			
Subtotal EDC Incentive Costs	\$ 605	\$ 1,223	\$ 5,010
Design & Development			\$ 265
Administration ^[1]	\$ 178	\$ 282	\$ 812
Management ^[2]			
Marketing ^[3]	\$ (18)	\$ 155	\$ 2,425
Technical Assistance	\$ 12	\$ 1,472	\$ 2,511
Subtotal EDC Implementation Costs	\$ 172	\$ 1,909	\$ 6,014
EDC Evaluation Costs	\$ 118	\$ 149	\$ 500
SWE Audit Costs			
Total EDC Costs^[4]	\$ 895	\$ 3,281	\$ 11,524
Participant Costs^[5]		\$ 4,760	\$ 12,242
Total TRC Costs^[6]	\$ 291	\$ 6,818	\$ 18,756
Total Lifetime Energy Benefits		\$ 23,985	\$ 51,249
Total Lifetime Capacity Benefits		\$ 1,078	\$ 2,402
Total TRC Benefits^[7]		\$ 25,063	\$ 53,651
TRC Ratio^[8]	0.00	3.68	2.86

NOTES

Per PUC direction, TRC inputs and calculations are required in the Annual Report only and should comply with the 2011 Total Resource Cost Test Order approved July 28, 2011. Please see the "Report Definitions" section of this report for more details.

[1] Includes the administrative CSP (rebate processing), tracking system, and general administration and clerical cost.

[2] Includes EDC program management, CSP program management, general management oversight, and major accounts.

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

[4] Per the 2011 Total Resource Cost Test Order, the Total EDC Costs refer to EDC incurred expenses only.

[5] Per the 2011 Total Resource Cost Test Order, the net Participant Costs are the costs for the end-use customer.

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

[7] Total TRC Benefits equals the sum of Total Lifetime Energy Benefits and Total Lifetime Capacity Benefits. Based upon verified gross kWh and kW savings. Benefits include: avoided supply costs, including the reduction in costs of electric energy, generation, transmission, and distribution capacity, and natural gas valued at marginal cost for periods when there is a load reduction.

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

7 Residential Low Income Energy Efficiency Program (LIEEP)

This program is an expansion of, and enhancement to the existing comprehensive Low-Income Usage Reduction Program (LIURP), and will provide additional electric usage savings measures and services to income-eligible customers. In addition, energy savings kits are offered when customers do not accept in-home services and/or when their electric usage is too low to qualify for other low income program services or in other situations that are identified to provide additional measures and obtain additional energy savings. Program Services are available to income qualified customers that reside in single family homes, mobile homes, duplexes, townhomes and multi-unit complexes. Services provided will be based on a detailed energy audit and tailored to the customer’s energy consumption and home type.

7.1 Program Updates

This program ceased mailing out energy conservation kits in early PY4.

7.2 Impact Evaluation Gross Savings

This measures that are offered by this program all have prescriptive evaluation algorithms, with the sole variable being the in-service rate or the CFL wattage. The CFL wattages are reported in the T&R system and are cross checked against contractor records and QA/QC on-site visit findings. ADM conducted telephone verification surveys to assess the in-service rates for the measures offered by this program.

7.2.1 Program Sampling

ADM used a simple random sample to evaluate this program.

Table 7-1: CPITD Reported Results by Quarter³⁷

Reporting Period	Participants	Reported Gross Energy Savings (MWh/yr)	Retail Level Reported Gross Demand Reduction (MW)	Generator Level Top 100 Reported Gross Demand Reduction (MW)	TRM Top 100 Verified Gross Demand Reduction (MW)	TRM Corrected Top 100 Verified Gross Demand Reduction (MW)	Evaluated Top 100 Verified Gross Demand Reduction (MW)	Incentives (\$1000)
PY4 Q1	622	506	0.05	0.03	0.04	0.04	0.04	\$ (693)

³⁷ For purposes of this report, all top 100 hour impacts are reported in PY4Q1.

PY4 Q2	8	16	0.00	0.00	0.00	0.00	0.00	\$ -
PY4 Q3	0	0	0.00	0.00	0.00	0.00	0.00	\$ -
PY4 Q4	0	0	0.00	0.00	0.00	0.00	0.00	\$ 693
PY4 Total	630	522	0.06	0.03	0.04	0.04	0.04	\$ -
CPITD Total	11,906	15,387	2.66	3.15	1.91	1.91	1.91	\$ 6,349

Table 7-2: Sampling Strategy for PY4

Stratum	Strata Boundaries (kWh)	Population Size	Assumed Coefficient of Variation (C _v) or Proportion in Sample Design	Achieved Sample Size	Evaluation Activity
1	All	630	0.4	15%	16
Program Total	All	630	0.4	15%	16

Table 7-3: PY4 Summary of Evaluation Results for Energy

Stratum	Reported Gross Energy Savings	Energy Realization Rate	Observed Coefficient of Variation (C _v) or Proportion	Relative Precision	Verified Gross Energy Savings	Unverified Gross Energy Savings
1	522	117%	0.33	10.48%	522	
Program Total	522	117%	0.33	10.48%	522	

The table below for demand reduction includes PYTD reported and verified demand reductions at the customer meter level for all impact evaluation sampling strata, and verified CPITD top 100-hour demand reductions at the generator level for the entire program.

Table 7-4: PY4 Summary of Evaluation Results for Demand

Stratum	Reported Gross Demand Reduction	Demand Realization Rate	Observed Coefficient of Variation (C _v) or Proportion	Relative Precision	PYTD TRM Verified Gross Demand	CPITD TRM Top 100 Verified Gross Demand	CPITD TRM Corrected Top 100 Verified Gross Demand	CPITD Evaluated Top 100 Verified Gross Demand

					Reduction (MW) (Retail)	Reduction (MW) (Generator)	Reduction (MW) (Generator)	Reduction (MW) (Generator)
All	0.06	114%	0.30	9.80%	0.06			
Program Total	0.06	114%	0.30	9.80%	0.06	1.91	1.91	1.91

7.3 Impact Evaluation Net Savings

Net-to-gross research was not conducted for this program as participation and contribution to portfolio savings in Phase I was limited. The Phase II effort is currently planning to conduct net-to-gross research.

7.4 Process Evaluation

Methodology

The process evaluation effort for LIEEP was conducted in conjunction with the process evaluation effort for the Joint Utility Usage Management Program (JUUMP). Tetra Tech completed a participant survey that gathered data on the following key researchable issues identified through program documentation review and program staff interviews:

- **Measure installation.** We asked participants whether measures they received through the program were installed to assess the installation rate.
- **Marketing and outreach.** We collected feedback regarding the customer's initial source of program information.
- **Customer satisfaction.** We characterize customer satisfaction across a number of topics such as experience with the auditor, measures received, and the program overall.
- **Customer audit experience.** We asked participants about whether the measures were directly installed by auditors and the type of information communicated during the audit process, as well as the usefulness of that information.

The sample consisted of program participants from Program Year 3, Quarter 1 (June 1, 2011) through Quarter 2 (November 30, 2011). The evaluation team attempted a census of the 104 JUUMP participants and completed 25 surveys for a 14.3 percent relative precision with 90 percent confidence. For LIEEP, 115 surveys were completed for a 7.6 percent relative precision with 90 percent confidence.

Key Findings

Key findings were reported in the Program Year 3 Annual Report.

Table 7-5: Status Report for Process Evaluations

Recommendations	EDC Status Report for Process Evaluations (Implemented, Being Considered, Rejected AND Explanation of Action Taken by EDC)
Limited Income Energy Efficiency Program (LIEEP)	
Adjust the water savings impacts in the Energy Savings Calculator by rate of receipt of water devices and incidence of natural gas water heaters.	Rejected - Ex-post reflects appropriate savings. In addition, program guidelines were clarified to only install measures in homes with electric water heaters.
Report a realization rate of 1.0 for CFLs.	Implemented.
Report a realization rate of 1.0 for refrigerators and room air conditioners.	Implemented.
Reinforce to auditors that measures be directly installed and not simply left behind.	Implemented.
Strive for more equity in provision of services between multifamily and single-family residences. If it is not feasible for the auditor to meet with these hard-to-reach multifamily customers, then the program may consider leaving behind additional information or literature providing similar information as that discussed through the walk-through audit.	Implemented.

7.5 Financial Reporting

This program implementation occurred prior to PY4, however the program continues to receive minimal supplemental costs. TRC results were within reasonable ranges. A breakdown of the program finances is presented in Table 7-6.

Table 7-6: Summary of LIEEP Program Finances

	IQ (\$1,000)	PYTD (\$1,000)	CPITD (\$1,000)
EDC Incentives to Participants			\$ 6,349
EDC Incentives to Trade Allies			
Subtotal EDC Incentive Costs			\$ 6,349
Design & Development			\$ 40
Administration ^[1]	\$ 16	\$ 56	\$ 362
Management ^[2]			
Marketing ^[3]	\$ 1	\$ 3	\$ 21
Technical Assistance	\$ 0	\$ (723)	\$ 707
Subtotal EDC Implementation	\$ 17	\$ (665)	\$ 1,129
EDC Evaluation Costs	\$ 12	\$ 15	\$ 74
SWE Audit Costs			
Total EDC Costs^[4]	\$ 29	\$ (650)	\$ 7,552
Participant Costs^[5]			
Total TRC Costs^[6]	\$ 29	\$ 535	\$ 7,552
Total Lifetime Energy Benefits		\$ 344	\$ 4,856
Total Lifetime Capacity Benefits		\$ 30	\$ 337
Total TRC Benefits^[7]		\$ 374	\$ 5,193
TRC Ratio^[8]	N/A	0.70	0.69

NOTES

Per PUC direction, TRC inputs and calculations are required in the Annual Report only and should comply with the 2011 Total Resource Cost Test Order approved July 28, 2011. Please see the "Report Definitions" section of this report for more details.

[1] Includes the administrative CSP (rebate processing), tracking system, and general administration and clerical cost.

[2] Includes EDC program management, CSP program management, general management oversight, and major accounts.

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

[4] Per the 2011 Total Resource Cost Test Order, the Total EDC Costs refer to EDC incurred expenses only.

[5] Per the 2011 Total Resource Cost Test Order, the net Participant Costs are the costs for the end-use customer.

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

[7] Total TRC Benefits equals the sum of Total Lifetime Energy Benefits and Total Lifetime Capacity Benefits. Based upon verified gross kWh and kW savings. Benefits include: avoided supply costs, including the reduction in costs of electric energy, generation, transmission, and distribution capacity, and natural gas valued at marginal cost for periods when there is a load reduction.

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

8 Joint Utility Usage Management Program

JUUMP Program: This program is an expansion of, and enhancement to the existing comprehensive Low-Income Usage Reduction Program (LIURP), that provides additional electric energy savings measures and services to income-eligible customers. The program sought to develop coordination and referral partnerships with natural gas distribution companies and the Department of Community and Economic Development Weatherization Assistance Program (WAP). Savings kits were offered and sent to customers who did not accept in-home services or when their usage was too low to qualify them for JUUMP, LIURP or WAP.

WARM Extra Measures Program: was an expansion and enhancement of the existing Low-Income Usage Reduction Program (LIURP) and provided additional electric energy savings measures and services to low-income customers. Extra measures such as CFLs and smart strips were provided to LIURP participants under this program.

WARM Plus Programs: This program is an expansion of, and enhancement to the existing comprehensive Low-Income Usage Reduction Program, known as WARM, that will provide additional electric energy savings measures and services to income-eligible customers.

Low-Income, Low-Use Program and Substitute Kits: This program is for low-income customers that do not meet the minimum usage of 600 kWh/month to qualify for the WARM program. These customers received CFLs, faucet aerators, LED nightlights, a furnace whistle and energy education materials. The substitute kits make up a relatively small portion of the program. These conservation kits are directly delivered to participants in cases where direct installation of measures is not possible.

8.1 Program Updates

Program administrators implemented changes that were approved by the Commission in the amended plan regarding 2012 program design. WPP included a broader scope so that additional customers can participate in JUUMP. After several conference calls with Columbia Gas of Pennsylvania and an in-person meeting with Equitable Gas Company, JUUMP will continue. However, it will also include referrals to NGDC's. Both West Penn Power and NGDC's will regularly exchange scheduled work lists. When a contractor for both utilities cannot be scheduled at the same time, each utility will schedule a work time that is convenient for the customer. The LIEEP program closed in July 2012 and JUUMP closed in February 2013 when funds were depleted, and customers were referred to the existing Low Income Usage Reduction Program, known as WARM.

8.2 Impact Evaluation Gross Savings

In PY4, there were reported savings and participation for all programs, but the WARM Extra Measures component had only one participant. The conservation kits accounted for 83% of PY4 program level savings. The evaluation activities for the various program components are discussed below.

WARM Plus Program:

This program component accounted for 6% of overall program impacts. The ex-ante energy savings for the Warm Plus program are based on the impact evaluation of the PY2 WARM Plus in other FirstEnergy service territories, which employed a statistical billing analysis. Given the need for pre- and post-treatment history, and the fact that the program came on line in PY4, a billing analysis was not possible for West Penn Power's WARM program. However, ADM was able to compare the gross reported savings per home to the gross reported savings for the WARM Program as evaluated in the last two program years for Met-Ed and Penelec. The reported impacts for West Penn are reasonable, but are lower than results seen in recent billing analyses for the WARM Plus Program in Met-Ed and Penelec. It is likely that a billing analysis would support higher gross impacts. However, at the time of this report enough time has not elapsed since measure installations to conduct a billing analysis. Given that the overall impacts of this program component are only 258 MWh, West Penn will not claim 'unverified' savings associated with this program component.

JUUMP Program

ADM reviewed completed program inspection checklists from on-site QA/QC visits conducted by the program's QA/QC contractor. The in-service rates and TRM-based impacts for various measures were determined through this review process.

LILU and Substitute Kits

The measures that are offered by this program all have prescriptive evaluation algorithms, with the sole variable being the in-service rate or the CFL wattage. ADM conducted telephone verification surveys to assess the in-service rates for the measures offered by this program.

8.2.1 Program Sampling

The sampling schemes for each program component are described below. The overall statistical precision of the program was 10% at the 85% confidence level.

WARM Extra Measures Program:

This program had one participant in PY4. The in-service rates for the installed measures are taken to be the same as those found through the QA/QC report reviews for the JUUMP program component.

JUUMP Program:

ADM conducted 10 QA/QC report reviews, selected randomly from QA/AC reports,

LILU and Substitute Kits:

ADM employed a simple random sample of 30 participants for the verification surveys.

Table 8-1: Residential Low-Income (WARM) Programs Reported Results by Quarter³⁸

Reporting Period	Participants	Reported Gross Energy Savings (MWh/yr)	Retail Level Reported Gross Demand Reduction (MW)	Generator Level Top 100 Reported Gross Demand Reduction (MW)	TRM Top 100 Verified Gross Demand Reduction (MW)	TRM Corrected Top 100 Verified Gross Demand Reduction (MW)	Evaluated Top 100 Verified Gross Demand Reduction (MW)	Incentives (\$1000)
PY4 Q1	419	422	0.13	0.77	0.07	0.07	0.07	\$ 1,582
PY4 Q2	955	594	0.09	0.00	0.00	0.00	0.00	\$ -
PY4 Q3	3,024	1,345	0.17	0.00	0.00	0.00	0.00	\$ 762
PY4 Q4	0	0	0.00	0.00	0.00	0.00	0.00	\$ (2,344)
PY4 Total	4,398	2,362	0.39	0.77	0.07	0.07	0.07	\$ -
CPITD Total	8,711	6,045	0.49	0.89	0.71	0.71	0.71	\$ 371

Table 8-2: Residential Low-Income (WARM) Programs Sampling Strategy for PY4

Stratum	Strata Boundaries	Population Size	Assumed Coefficient of Variation (C _v) or Proportion in Sample Design	Target Levels of Confidence & Precision	Target Sample Size	Achieved Sample Size	Evaluation Activity
Warm Plus	All	258	n/a	n/a	258	258	Tracking System Review
Warm Extra Measures	All	1	< 0.5	n/a	1	1	Tracking System Review
JUUMP	All	470	0.5	25%	10	10	TRM Calculations from QA/QC on-site review
LILU and Substitute Kits	All	3,669	0.5	12%	30	30	Telephone Verification Surveys
Program Total		4,398		15%	299	299	4,398

³⁸ For purposes of this report, all top 100 hour impacts are reported in PY4Q1.

Table 8-3: PY4 Residential Low-Income (WARM) Programs Summary of Evaluation Results for Energy

Stratum	Reported Gross Energy Savings	Energy Realization Rate	Observed Coefficient of Variation (C _v) or Proportion	Relative Precision	Verified Gross Energy Savings
Warm Plus	294	100%	n/a	30%	294
Warm Extra Measures	0.25	103%	< 0.5	0%	0.26
JUUMP	536	194%	0.42	19%	1,038
LILU and Substitute Kits	1,532	120%	0.25	6%	1,846
Program Total	2,362	135%		8%	3,178

The table below for demand reduction includes PYTD reported and verified demand reductions at the customer meter level for all impact evaluation sampling strata, and verified CPITD top 100-hour demand reductions at the generator level for the entire program.

Table 8-4: PY4 Residential Low-Income (WARM) Programs Summary of Evaluation Results for Demand

Stratum	Reported Gross Demand Reduction	Demand Realization Rate	Observed Coefficient of Variation (C _v) or Proportion	Relative Precision	PYTD TRM Verified Gross Demand Reduction (MW) (Retail)	CPITD TRM Top 100 Verified Gross Demand Reduction (MW) (Generator)	CPITD TRM Corrected Top 100 Verified Gross Demand Reduction (MW) (Generator)	CPITD Evaluated Top 100 Verified Gross Demand Reduction (MW) (Generator)
Warm Plus	0.13	100%	n/a	30%	0.13			
Warm Extra Measures	0.01	100%	< 0.5	0%	0.01			
JUUMP	0.18	68%	0.53	24%	0.12			
LLILU and Substitute Kits	0.08	120%	0.42	11%	0.09			
Program Total	0.40	90%		14%	0.36	0.71	0.71	0.71

8.3 Impact Evaluation Net Savings

Per Statewide Evaluator (SWE)³⁹, “the SWE Team recommends using a NTGR value of 1.0 for low-income programs, based on the literature review of expert resources and practices in other states. “. Therefore, this research was not conducted.

8.4 Process Evaluation

Methodology

See Section 7. Limited Income Energy Efficiency Program (LIEEP).

Key Findings

See Section 7. Limited Income Energy Efficiency Program (LIEEP).

Table 8-5: Status Report for Process Evaluations

Recommendations	EDC Status Report for Process Evaluations (Implemented, Being Considered, Rejected AND Explanation of Action Taken by EDC)
Limited Income Energy Efficiency Program (LIEEP)	
See Section 10. Limited Income Energy Efficiency Program (LIEEP)	

³⁹ Statewide Evaluator Guidance Memo, *New-to-gross Study Methods, Review and Recommendations*. January 13, 2013.

8.5 Financial Reporting

All program expenses were within approved budgets, and TRC results were within reasonable ranges. A breakdown of the program finances is presented in **Table 8-6**

Table 8-6: Summary of JUUMP Programs Finances

	IQ (\$1,000)	PYTD (\$1,000)	CPITD (\$1,000)
EDC Incentives to Participants			\$ 371
EDC Incentives to Trade Allies			
Subtotal EDC Incentive Costs			\$ 371
Design & Development			\$ 25
Administration ^[1]	\$ (5)	\$ 180	\$ 353
Management ^[2]			
Marketing ^[3]	\$ 0	\$ 9	\$ 24
Technical Assistance	\$ 56	\$ 3,445	\$ 3,734
Subtotal EDC Implementation	\$ 51	\$ 3,634	\$ 4,136
EDC Evaluation Costs	\$ 9	\$ 40	\$ 98
SWE Audit Costs			
Total EDC Costs^[4]	\$ 61	\$ 3,674	\$ 4,605
Participant Costs^[5]			
Total TRC Costs^[6]	\$ 61	\$ 3,674	\$ 4,605
Total Lifetime Energy Benefits		\$ 3,115	\$ 3,771
Total Lifetime Capacity Benefits		\$ 286	\$ 305
Total TRC Benefits^[7]		\$ 3,401	\$ 4,076
TRC Ratio^[8]	n/a	0.93	0.89

NOTES

Per PUC direction, TRC inputs and calculations are required in the Annual Report only and should comply with the 2011 Total Resource Cost Test Order approved July 28, 2011. Please see the "Report Definitions" section of this report for more details.

[1] Includes the administrative CSP (rebate processing), tracking system, and general administration and clerical cost.

[2] Includes EDC program management, CSP program management, general management oversight, and major accounts.

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

[4] Per the 2011 Total Resource Cost Test Order, the Total EDC Costs refer to EDC incurred expenses only.

[5] Per the 2011 Total Resource Cost Test Order, the net Participant Costs are the costs for the end-use customer.

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

[7] Total TRC Benefits equals the sum of Total Lifetime Energy Benefits and Total Lifetime Capacity Benefits. Based upon verified gross kWh and kW savings. Benefits include: avoided supply costs, including the reduction in costs of electric energy, generation, transmission, and distribution capacity, and natural gas valued at marginal cost for periods when there is a load reduction.

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

9 Commercial / Industrial Small Sector Equipment Program

This program consists of the following components:

Equipment: This program component provides for the implementation of cost effective, high efficiency measures through the Nonstandard Lighting, Heating Ventilating and Air-conditioning, Motors & Drives, Specialty Equipment and Custom incentive programs.

Energy Audit and Technical Assessment: This program component provides information, a list of auditors and funds all of the CFL installations for this class of customers marketed through Nonstandard Lighting incentives.

9.1 Program Updates

No changes to this program during PY4.

9.2 Impact Evaluation Gross Savings

This program implements both custom measures and prescriptive measures.

The majority of the gross reported energy savings for this program were attributable to lighting measures. The remainder of the savings were attributable to prescriptive and custom motors projects, and the remainder to custom projects. The M&V methodology for this program is described below.

Analytical Desk Review: Prescriptive and Custom

At the end of each quarter ADM reviewed an updated dataset from the T&R system to define a discrete set of rebates that would be included in the population for that quarter's evaluation sampling process. Each sampled site underwent a thorough desk review before ADM visited the site or calculated ex post verified savings. The desk review included verifying invoices, re-calculating claimed savings using TRM algorithms and/or ex ante assumptions (i.e. fixture quantities, motor horse-powers, EFLHs, etc.), and identifying key parameters to be researched in the M&V plan.

This review informed ADM's data acquisition activities by identifying missing data and sites at which ADM needed to install monitoring equipment. The desk review was also used to flag sites that were claimed using prescriptive algorithms, but whose savings needed to be calculated using a custom approach. Examples include process cooling chillers mistakenly identified as space cooling chillers, and variable frequency drives installed in instances that require metering or trending. In certain cases – particularly with photovoltaic, compressed air, or refrigeration upgrade measures, metering or trending data were available. On-site data collection was not required in such cases where the available data was sufficient to complete the measurement and verification.

For custom projects desk reviews were performed in order to create an Evaluation, Measurement, & Verification plan for each sampled site. ADM used the project documentation and site contact to determine what monitoring equipment needed to be installed and if baseline monitoring was possible or needed. Many of the larger custom projects fell in ADM's 'certainty' stratum and were evaluated concurrently. In such cases the gross reported and gross verified savings are equal.

ADM worked with SAIC and West Penn Power to identify custom sites at which monitoring would be required by reviewing site documentation for sites early in SAIC's approval process and flagging sites which would only be evaluable with monitored baseline data. ADM reviewed each Custom Incentive application before its approval to ensure its ability to be evaluated.

Verification /Data Acquisition (DAQ)

ADM used surveys, on-site verification, and/or data logging in order to address uncertainties identified in the desk review process. ADM determined the requisite level of additional verification by applying the following general rule-set:

- Photovoltaic projects were evaluated with Solar Advisor Model (SAM) simulations that were first calibrated to historical generation records and then weather normalized.
- Lighting projects required on-site visits⁴⁰ and larger projects required logging hours of use
- Large savings custom HVAC upgrades were evaluated by billing analyses when possible
- Some very small, prescriptive projects (e.g., one rooftop unit, five traffic signals, or one solid door refrigerator) did not require on-site inspections if a desk review is conclusive.
- If projects that came in prescriptive paths such as the HVAC or Motors/Drives applications appear to be "custom" in nature, they were evaluated as custom projects.

In this way ADM ensured that enough information was gathered to make accurate and robust site analyses.

Post Data Acquisition analysis

In order to promote consistency and accuracy, ADM created a Microsoft Excel based calculator for each prescriptive measure rebated in the program that has a stipulated savings algorithm in the Pennsylvania TRM. Each calculator has one spreadsheet that is used to recreate the claimed savings values by entering in values according to the rebate application and site documentation during the desk review. There is a

⁴⁰ There are exceptions to this rule. For West Penn Power, two of 35 sampled lighting projects underwent desk review but did not require on-site visits. These projects were small savings projects and, weighted by the sample weights, represented approximately 5% of the overall program's impacts.

second sheet that is then used to calculate ex post verified savings by updating key parameters according to on-site data collection. In many cases no changes were made between these two sheets, as all key variables were identified correctly through the desk review.

Custom measures were evaluated according to the site-specific EM&V plan that was written during the desk review and modified, if need, after an initial interview with the project applicant or contact person. Given the nature of these measures, the custom analyses employed monitored data, cut-sheets, and one-time power measurements to characterize energy use and energy savings. For measures installed on equipment used in industrial processes, ADM also collected annual production data (in addition to any production collected during the monitored time period). This was used to normalize energy savings to production.

9.2.1 Program Sampling

ADM evaluated the commercial and industrial programs using stratified ratio estimation. Separate samples were drawn, at the 85% confidence level with 15% precision at the annual evaluation level, for each operating company, program, and quarter. A 'sample point' denotes a particular rebate which was randomly sampled within its population.

At the end of the second, third, and fourth quarter ADM reviewed tracking data to define a discrete list of rebates that became the sample population for that quarter. Once separated into their respective operating companies and programs, this population was then stratified according to measure category (prescriptive vs. custom), common drivers of realization rates or the variability of the realization rates, modes, and the magnitude of rebated savings (used to create 'certainty' strata⁴¹). ADM used a coefficient of variation (CV) of 0.4 for all "Nonstandard Lighting for Business" projects, a CV of 0.6 for all custom projects and "Standard Lighting for Business" projects, and a CV of 1.0 for prescriptive non-lighting projects based on the PY2 and PY3 evaluations. The actual observed error ratios for the various strata, as trended from ADM's sample of previous evaluation years are significantly smaller than the CV estimates used herein.

⁴¹ There are some projects that were evaluated concurrently but ADM but had savings that fell below the certainty threshold. These projects were also placed in the certainty category so that they would represent only themselves in ADM's evaluation sample.

Table 9-1: Commercial / Industrial Small Sector Equipment Program Reported Results by Quarter⁴²

Reporting Period	Participants	Reported Gross Energy Savings (MWh/yr)	Retail Level Reported Gross Demand Reduction (MW)	Generator Level Top 100 Reported Gross Demand Reduction (MW)	TRM Top 100 Verified Gross Demand Reduction (MW)	TRM Corrected Top 100 Verified Gross Demand Reduction (MW)	Evaluated Top 100 Verified Gross Demand Reduction (MW)	Incentives (\$1000)
PY4 Q1	9,482	19,230	5.5	2.99	2.86	2.86	2.86	\$ 252
PY4 Q2	323	19,407	3.6	0.00	0.00	0.00	0.00	\$ 773
PY4 Q3	166	12,940	2.0	0.00	0.00	0.00	0.00	\$ 760
PY4 Q4	307	23,214	16.7	0.00	0.00	0.00	0.00	\$3,675
PY4 Total	10,278	74,791	27.7	2.99	2.86	2.86	2.86	\$5,460
CPITD Total	37,842	149,194	49	28.55	21.69	22.05	22.62	\$8,745

Table 9-2: Commercial / Industrial Small Sector Equipment Program Sampling Strategy for PY4

Stratum Name	Reported Gross Savings	Strata Boundaries	Population Size	Assumed CV	Achieved Sample	Evaluation Activity
CFL0	13,277,928	1,000	9,391	0.5	138	Survey + PY3 Metering Study
CFL1	0	4,000	0	0.5	0	n/a
CFL2	0	n/a	0	0.5	0	n/a
ADI0	17,601,248	10,000,000	51	0.4	5	Desk Review, On-Site
ADI1	0	1,000,000	0	0.4	0	n/a
NSL0	14,397,296	100,000	554	0.4	6	Desk Review, On Site
NSL1	17,412,259	700,000	79	0.4	4	Desk Review, On Site
NSL2	4,500,375	n/a	5	0.4	2	Desk Review, On Site
SLB0	0	100,000	0	0.6	0	n/a
SLB1	0	500,000	0	0.6	0	n/a
SLB2	0	n/a	0	0.6	0	n/a
Prescriptive	431,496	100,000	69	1.0	1	Desk Review, On Site
Prescriptive	455,813	500,000	1	1.0	1	Desk Review, On Site
Prescriptive	0	n/a	0	1.0	0	n/a
Custom0	1,465,963	100,000	52	0.6	1	Desk Review, On Site
Custom1	2,614,965	500,000	14	0.6	2	Desk Review, On Site
Custom2	2,134,635	n/a	1	0.6	1	Desk Review, On Site
SAL0	238,609	10,000	42	0.4	1	Desk Review, On Site
SAL1	260,016	100,000	19	0.4	1	Desk Review, On Site
SAL2	0	n/a	0	0.4	0	n/a
Total	74,790,603	n/a	10,278	n/a	163	n/a

⁴² For purposes of this report, all top 100 hour impacts are reported in PY4Q1.

**Table 9-3: PY4 Commercial / Industrial Small Sector Equipment Program Summary of Evaluation
Results for Energy**

Stratum Name	Reported Gross Energy Savings (kWh)	Realization Rate	Observed CV	Relative Precision	Verified Gross Energy Savings (kWh)
CFL0	13,277,928	140%	0.5	6%	18,609,187
CFL1	0	n/a	0.5	n/a	
CFL2	0	n/a	0.5	n/a	
ADI0	17,601,248	94%	0.4	57%	16,558,970
ADI1	0	n/a	0.4	n/a	
NSL0	14,397,296	100%	0.4	23%	14,386,557
NSL1	17,412,259	89%	0.4	28%	15,521,725
NSL2	4,500,375	89%	0.4	32%	4,016,680
SLB0	0	n/a	0.6	n/a	
SLB1	0	n/a	0.6	n/a	
SLB2	0	n/a	0.6	n/a	
Prescriptive0	431,496	149%	1.0	143%	642,212
Prescriptive1	455,813	155%	1.0	0%	706,220
Prescriptive2	0	n/a	1.0	n/a	
Custom0	1,465,963	125%	0.6	86%	1,835,693
Custom1	2,614,965	74%	0.6	57%	1,947,395
Custom2	2,134,635	100%	0.6	0%	2,134,635
SAL0	238,609	93%	0.4	57%	221,742
SAL1	260,016	103%	0.4	56%	267,007
SAL2	0	n/a	0.4	n/a	
Total	74,790,603	103%	n/a	10%	76,848,022

The table below for demand reduction includes PYTD reported and verified demand reductions at the customer meter level for all impact evaluation sampling strata, and verified CPITD top 100-hour demand reductions at the generator level for the entire program. Please note, as discussed in Section 1 and Appendix A of this Report, the CPITD Top 100 demand reduction values in this table are shown using values that represent: 1) calculations published in the 2012 Pennsylvania TRM (“TRM”); 2) calculations that include a correction to the Residential CFL coincidence factor (“TRM Corrected”); and, 3) calculations

that incorporate alternative measurement approaches from the 2012 TRM to more accurately assess the peak load impacts from residential lighting during the Company’s Top 100 Hours (“Evaluated”).

**Table 9-4: PY4 Commercial / Industrial Small Sector Equipment Program Summary of Evaluation
Results for Demand**

Stratum Name	Reported Demand Reductions (kW)	Gross Demand Reductions (kW)	Realization Rate	Observed CV	Relative Precision	Verified Demand Reductions (kW)	Gross Demand Reductions (kW)
CFL0		4,647	75%	0.5	6%		3,508
CFL1		0	n/a	0.5	n/a		
CFL2		0	n/a	0.5	n/a		
ADI0		15,702	95%	0.4	24%		14,927
ADI1		0	n/a	0.4	n/a		
NSL0		2,789	109%	0.4	23%		3,034
NSL1		2,940	111%	0.4	28%		3,257
NSL2		542	80%	0.4	32%		436
SLB0		0	n/a	0.6	n/a		
SLB1		0	n/a	0.6	n/a		
SLB2		0	n/a	0.6	n/a		
Prescriptive0		145	180%	1.0	143%		260
Prescriptive1		52	357%	1.0	0%		186
Prescriptive2		0	n/a	1.0	n/a		
Custom0		601	54%	0.6	86%		326
Custom1		251	194%	0.6	57%		488
Custom2		0	n/a	0.6	0%		
SAL0		28	88%	0.4	57%		25
SAL1		31	102%	0.4	56%		32
SAL2		0	n/a	0.4	n/a		
Total		27,730	95%	n/a	15%		26,478
CPITD TRM Top 100 Verified Gross Demand Reduction (MW) (Generator)							21.7
CPITD TRM Corrected Top 100 Verified Gross Demand Reduction (MW) (Generator)							22.0
CPITD Evaluated Top 100 Verified Gross Demand Reduction (MW) (Generator)							22.6

9.3 Impact Evaluation Net Savings

The evaluation team employed the self-report approach (SRA) to estimate free-ridership and spillover effects. The participant 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 participant 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.

The sampling frame for the customer decision-maker survey was C&I Equipment program participants⁴³ from Program Year 3. The evaluation team surveyed a census of customers in all equipment areas to estimate net-to-gross, with the exception of lighting. For lighting, the evaluation team sampled a sufficient number of participants to achieve a confidence interval level of 90 percent +/- 10 percent at the utility level.

Free-ridership and like spillover were evaluated by measure category: standard lighting, non-standard lighting, HVAC, motors, and custom. The evaluation team completed 70 participant surveys at the measure level for a 7.9 percent relative precision with 90 percent confidence (for free-ridership assessment).

The West Penn Power program NTG research indicates estimates of 43.4 percent free-ridership and 8.9 percent spillover for a net-to-gross ratio of 65.5 percent at the combined measure level. The non-standard lighting free-ridership rate was 37.2 percent, spillover was 10.5 percent, and the net-to-gross ratio was estimated to be 73.3 percent. Measure level free-ridership and spillover rates for measures other than non-standard lighting ranged from 0.0 percent to 99.9 percent; however, great caution is needed when interpreting these results as sample sizes are very small. The evaluation team recommends the inclusion of market actor interviews in future net-to-gross research to assess the attribution of the program to decisions made by these program partners. Given the limited number of sample points at each measure-level, the evaluation team did not provide any recommendations for specific measure-level modifications based on this research.

9.4 Process Evaluation

Evaluation Methodology

The process evaluation effort consisted of participant surveys and in-depth interviews with participating auditors. Key researchable issues were identified based on the evaluator's experience assessing other residential home energy audits and outreach programs and through interviews with program staff. These issues included:

- **Equipment installed and impact of program on participation.** Participants were about the equipment supported by the program and if the program was successful at getting them to install higher-efficient equipment.

⁴³ The net-to-gross research and process evaluation effort was combined for small and large C&I equipment, and government/non-profit sector participants. Process and net-to-gross evaluations were completed for these sectors overall because the programs were designed, marketed, and operated essentially the same and participation was limited at the small, large, and government/non-profit sectors at the time of the evaluation effort. Caution is recommended when interpreting by sector. In Phase II, this will be reviewed and consideration given to an expanded effort, or separate efforts, if warranted.

- **Program marketing.** Participants were asked how they heard about the program and any barriers to implementing energy efficiency projects.
- **Participant satisfaction.** Participants were asked a number of satisfaction questions in regards to specific equipment, interactions with program staff, and with the program overall.
- **Program wait-list affected on project.** Participants placed on a wait-list were asked about the status of their project, how often they receive program updates, and their wait list status.

Tetra Tech conducted a telephone survey of C&I Equipment program participants from Program Year 3 in conjunction with the net-to-gross research. Process and net-to-gross evaluations were completed for the C&I and government/non-profit sectors overall as participation was limited at the time of the evaluation effort. In Phase II, this will be reviewed and consideration given to an expanded effort, or separate efforts, if warranted.

Key Findings

Key findings were reported in the Program Year 3 Annual report.

Table 9-5: Status Report for Process Evaluations

Recommendations	EDC Status Report for Process Evaluations (Implemented, Being Considered, Rejected AND Explanation of Action Taken by EDC)
Commercial/Industrial Small Sector Equipment	
Collect all participation data electronically including all project information including such as detailed equipment description (old and new) and the quantity of equipment installed, when appropriate.	Being Considered
Consider additional marketing efforts. The preferred methods of contact mentioned most often were through email, mail or the FirstEnergy website. FirstEnergy may want to consider more strategic marketing efforts, particularly to small businesses.	Being Considered
Provide a means (such as website notification or periodic e-blasts) for contractors and customers to check the status of the program prior to applying to the program.	Being Considered
Review the rebate application process to ensure requirements are easy to understand and that rebates are issued in a timely fashion.	Being Considered

9.5 Financial Reporting

All program expenses were within approved budgets, and TRC results were within reasonable ranges. A breakdown of the program finances is presented in **Table 9-6**

Table 9-6: Summary of Commercial / Industrial Small Sector Equipment Program Finances

	IQ (\$1,000)	PYTD (\$1,000)	CPITD (\$1,000)
EDC Incentives to Participants	\$ 3,675	\$ 5,460	\$ 8,745
EDC Incentives to Trade Allies			
Subtotal EDC Incentive Costs	\$ 3,675	\$ 5,460	\$ 8,745
Design & Development			\$ 308
Administration ^[1]	\$ 54	\$ 234	\$ 1,148
Management ^[2]			
Marketing ^[3]	\$ 881	\$ 1,123	\$ 1,567
Technical Assistance	\$ 2,119	\$ 3,002	\$ 4,193
Subtotal EDC Implementation	\$ 3,054	\$ 4,359	\$ 7,216
EDC Evaluation Costs	\$ 275	\$ 408	\$ 801
SWE Audit Costs			
Total EDC Costs^[4]	\$ 7,005	\$ 10,227	\$ 16,763
Participant Costs^[5]		\$ 39,611	\$ 45,204
Total TRC Costs^[6]	\$ 3,330	\$ 44,378	\$ 53,221
Total Lifetime Energy Benefits		\$ 54,800	\$ 80,389
Total Lifetime Capacity Benefits		\$ 18,392	\$ 20,527
Total TRC Benefits^[7]		\$ 73,192	\$ 100,916
TRC Ratio^[8]		1.65	1.90

NOTES

Per PUC direction, TRC inputs and calculations are required in the Annual Report only and should comply with the 2011 Total Resource Cost Test Order approved July 28, 2011. Please see the "Report Definitions" section of this report for more details.

[1] Includes the administrative CSP (rebate processing), tracking system, and general administration and clerical cost.

[2] Includes EDC program management, CSP program management, general management oversight, and major accounts.

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

[4] Per the 2011 Total Resource Cost Test Order, the Total EDC Costs refer to EDC incurred expenses only.

[5] Per the 2011 Total Resource Cost Test Order, the net Participant Costs are the costs for the end-use customer.

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

[7] Total TRC Benefits equals the sum of Total Lifetime Energy Benefits and Total Lifetime Capacity Benefits. Based upon verified gross kWh and kW savings. Benefits include: avoided supply costs, including the reduction in costs of electric energy, generation, transmission, and distribution capacity, and natural gas valued at marginal cost for periods when there is a load reduction.

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

10 Commercial / Industrial Large Sector Equipment Program

This program consists of the following components:

Performance Contracting and Equipment: Large commercial and industrial (and other large non-residential) customers may elect to secure Demand Side Management/Energy Efficiency (DSM/EE) services through an Energy Services Company (ESCO) that will identify opportunities, implement retrofits and attain payment through the savings generated by the project over time.

Industrial Motors and Variable Speed Drives (VSD): This program is designed to encourage West Penn Power's commercial and industrial customers to: 1) upgrade their existing motors to NEMA Premium® motors when switching out old motors due to breakdowns and or programmed replacements; and, 2) install variable speed drives on motors that do not always operate at the same speed.

The variable speed drive program is designed for commercial and industrial energy customers whose motors are utilized for increased operating hours and have a higher variability of loads. Applications with low variability of loads where the motor runs at constant speed are not good candidates for a variable-speed drive.

10.1 Program Updates

No changes to this program during PY4.

10.2 Impact Evaluation Gross Savings

This program implements both custom measures and prescriptive measures. The great majority of the gross reported energy savings for this program were attributable to prescriptive and performance lighting measures. The M&V methodology for this program is identical to the approach used for the Small C/I equipment program described in section 9.2.

10.2.1 Program Sampling

The sampling methodology for this program is identical to the approach used for the Small C/I equipment program described in section. Program-specific details are in Table 10-3

Table 10-1: Commercial / Industrial Large Sector Equipment Program Reported Results by Quarter⁴⁴

Reporting Period	Participants	Reported Gross Energy Savings (MWh/yr)	Retail Level Reported Gross Demand Reduction (MW)	Generator Level Top 100 Reported Gross Demand Reduction (MW)	TRM Top 100 Verified Gross Demand Reduction (MW)	TRM Corrected Top 100 Verified Gross Demand Reduction (MW)	Evaluated Top 100 Verified Gross Demand Reduction (MW)	Incentives (\$1000)
PY4 Q1	12	4,188	0.5	2.44	2.83	2.83	2.83	\$ 227
PY4 Q2	48	10,991	1.3	0.00	0.00	0.00	0.00	\$ 535
PY4 Q3	46	21,785	2.9	0.00	0.00	0.00	0.00	\$ 1,146
PY4 Q4	43	16,655	7.4	0.00	0.00	0.00	0.00	\$ 1,383
PY4 Total	149	53,619	12.1	2.44	2.83	2.83	2.83	\$ 3,291
CPITD Total	201	78,180	8.1	7.48	8.10	8.10	8.10	\$ 5,189

Table 10-2: Commercial / Industrial Large Sector Equipment Program Sampling Strategy for PY4

Stratum Name	Reported Gross Savings	Strata Boundaries	Population Size	Assumed CV	Achieved Sample	Evaluation Activity
CFLO	0	2,200	0	0.5	0	n/a
CFL1	0	6,000	0	0.5	0	n/a
CFL2	0	n/a	0	0.5	0	n/a
NSLO	15,335,845	600,000	96	0.4	7	Desk Review, On-
NSL1	20,964,518	3,000,000	18	0.4	6	Desk Review, On-
NSL2	8,523,613	n/a	2	0.4	2	Desk Review, On-
SLB0	0	100,000	0	0.6	0	n/a
SLB1	0	500,000	0	0.6	0	n/a
SLB2	0	n/a	0	0.6	0	n/a
Prescriptive0	21,927	100,000	8	1.0	1	Desk Review, On-
Prescriptive1	0	500,000	0	1.0	0	n/a
Prescriptive2	0	n/a	0	1.0	0	n/a
Custom0	0	1	0	0.6	0	n/a
Custom1	3,690,164	1,000,000	20	0.6	2	Desk Review, On-
Custom2	5,082,774	n/a	5	0.6	4	Desk Review, On-
SALO	0	10,000	0	0.5	0	n/a
SAL1	0	100,000	0	0.5	0	n/a
SAL2	0	n/a	0	0.5	0	n/a
Total	53,618,841	n/a	149	n/a	22	n/a

⁴⁴ For purposes of this report, all top 100 hour impacts are reported in PY4Q1.

**Table 10-3: PY4 Commercial / Industrial Large Sector Equipment Program Summary of Evaluation
Results for Energy**

Stratum	Reported Gross Energy Savings	Energy Realization Rate	Observed Coefficient of Variation (C_v) or Proportion	Relative Precision	Verified Gross Energy Savings
CFL0	0	n/a	0.5	n/a	
CFL1	0	n/a	0.5	n/a	
CFL2	0	n/a	0.5	n/a	
NSL0	15,335,845	95%	0.4	21%	14,553,890
NSL1	20,964,518	83%	0.4	19%	17,467,878
NSL2	8,523,613	79%	0.4	0%	6,703,261
SLB0	0	n/a	0.6	n/a	
SLB1	0	n/a	0.6	n/a	
SLB2	0	n/a	0.6	n/a	
Prescriptive0	21,927	99%	1.0	135%	21,816
Prescriptive1	0	n/a	1.0	n/a	
Prescriptive2	0	n/a	1.0	n/a	
Custom0	0	n/a	0.6	n/a	
Custom1	3,690,164	132%	0.6	58%	4,857,721
Custom2	5,082,774	99%	0.6	19%	5,008,186
SAL0	0	n/a	0.5	n/a	
SAL1	0	n/a	0.5	n/a	
SAL2	0	n/a	0.5	n/a	
Total	53,618,841	91%	n/a	11%	48,612,752

The table below for demand reduction includes PYTD reported and verified demand reductions at the customer meter level for all impact evaluation sampling strata, and verified CPITD top 100-hour demand reductions at the generator level for the entire program.

**Table 10-4: PY4 Commercial / Industrial Large Sector Equipment Program Summary of Evaluation
Results for Demand**

Stratum	Reported Gross Demand Reduction	Demand Realization Rate	Observed Coefficient of Variation (C _v) or Proportion	Relative Precision	Verified Gross Demand Reduction
CFL0	0	n/a	0.5	n/a	
CFL1	0	n/a	0.5	n/a	
CFL2	0	n/a	0.5	n/a	
NSL0	7,148	118%	0.4	21%	8,404
NSL1	2,732	100%	0.4	19%	2,727
NSL2	967	93%	0.4	0%	897
SLB0	0	n/a	0.6	n/a	
SLB1	0	n/a	0.6	n/a	
SLB2	0	n/a	0.6	n/a	
Prescriptive0	21	99%	1.0	135%	21
Prescriptive1	0	n/a	1.0	n/a	
Prescriptive2	0	n/a	1.0	n/a	
Custom0	0	n/a	0.6	n/a	
Custom1	533	254%	0.6	58%	1,353
SAL0	0	n/a	0.5	n/a	
SAL2	0	n/a	0.5	n/a	
Total	12,050	116%	n/a	14%	13,935
CPITD TRM Top 100 Verified Gross Demand Reduction (MW) (Generator)					8.1
CPITD TRM Corrected Top 100 Verified Gross Demand Reduction (MW) (Generator)					8.1
CPITD Evaluated Top 100 Verified Gross Demand Reduction (MW) (Generator)					8.1

10.3 Impact Evaluation Net Savings

See Section 9. Commercial/Industrial Small Sector Equipment.

10.4 Process Evaluation

Tetra Tech conducted a telephone survey of the C&I and Government and Institutional Equipment programs participants from Program Year 3 in conjunction with the net-to-gross research. Process and net-to-gross evaluations were completed for these sectors overall because the programs were designed, marketed, and operated essentially the same and participation was limited at the small, large, and government/non-profit sectors at the time of the evaluation effort. In Phase II, this will be reviewed and consideration given to an expanded effort, or separate efforts, if warranted.

Evaluation Methodology

See Section 9. Commercial/Industrial Small Sector Equipment.

Key Findings

See Section 9. Commercial/Industrial Small Sector Equipment.

Table 10-5: Status Report for Process Evaluations

Recommendations	EDC Status Report for Process Evaluations (Implemented, Being Considered, Rejected AND Explanation of Action Taken by EDC)
Commercial/Industrial Large Sector Performance Contracting/Equipment	
See Section 9. Commercial/Industrial Small Sector Equipment	

10.5 Financial Reporting

All program expenses were within approved budgets, and TRC results were within reasonable ranges. A breakdown of the program finances is presented in Table 10-6

Table 10-6: Summary of Commercial / Industrial Large Sector Equipment Program Finances

	IQ (\$1,000)	PYTD (\$1,000)	CPITD (\$1,000)
EDC Incentives to Participants	\$1,383	\$3,291	\$5,189
EDC Incentives to Trade Allies			
Subtotal EDC Incentive Costs	\$1,383	\$3,291	\$5,189
Design & Development			\$667
Administration ^[1]	\$20	\$111	\$709
Management ^[2]			
Marketing ^[3]	\$(0)	\$102	\$285
Technical Assistance	\$110	\$194	\$1,481
Subtotal EDC Implementation Costs	\$129	\$406	\$3,143
EDC Evaluation Costs	\$7	\$25	\$115
SWE Audit Costs			
Total EDC Costs^[4]	\$1,520	\$3,722	\$8,447
Participant Costs^[5]		\$11,158	\$15,820
Total TRC Costs^[6]	\$137	\$11,589	\$19,078
Total Lifetime Energy Benefits		\$34,154	\$46,979
Total Lifetime Capacity Benefits		\$11,060	\$12,531
Total TRC Benefits^[7]		\$45,214	\$59,510
TRC Ratio ^[8]	0.00	3.90	3.12

NOTES

Per PUC direction, TRC inputs and calculations are required in the Annual Report only and should comply with the 2011 Total Resource Cost Test Order approved July 28, 2011. Please see the "Report Definitions" section of this report for more details.

[1] Includes the administrative CSP (rebate processing), tracking system, and general administration and clerical cost.

[2] Includes EDC program management, CSP program management, general management oversight, and major accounts.

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

[4] Per the 2011 Total Resource Cost Test Order, the Total EDC Costs refer to EDC incurred expenses only.

[5] Per the 2011 Total Resource Cost Test Order, the net Participant Costs are the costs for the end-use customer.

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

[7] Total TRC Benefits equals the sum of Total Lifetime Energy Benefits and Total Lifetime Capacity Benefits. Based upon verified gross kWh and kW savings. Benefits include: avoided supply costs, including the reduction in costs of electric energy, generation, transmission, and distribution capacity, and natural gas valued at marginal cost for periods when there is a load reduction.

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

11 Customer Resources Demand Response Program – CSP Mandatory and Voluntary Curtailment Program

For C/I, as well as government sector customers, West Penn Power solicited curtailment service providers (“DR-CSPs”) to provide customer curtailable load during the Company’s targeted hours of 100 hours of highest demand. The Plan included both a Mandatory Program and a Voluntary Program. The Companies developed an RFP supporting the mandatory program offering firm pricing for commitments for peak load reductions during the top 100 hours, and a voluntary program offering supplemental payments for voluntary customer reductions during the top 100 hours.

11.1 Program Updates

West Penn Power contracted with nine DR-CSPs and eight individual customers to deliver load reductions under both the Mandatory and Voluntary Programs. Additional DR-CSPs participated in the Voluntary Program in conjunction with participation in PJM programs.

11.2 Impact Evaluation Gross Savings

This measurement and verification (“M&V”) report describes ADM’s impact evaluation for the Commercial and Industrial Demand Response Program offered by West Penn Power.

During the top 100 hours, the Penelec C/I Demand Response Program achieved 7,836 MWh of energy savings (equivalent to 78.36 MW average load reduction over the top 100 hours) at the gross reported level at the customer meters. ADM sampled seven projects in its impact evaluation. The seven sampled projects account for about 81% of the total program savings. The general evaluation approach was to conduct independent savings calculations. For each sampled site, ADM calculated the following customer load baselines (CBLs):

- PJM Three Day Type CBL
- PJM Three Day Type CBL with Symmetric Additive Adjustment (SAA)
- PJM Custom “Manual” CBL (3 hours post-event, 2 hours pre-event, 1 hour buffer)
- Several “Custom” CBLs created by ADM

Whenever custom CBLs are considered, the impacts from the ‘next best’ PJM protocol are also recorded. The program-level realization rate is reported for two scenarios:

- The ‘ADM Best Approach’ scenario that includes custom CBLs (non-PJM CBLs)
- The ‘PJM-only’ approach relies on the three PJM CBLs listed above

For all four FirstEnergy Pennsylvania EDCs, the program level realization rates are comparable (within 2%) for the two scenarios.

ADM used the following guidelines for auditing the proposed CBL schemes and in the determination of alternate CBLs if needed:

1. If the applicant was registered in PJM's Economic DR Programs, then ADM showed some preference for the CBL accepted by PJM.
 - The reasoning is that if PJM approved the CBL methodology, then the CBL can be considered to be vetted for Act 129 purposes.
2. In cases where the applicant had not registered in PJM's Economic DR Programs, and proposed CBL appeared to be reasonable, with acceptable relative root mean square errors (RRMSE) so that PJM would have likely accepted the proposed CBL, then ADM showed preference for the proposed CBL.
3. In case where the proposed CBL had validity issues or was significantly outperformed during influential event days by other CBLs, ADM overrode the proposed CBL and assigned an alternate CBL.
 - Consistent with PJM protocol, ADM preferred CBLs with lower RRMSE scores. In many cases several CBLs had comparable RRMSEs. ADM judged the apparent performance of CBLs on key event days (those with the largest potential top 100 hour energy savings) by comparing graphs of the CBLs and facility loads for the event day, for surrounding days, and for previous and subsequent "like" weekdays.
 - All other things comparable, the preferred CBL was the Three Day Type with SAA.
 - SAA or other day-of-event corrections were not used in cases where the applicant appeared to alter usage prior to the official event start. In such cases the SAA or 3/2 "manual" protocols may appear to have great RRMSEs but often produce biased results on event days.

ADM's independent analyses have resulted in a realization rate of 96.8%, with a sampling precision of 11% at the 85% confidence level.

11.2.1 Program Sampling

ADM employed a stratified sampling scheme to evaluate this program. The sampling scheme separated the projects into four groups or strata. The first stratum includes the largest applicants in terms of expected top 100 hour contributions while the fourth stratum contains the smallest projects. A total of 12 projects were sampled for West Penn Power. The initial sample sizes were calculated with a goal of achieving $\pm 15\%$ relative precision at the 85% confidence level with an assumed coefficient of variation (CV) of 0.5. ADM later calculated the error ratio from 42 sampled projects across all four FirstEnergy Pennsylvania electric distribution companies and found that the error ratio was close to 0.3 reinforcing the reasonableness of the sample. The distribution of verified vs. reported impacts, along with project-level realization rates, is shown in Figure 11-1.

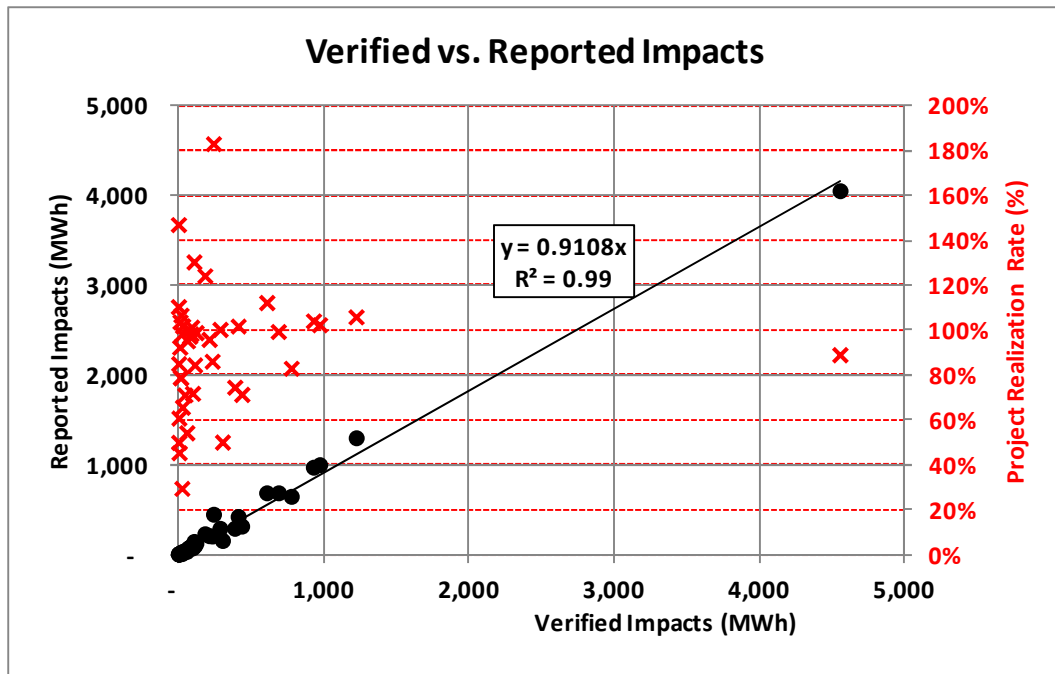


Figure 11-1. Verified vs. reported impacts during the top 100 hours for 42 projects sampled across all four EDCs.

Table 11-1. Sampling Strategy for PY4

Stratum	Strata Boundaries (MWh)	Population Size	Assumed Coefficient of Variation (C_v) or Proportion in Sample Design	Achieved Sample Size	Evaluation Activity
1	200	4	0.5	4	Independent CBL construction and top 100 hour overlap assessment
2	30	13	0.5	2	Independent CBL construction and top 100 hour overlap assessment
3	0	156	0.5	1	Independent CBL construction and top 100 hour overlap assessment
Program Total		173		7	

The table below for demand reduction includes PYTD reported and verified demand reductions at the customer meter level for all impact evaluation sampling strata, and verified CPITD top 100-hour demand reductions at the generator level for the entire program.

Table 11-2. PY4 Summary of Evaluation Results

Stratum	Reported Gross Demand Reduction	Demand Realization Rate	Observed Coefficient of Variation (C _v) or Proportion	Relative Precision	PYTD TRM Verified Gross Demand Reduction (MW) (Retail)	CPITD TRM Top 100 Verified Gross Demand Reduction (MW) (Generator)	CPITD TRM Corrected Top 100 Verified Gross Demand Reduction (MW) (Generator)	CPITD Evaluated Top 100 Verified Gross Demand Reduction (MW) (Generator)
1	59.94	94%	0.5	0%	56.31			
2	9.22	118%	0.5	47%	10.86			
3	9.20	95%	0.5	72%	8.70			
Program Total	78.36	97%			75.87 ⁴⁵	93.6	93.6	93.6

11.3 Impact Evaluation Net Savings

Net-to-gross research was conducted for this program by the statewide evaluator; therefore, the evaluation team did not conduct.

11.4 Process Evaluation

A process evaluation was not conducted for this program as it was a one-time offering not planned for Phase II.

⁴⁵ As the top 100 contributions of all programs were finalized, the top 100 definitions shifted due to updated 'addbacks'. As a result, the average retail level verified demand reductions over the final top 100 hours is 78.02 MW. The 75.87 value shown above is derived from a penultimate definition of the top 100 hours.

11.5 Financial Reporting

All program expenses were within approved budgets, and TRC results were within reasonable ranges. A breakdown of the program finances is presented in **Table 11-3**

Table 11-3: Summary of Commercial / Industrial Large Sector Demand Response Program Finances

	IQ (\$1,000)	PYTD (\$1,000)	CPITD (\$1,000)
EDC Incentives to Participants	\$ 206	\$ 5,582	\$ 5,582
EDC Incentives to Trade Allies			
Subtotal EDC Incentive Costs	\$ 206	\$ 5,582	\$ 5,582
Design & Development			
Administration ^[1]	\$ 12	\$ 45	\$ 180
Management ^[2]			
Marketing ^[3]	\$ 1	\$ 2	\$ 55
Technical Assistance	\$ 0	\$ 4	\$ 404
Subtotal EDC Implementation	\$ 12	\$ 52	\$ 639
EDC Evaluation Costs	\$ 22	\$ 61	\$ 83
SWE Audit Costs			
Total EDC Costs^[4]	\$ 241	\$ 5,695	\$ 6,304
Participant Costs^[5]	\$ 206	\$ 5,582	\$ 5,582
Total TRC Costs^[6]	\$ 241	\$ 5,695	\$ 6,304
Total Lifetime Energy Benefits			
Total Lifetime Capacity Benefits		\$ 6,211	\$ 6,211
Total TRC Benefits^[7]		\$ 6,211	\$ 6,211
TRC Ratio^[8]	0.00	1.09	0.99

NOTES

Per PUC direction, TRC inputs and calculations are required in the Annual Report only and should comply with the 2011 Total Resource Cost Test Order approved July 28, 2011. Please see the "Report Definitions" section of this report for more details.

[1] Includes the administrative CSP (rebate processing), tracking system, and general administration and clerical cost.

[2] Includes EDC program management, CSP program management, general management oversight, and major accounts.

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

[4] Per the 2011 Total Resource Cost Test Order, the Total EDC Costs refer to EDC incurred expenses only.

[5] Per the 2011 Total Resource Cost Test Order, the net Participant Costs are the costs for the end-use customer.

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

[7] Total TRC Benefits equals the sum of Total Lifetime Energy Benefits and Total Lifetime Capacity Benefits. Based upon verified gross kWh and kW savings. Benefits include: avoided supply costs, including the reduction in costs of electric energy, generation, transmission, and distribution capacity, and natural gas valued at marginal cost for periods when there is a load reduction.

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

12 Conservation Voltage Reduction Program

The CVR Program targets select distribution circuits where voltage reduction can be achieved while maintaining voltage within regulatory requirements. The CVR Program incorporates voltage regulation techniques on select distribution circuits that result in lower service voltage levels which causes a reduction of energy consumption and demand by customers and losses in the utility system. The Company has reviewed its distribution system to identify circuits where the CVR Program could be implemented (i.e., voltages can be adjusted) with limited to no circuit upgrades and voltages can be maintained within regulatory requirements. The voltage set points for selected Company distribution substations with automatic voltage controls (AVCs) and load tap changers (LTCs) will be recalibrated to deliver a 1.5% lower voltage. The voltage will be monitored to ensure that voltage levels do not drop below regulatory requirements.

12.1 Program Updates

There were no changes to this program during PY4.

12.2 Impact Evaluation Gross Savings

The CVR program's gross impacts were measured with retrofit isolation testing (i.e., tests to generate controlled experimental data to support statistical estimation of the impacts) on selected transformers. Sampled transformers had voltage drops induced through supervisory control and data acquisition (SCADA) system. The tests were conducted in winter 2012, spring 2013, and summer 2013 to capture possible seasonal variations in the impact of the CVR program. Analysis of data from transformers that were not part of the test groups enabled a difference in differences (DID) approach.

The impact evaluation effort included seven coordinated efforts. The approach is as follows:

1. Measure the average voltage drop achieved by the program.
2. Measure the relative change in energy usage that results from the voltage drop.
3. Calculate the weather-normalized annual energy savings
4. Calculate the average demand reduction during the top 100 hours
5. Generalize the impacts from sampled transformers to non-sampled transformers.
6. Adjust the energy savings down to the meter level, and the demand reductions up to the generator level.
7. Allocate savings to sector.

These six steps above are described briefly below.

Voltage Change Measurement

To verify that the CVR program reduced voltages at the transformer level and to measure the voltage change implemented, ADM inspected 15-minute interval voltage records for the period May 2011 to October 2013 for 58 transformers in the CVR program that had voltage meters available. Voltages were averaged to the daily level and inspected graphically for each transformer. Voltage drops were calculated as the difference between the average voltage for the five days preceding the voltage change and for the five days following the voltage change. The program was implemented approximately in two phases, with the first phase in 2011 and the second wave in 2012 and 2013 (mostly 2012). Results for the two phases are summarized in the following table.

Stratum	Number of Transformers	Total MVA	Number Confirmed Voltage Drops	Average Delta V for EE	Delta V for Top 100
2011 – MWh Meter	36	608	27	1.36%	1.44%
2011 – Ratchet Meter	36	175	n/a	1.36%	1.44%
2012 – MWh Meter	22	320	14	1.11%	0.50%
2012 – Ratchet Meter	16	90	n/a	1.11%	0.50%
<p>1) The typical observed voltage drop was 1.8%. The lower values in this table reflect contributions of 0% for transformers that, for EE, were not in the lower voltage state as of May 31 2013 (with allowance of temporary increased voltage for M&V purposes in Summer 2013, or were not in the lower voltage state during the top 10 hours of 2012 for DR.</p> <p>2) Two of the transformers in the 2012 – MWh Meter stratum were intentionally removed from the program on August 22 2012. These transformers do not contribute to verified gross energy savings, but their top 100 hour impacts are counted up through August 21 2012.</p>					

Measure the Energy Impacts from CVR

Not all loads react in the same way to a voltage change. As a simple example, an incandescent lamp, being a purely resistive load from an electrical perspective, will change power linearly with voltage. For purely resistive loads, a 1% voltage drop will cause a 1% drop in power for a given hour. Other loads (such as motors, air conditioners, etc.) may have a different sensitivity. The ratio of the relative change in energy to a change in voltage is called the *CVR factor* (CVRf). The energy savings from the program over a given period of time can be cast in the following form:

$$\Delta\text{kWh} = \text{kWh} \times \Delta V \times \text{CVRf}$$

where ΔkWh is the energy savings during the period of interest, kWh is the total electric energy usage during the period of interest, and ΔV is the average voltage reduction.

Equipment may have CVR factors that range from less than zero to greater than 1. Due to the diversity of equipment responses to voltage change, it is important to sample several different transformers. Also, because the makeup of electric load changes from season to season, it is necessary to make CVRf measurements at different times of the year. ADM conducted three separate rounds of testing in 2013 to measure the CVRf at different times of the year. Results from the three tests are used to support energy and demand impact assessments. Testing in 2012 was not possible given the constraint of producing load reductions during the top 100 hours of the summer in 2012.

The first round of testing occurred in Feb. 2013 and included 16 transformers. The transformers were alternated in CVR on and off modes remotely through SCADA controls in “week on / week off” schedules. Two alternate schedules were used to minimize the impact of exogenous effects on energy usage. The group of transformers on the first schedule exhibited a CVRf greater than 1.3, while the group on the second schedule exhibited a much lower CVRf of -0.4. One reason for the difference is the “signal to noise” ratio is rather low for this measure. Methods of enhancing signal to noise include increasing sample size, increasing experiment duration, and adding control groups to net out possible impacts from exogenous factors. ADM’s analysis incorporated all three approaches.

In spring and summer 2013, ADM conducted two more rounds of testing. These testing schemes employed alternating day-on / day-off voltage schedules, for a total of seven “CVR-on” days respectively for each of the spring and summer tests. The CVR factor (after DID corrections) for the spring tests was measured to be 1.17 – significantly higher than the 0.63 measured in winter, though with an 85% confidence interval spanning from 0.83 to 1.51. The high CVR factor spurred validation tests that included inspection of power and voltage data at the hourly level, alternate model specifications, and a sensitivity analysis of CVRf to the choice in cooling and heating degree day (CDD and HDD respectively) bases. Although the unadjusted results vary with respect to modeling choices, the net results from the DID approach were found to be relatively stable. Figure 2-2 shows the CVRf as a function of CDD and HDD. The results vary in a relatively narrow range over a wide range of parameter space.

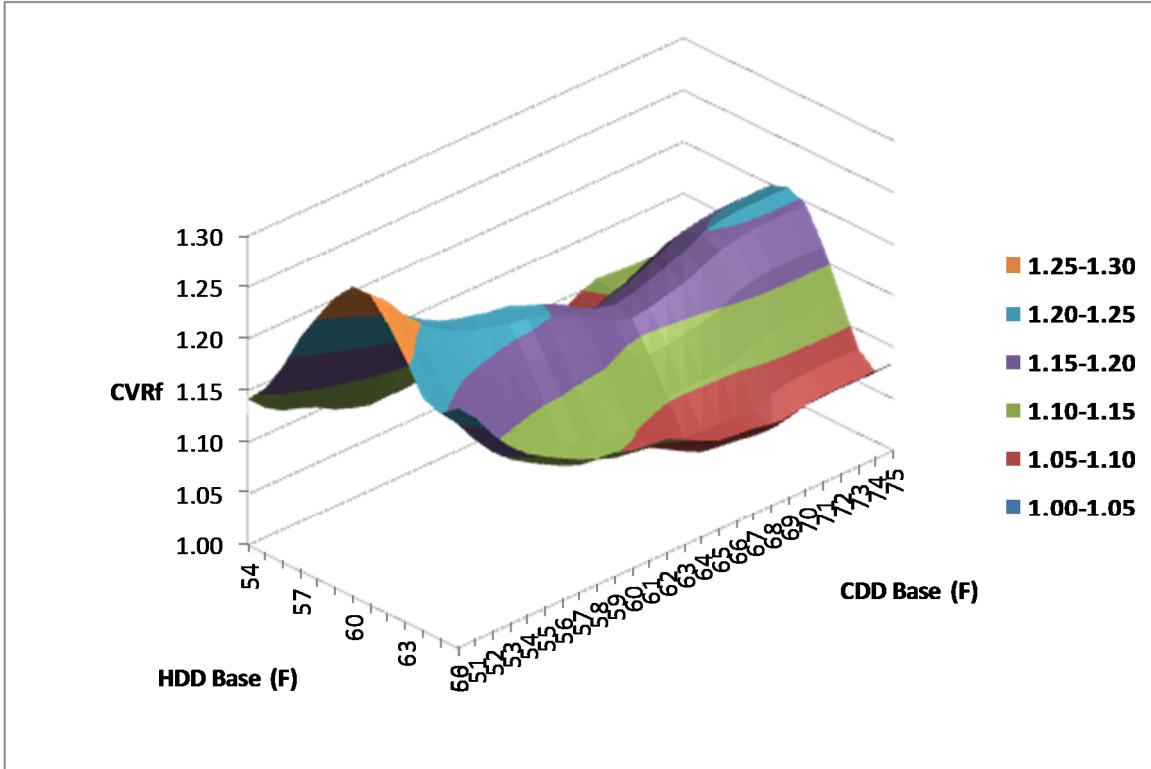


Figure 12-1. CVR voltage change for a transformer that was removed from the program August 22, 2012.

The summer tests included a larger sample of transformers, with 24 in the treatment group and 31 in the control group. The testing schedule was a day-on / day-off schedule, with a total of seven “CVR-on” days. The net CVRf for the summer testing period was 0.85, with an 85% confidence interval ranging from 0.65 to 1.5. ADM applied the winter CVRf of 0.63 for the months November through March, the summer CVRf of 0.85 for the months June through September, and the spring CVRf for the two “shoulder seasons”. An alternate approach would be to take the average of all three CVRf measurements as the annual value for CVRf. The alternate approach would result in nearly identical annual energy savings, but 4% higher demand reductions during summer.

Results are summarized in the following Table.

Season	CVRf	Relative Precision @85%CL	N Treat	N Control	Number of "On-CVR" Days	Type of Testing Scheme
Winter	0.64	29%	16	37	14	On-Week / Off-Week (2 offset schedules)
Spring	1.11	27%	17	39	7	On-Day / Off-Day
Summer	0.85	24%	24	31	7	On-Day / Off-Day
Total	0.86	15.7%			28	

Measurement of Annual Energy Savings

The weather normalized annual energy savings are calculated for all 56 transformers in the treatment and control groups⁴⁶. The energy savings are calculated for the 2011 and 2012 sets separately, as these groups comprise separate evaluation samples. Each transformer's daily average electric loads are multiplied by its measured voltage drop (or zero for the aforementioned 17 transformers that did not have ostensible voltage drops), and by the seasonal CVRf, and summed for all days from June 1 2012 to May 31 2013. The resulting energy savings for the 56 transformers are 38,578 MWh. These results are then weather normalized by modeling the total load of all 56 transformers as a function of CDD and HDD. The resulting model is then seeded with TMY3 weather data to form an adjusted number. Weather normalization resulted in a slight (0.25%) reduction in the annual electric loads, and in turn the energy savings. Note that there are 110 transformers in the CVR program. The extrapolation of impacts from the 56 transformers with MWh meters to the other 54 is discussed later in this section.

Top 100 Hour Demand Reductions

Measure the demand reduction in the top 100 hours of 2012. The demand reduction can be cast in the following form:

$$\Delta kW_{\text{Top100}} = kW_{\text{Top100}} \times \Delta V \times \text{CVRf}$$

Data from 58 transformers are used to calculate impacts during the top 100 hours of 2012. The impacts are cast as an hourly array and are aligned with the other Act 129 impacts to determine top 100 hour impacts.

⁴⁶ As previously discussed, two of the 58 transformers contribute to demand reductions only.

Extrapolation of Impacts to Non-Sampled Transformers

Out of the 110 transformers in the CVR program, 58 are equipped with recording power and voltage meters and “ratchet” demand meters that record only the peak load, in MVA, on the transformers. For these transformers, there is a linear relationship between ratchet load and annual energy usage⁴⁷. The remaining 52 transformers are equipped with ratchet demand meters. Therefore, linear scaling is used to impute results from the 58 MWh metered transfers to the 52 “ratchet metered” transformers. First, the average MWh savings per ratchet MW load is calculated for each group of sampled transformers (the 2011 and 2012 groups are considered as separate sampling strata). The energy savings for the ratchet metered transformers in the 2011 stratum is calculated as the product of the MWh Savings to ratchet MW ratio of the 2011 MWh metered transformers and the total ratchet MW of the 2011 ratchet metered group. A similar calculation yields the savings for the 2012 ratchet metered group.

Adjust for Line Losses

Reported energy savings must be at the customer meter while the demand reductions must be reported at the generator bus. Most of the transformers in the CVR program (approximately 85% when weighted by load) have transmission voltage (138kV) on the high side and a secondary voltage (12kV) on the low side. Therefore, one may expect that the average losses between the transformers and the customer meters would be the difference between system-wide average line losses (7.69%, when weighted by sales for all customer losses (Transmission, Subtransmission, Secondary, Primary) and the line losses for transmission customers (1.94%) or 5.75%. Therefore energy savings measured at the transformers are scaled down by a factor of 0.9425 to equate them to savings at the meter level.

Demand reductions, on the other hand, need to be scaled to the generator bus. To accomplish this, we first adjust the savings to the customer meter level, and then apply line losses consistent with what was performed for other energy efficiency or demand response programs reflecting losses that grow exponentially with load.

Allocate Savings to Sectors

To allocate savings to sectors for table 2-2, ADM referenced loads for residential, commercial, and industrial sectors in West Penn Power’s FERC Form 1 from Q4 of 2011. Additionally, the contribution to the low income sector is taken as the fraction of the residential low-income sector against the total customer population, which is approximately 10%. ADM assumed 10% of the non-residential load was

⁴⁷ Notable exceptions to this rule only involve cases where the scaling technique here would *underestimate* the transformer’s annual energy usage.

associated with government and non-profit sector. This is lower than West Penn Power’s actual Act 129 achievements for this sector, which are 24% of the portfolio level savings. The remaining savings are apportioned to small and large commercial sectors respectively in proportion to the ratio of commercial to industrial sectors as reported in FERC Form 1.

Table 12-1: CPITD CVR Program Reported Results by Quarter⁴⁸

Reporting Period	Participants	Reported Gross Energy Savings (MWh/yr)	Retail Level Reported Gross Demand Reduction (MW)	Generator Level Top 100 Reported Gross Demand Reduction (MW)	TRM Top 100 Verified Gross Demand Reduction (MW)	TRM Corrected Top 100 Verified Gross Demand Reduction (MW)	Evaluated Top 100 Verified Gross Demand Reduction (MW)	Incentives (\$1000)
PY4 Q1	n/a	13,123	9.49	11.38	11.38	11.38	11.38	\$ -
PY4 Q2	n/a	13,123						\$ -
PY4 Q3	n/a	13,123						\$ 2,583
PY4 Q4	n/a	13,123						\$ (2,583)
PY4 Total		52,492	9.49	11.38	11.38	11.38	11.38	\$ -
CPITD Total		52,492	9.49	11.38	11.38	11.38	11.38	\$ -

⁴⁸ For purposes of this report, all top 100 hour impacts are reported in PY4Q1.

Table 12-2: CVR Program Reported Results by Sector

Sector	Participants	Reported Gross Energy Savings (MWh/yr)	Top 100 Hours Reported Gross Demand Reduction (MW)	Total Reported Gross Demand Reduction (MW)	Incentives (\$1,000)
Residential	n/a	14,133	3.06	2.55	0
Low-Income	n/a	5,101	1.11	0.92	0
Small Commercial and Industrial	n/a	3,326	0.72	0.60	0
Large Commercial and Industrial	n/a	11,517	2.50	2.08	0
Government and Non-Profit	n/a	18,415	3.99	3.33	0
PY4 Total	n/a	52,492	11.38	9.49	0
CPITD Total	n/a	52,492	11.38	9.49	0

Table 12-3: CVR Program Sampling Strategy for PY4

Stratum	Strata Boundaries	Population Size	Assumed Coefficient of Variation (C _v) or Proportion in Sample Design	Target Levels of Confidence & Precision	Target Sample Size	Achieved Sample Size	Evaluation Activity
2011 MWh Meter	n/a	36	.5	25%	20	55 transformer-tests, 58 voltage inspections	DID Interval Meter Analysis Voltage Inspection
2012 MWh Meter	n/a	22	.5	25%	20		
2011 ratchet Meter	n/a	36	.5	25%	20	All	Impute data from 2011 MWh stratum
2012 ratchet Meter	n/a	16	.5	50%	n/a	all	Impute data from 2011 MWh stratum
Program Total		110		15%			

Table 12-4: PY4 CVR Program Summary of Evaluation Results for Energy

Stratum	Reported Gross Energy Savings	Energy Realization Rate	Observed Coefficient of Variation (C_v) or Proportion	Relative Precision	Verified Gross Energy Savings	Unverified Gross Energy Savings
2011 MWh Meter	28,841	89%	0.5	15%	25,812	
2012 MWh Meter	11,681	89%	0.5	15%	10,454	
2011 ratchet Meter	8,626	89%	n/a	17%	7,720	
2012 ratchet Meter	3,345	89%	n/a	21%	2,993	
Program Total	52,492	89%		16%	46,980	
*Relative precision includes contributions from sampling and measurement. Relative precision from sampling alone is under 15%						

The table below for demand reduction includes PYTD reported and verified demand reductions at the customer meter level for all impact evaluation sampling strata, and verified CPITD top 100-hour demand reductions at the generator level for the entire program.

Table 12-5: PY4 CVR Program Summary of Evaluation Results for Demand (Top 100 Hours) Stratum

Stratum	Reported Gross Demand Reduction	Demand Realization Rate	Observed Coefficient of Variation (Cv) or Proportion	Relative Precision	PYTD TRM Verified Gross Demand Reduction (MW) (Retail)	CPITD TRM Top 100 Verified Gross Demand Reduction (MW) (Generator)	CPITD TRM Corrected Top 100 Verified Gross Demand Reduction (MW) (Generator)	CPITD Evaluated Top 100 Verified Gross Demand Reduction (MW) (Generator)
2011-MWh Meter	5.55	89%	0.5	15%	4.97			
2011 - MIP Meter	2.15	89%	0.5	15%	1.92			
2012 - MWh Meter	1.64	89%	n/a	17%	1.47			
2012-MIP Meter	0.64	89%	n/a	21%	0.57			
Special - Top 100 Only	0.64	89%	0.5	15%	0.57			
Program Total	10.60	89%		16%	9.49	11.38	11.38	11.38

12.3 Impact Evaluation Net Savings

A net-to-gross assessment was not formally conducted for this program. A review of program logic and the difference in difference approach used to assess gross impacts indicate that the net to gross ratio should be 1.

12.4 Process Evaluation

No formal process evaluation was conducted for this program.

12.5 Financial Reporting

All program expenses were within approved budgets, and TRC results were within reasonable ranges. A breakdown of the program finances is presented in **Table 12-6**

Table 12-6: Summary of CVR Program Finances

	IQ (\$1,000)	PYTD (\$1,000)	CPITD (\$1,000)
EDC Incentives to Participants			
EDC Incentives to Trade Allies			
Subtotal EDC Incentive Costs			
Design & Development			
Administration ^[1]	\$ 767	\$ 792	\$ 880
Management ^[2]			
Marketing ^[3]	\$ 0	\$ 1	\$ 1
Technical Assistance	\$ 0	\$ 1	\$ 5
Subtotal EDC Implementation	\$ 768	\$ 794	\$ 887
EDC Evaluation Costs	\$ 24	\$ 27	\$ 29
SWE Audit Costs			
Total EDC Costs^[4]	\$ 791	\$ 821	\$ 916
Participant Costs^[5]			
Total TRC Costs^[6]	\$ 791	\$ 821	\$ 916
Total Lifetime Energy Benefits		\$ 40,088	\$ 40,088
Total Lifetime Capacity Benefits		\$ 7,590	\$ 7,590
Total TRC Benefits^[7]		\$ 47,678	\$ 47,678
TRC Ratio^[8]	N/A	58.08	52.04

NOTES

Per PUC direction, TRC inputs and calculations are required in the Annual Report only and should comply with the 2011 Total Resource Cost Test Order approved July 28, 2011. Please see the "Report Definitions" section of this report for more details.

[1] Includes the administrative CSP (rebate processing), tracking system, and general administration and clerical cost.

[2] Includes EDC program management, CSP program management, general management oversight, and major accounts.

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

[4] Per the 2011 Total Resource Cost Test Order, the Total EDC Costs refer to EDC incurred expenses only.

[5] Per the 2011 Total Resource Cost Test Order, the net Participant Costs are the costs for the end-use customer.

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

[7] Total TRC Benefits equals the sum of Total Lifetime Energy Benefits and Total Lifetime Capacity Benefits. Based upon verified gross kWh and kW savings. Benefits include: avoided supply costs, including the reduction in costs of electric energy, generation, transmission, and distribution capacity, and natural gas valued at marginal cost for periods when there is a load reduction.

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

13 Governmental & Institutional Program

This sector is eligible for all the incentive programs the small or large C/I sector is eligible for, including the Nonstandard Lighting, Heating Ventilating and Air-conditioning, Motors & Drives, Specialty Equipment and Custom. In March 2011, the Company received approval to enhance the program to include an opt-in CFL kit offering. Customers enrolled in this program were eligible to receive a single CFL kit or multiple CFL kits at no cost.

13.1 Program Updates

There were no changes to this program during PY4.

13.2 Impact Evaluation Gross Savings

The impact evaluation effort is identical to the 'Small Commercial/Industrial' program's effort, discussed in section 9.2.

Table 13-1: Governmental & Institutional Program Reported Results by Quarter⁴⁹

Reporting Period	Participants	Reported Gross Energy Savings (MWh/yr)	Retail Level Reported Gross Demand Reduction (MW)	Generator Level Top 100 Reported Gross Demand Reduction (MW)	TRM Top 100 Verified Gross Demand Reduction (MW)	TRM Corrected Top 100 Verified Gross Demand Reduction (MW)	Evaluated Top 100 Verified Gross Demand Reduction (MW)	Incentives (\$1000)
PY4 Q1	16	801	0.16	9.52	8.90	8.90	8.90	\$ 1,952
PY4 Q2	238	9,201	8.26	0.00	0.00	0.00	0.00	\$ 430
PY4 Q3	71	6,369	0.68	0.00	0.00	0.00	0.00	\$ 77
PY4 Q4	95	9,572	1.53	0.00	0.00	0.00	0.00	\$ 1,003
PY4 Total	420	25,943	10.63	9.52	8.90	8.90	8.90	\$ 3,462
CPITD Total	1,485	110,893	24.62	26.79	24.61	24.61	24.61	\$ 4,680

⁴⁹ For purposes of this report, all top 100 hour impacts are reported in PY4Q1.

Table 13-2: Government & Institutional Program Sampling Strategy for PY4

Stratum Name	Reported Savings	Gross	Strata Boundaries	Population Size	Assumed CV	Achieved Sample	Evaluation Activity
CFL0		0	2,200	0	0.5	0	n/a
CFL1		0	6,000	0	0.5	0	n/a
CFL2		0	n/a	0	0.5	0	n/a
NSL0		5,433,259	125,000	206	0.4	7	Desk Review, On-Site
NSL1		10,423,329	1,000,000	35	0.4	5	Desk Review, On-Site
NSL2		1,713,974	n/a	1	0.4	1	Desk Review, On-Site
SLB0		0	100,000	0	0.6	0	n/a
SLB1		0	500,000	0	0.6	0	n/a
SLB2		0	n/a	0	0.6	0	n/a
Prescriptive0		53,282	100,000	25	1.0	1	Desk Review, On-Site
Prescriptive1		0	500,000	0	1.0	0	n/a
Prescriptive2		0	n/a	0	1.0	0	n/a
Custom0		0	1	0	0.6	0	n/a
Custom1		4,958,471	750,000	66	0.6	3	Desk Review, On-Site
Custom2		2,728,416	n/a	3	0.6	3	Desk Review, On-Site
SAL0		632,513	999,999	7	0.4	2	Desk Review, On-Site
SAL1		0	99,999,999	0	0.4	0	n/a
SAL2		0	n/a	0	0.4	0	n/a
Total		25,943,243	n/a	343	n/a	22	

Table 13-3: PY4 Government & Institutional Program Summary of Evaluation Results for Energy

Stratum Name	Reported Gross Energy Savings	Realization Rate	Observed CV	Relative Precision	Verified Gross Energy Savings
CFL0	0	n/a	0.5	n/a	
CFL1	0	n/a	0.5	n/a	
CFL2	0	n/a	0.5	n/a	
NSL0	5,433,259	93%	0.4	21%	5,046,542
NSL1	10,423,329	76%	0.4	24%	7,903,466
NSL2	1,713,974	85%	0.4	0%	1,465,126
SLB0	0	n/a	0.6	n/a	
SLB1	0	n/a	0.6	n/a	
SLB2	0	n/a	0.6	n/a	
Prescriptive0	53,282	100%	1.0	141%	53,282
Prescriptive1	0	n/a	1.0	n/a	
Prescriptive2	0	n/a	1.0	n/a	
Custom0	0	n/a	0.6	n/a	
Custom1	4,958,471	81%	0.6	49%	4,009,334
Custom2	2,728,416	99%	0.6	0%	2,704,889
SAL0	632,513	103%	0.4	34%	649,488
SAL1	0	n/a	0.4	n/a	

SAL2	0	n/a	0.4	n/a	
Total	25,943,243	84%	n/a	13%	21,832,127

The table below for demand reduction includes PYTD reported and verified demand reductions at the customer meter level for all impact evaluation sampling strata, and verified CPITD top 100-hour demand reductions at the generator level for the entire program.

Table 13-4: PY4 Government & Institutional Program Summary of Evaluation Results for Demand

Stratum Name	Reported Gross Demand Savings (kW)	Realization Rate	Observed CV	Relative Precision	Verified Gross Demand Savings (kW)
CFL0	0	n/a	0.5	n/a	
CFL1	0	n/a	0.5	n/a	
CFL2	0	n/a	0.5	n/a	
NSL0	1,125	104%	0.4	21%	1,173
NSL1	5,090	103%	0.4	24%	5,239
NSL2	281	88%	0.4	0%	248
SLB0	0	n/a	0.6	n/a	
SLB1	0	n/a	0.6	n/a	
SLB2	0	n/a	0.6	n/a	
Prescriptive0	65	0%	1.0	141%	0
Prescriptive1	0	n/a	1.0	n/a	
Prescriptive2	0	n/a	1.0	n/a	
Custom0	0	n/a	0.6	n/a	
Custom1	3,684	76%	0.6	49%	2,800
Custom2	374	125%	0.6	0%	467
SAL0	9	92%	0.4	34%	9
SAL1	0	n/a	0.4	n/a	
SAL2	0	n/a	0.4	n/a	
Total	10,628	93%	n/a	19%	9,935
CPITD TRM Top 100 Verified Gross Demand Reduction (MW) (Generator)					24.61
CPITD TRM Corrected Top 100 Verified Gross Demand Reduction (MW) (Generator)					24.61
CPITD Evaluated Top 100 Verified Gross Demand Reduction (MW) (Generator)					24.61

13.3 Impact Evaluation Net Savings

See Section 9. Commercial/Industrial Small Sector Equipment.

13.4 Process Evaluation

Tetra Tech conducted a telephone survey of the C&I and Government and Institutional Equipment programs participants from Program Year 3 in conjunction with the net-to-gross research. Process and net-to-gross evaluations were completed for these sectors overall because the programs were designed, marketed, and operated essentially the same and participation was limited at the small, large, and government/non-profit sectors at the time of the evaluation effort. In Phase II, this will be reviewed and consideration given to an expanded effort, or separate efforts, if warranted.

Evaluation Methodology

See Section 9. Commercial/Industrial Small Sector Equipment.

Key Findings

See Section 9. Commercial/Industrial Small Sector Equipment.

Table 13-5: Status Report for Process Evaluations

Recommendations	EDC Status Report for Process Evaluations (Implemented, Being Considered, Rejected AND Explanation of Action Taken by EDC)
Government and Institutional	
See Section 9. Commercial/Industrial Small Sector Equipment	

13.5 Financial Reporting

All program expenses were within approved budgets, and TRC results were within reasonable ranges. A breakdown of the program finances is presented in Table 13-6.

Table 13-6 Summary of Government & Institutional Program Finances

	IQ (\$1,000)	PYTD (\$1,000)	CPITD (\$1,000)
EDC Incentives to Participants	\$1,003	\$3,462	\$4,680
EDC Incentives to Trade Allies			
Subtotal EDC Incentive Costs	\$1,003	\$3,462	\$4,680
Design & Development			\$111
Administration ^[1]	\$21	\$77	\$483
Management ^[2]			
Marketing ^[3]	\$39	\$60	\$212
Technical Assistance	\$221	\$526	\$884
Subtotal EDC Implementation Costs	\$281	\$663	\$1,690
EDC Evaluation Costs	\$32	\$50	\$296
SWE Audit Costs			
Total EDC Costs^[4]	\$1,317	\$4,175	\$6,666
Participant Costs^[5]		\$24,882	\$45,614
Total TRC Costs^[6]	\$313	\$25,595	\$47,600
Total Lifetime Energy Benefits		\$18,621	\$62,134
Total Lifetime Capacity Benefits		\$7,943	\$11,749
Total TRC Benefits^[7]		\$26,565	\$73,884
TRC Ratio^[8]		1.04	1.55

NOTES

Per PUC direction, TRC inputs and calculations are required in the Annual Report only and should comply with the 2011 Total Resource Cost Test Order approved July 28, 2011. Please see the "Report Definitions" section of this report for more details.

[1] Includes the administrative CSP (rebate processing), tracking system, and general administration and clerical cost.

[2] Includes EDC program management, CSP program management, general management oversight, and major accounts.

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

[4] Per the 2011 Total Resource Cost Test Order, the Total EDC Costs refer to EDC incurred expenses only.

[5] Per the 2011 Total Resource Cost Test Order, the net Participant Costs are the costs for the end-use customer.

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

[7] Total TRC Benefits equals the sum of Total Lifetime Energy Benefits and Total Lifetime Capacity Benefits. Based upon verified gross kWh and kW savings. Benefits include: avoided supply costs, including the reduction in costs of electric energy, generation, transmission, and distribution capacity, and natural gas valued at marginal cost for periods when there is a load reduction.

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

14 Time of Use (TOU) with Critical Peak Pricing (CPP) Rate

The TOU program rates reflect the cost of serving customers during different time periods, but do not change as frequently as hourly. TOU encourages commercial, industrial, government, school, and non-profit customers under 500 kW to lower their demand and energy consumption during on-peak periods by charging a higher price that reflects the higher cost of serving customers, and charging lower prices during off-peak periods that reflects the lower cost of serving customers. TOU also includes critical peak pricing that is designed to address the short-term need to reduce demand at the time of the system peak by charging prices significantly higher than on-peak periods. Critical peak pricing periods will vary in frequency and duration using predefined or notified peak hours, but will balance the need to keep the period as short as possible to effectively allow customers to reduce demand or shift usage to lower cost periods. TOU is voluntary and is only available to customers that are receiving utility-provided default service. TOU relies on a smart meter to measure the customer's demand and energy usage during the various TOU periods.

14.1 Program Updates

This program was not implemented.

14.2 Impact Evaluation Gross Savings

An Impact Evaluation was not conducted

14.3 Impact Evaluation Net Savings

Net To Gross research was not conducted

14.4 Process Evaluation

Process Evaluation was not conducted

14.5 Financial Reporting

A breakdown of the program finances is presented in Table 14-1

Table 14-1: Summary of Program Finances

	IQ (\$1,000)	PYTD (\$1,000)	CPITD (\$1,000)
EDC Incentives to Participants			
EDC Incentives to Trade Allies			
Subtotal EDC Incentive Costs			
Design & Development			\$ 6
Administration ^[1]	\$ 2	\$ 9	\$ 55
Management ^[2]			
Marketing ^[3]	\$ 0	\$ 0	\$ 17
Technical Assistance	\$ 0	\$ 0	\$ 28
Subtotal EDC Implementation Costs	\$ 2	\$ 10	\$ 106
EDC Evaluation Costs	\$ 33	\$ 43	\$ 62
SWE Audit Costs			
Total EDC Costs^[4]	\$ 35	\$ 54	\$ 168
Participant Costs^[5]			
Total TRC Costs^[6]	\$ 35	c 54	\$ 168
Total Lifetime Energy Benefits			
Total Lifetime Capacity Benefits			
Total TRC Benefits^[7]	N/A		
TRC Ratio^[8]	N/A	0	0

NOTES

Per PUC direction, TRC inputs and calculations are required in the Annual Report only and should comply with the 2011 Total Resource Cost Test Order approved July 28, 2011. Please see the "Report Definitions" section of this report for more details.

[1] Includes the administrative CSP (rebate processing), tracking system, and general administration and clerical cost.

[2] Includes EDC program management, CSP program management, general management oversight, and major accounts.

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

[4] Per the 2011 Total Resource Cost Test Order, the Total EDC Costs refer to EDC incurred expenses only.

[5] Per the 2011 Total Resource Cost Test Order, the net Participant Costs are the costs for the end-use customer.

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

[7] Total TRC Benefits equals the sum of Total Lifetime Energy Benefits and Total Lifetime Capacity Benefits. Based upon verified gross kWh and kW savings. Benefits include: avoided supply costs, including the reduction in costs of electric energy, generation, transmission, and distribution capacity, and natural gas valued at marginal cost for periods when there is a load reduction.

[10] TRC Ratio equals Total TRC Benefits divided by Total TRC Costs.

15 Customer Load Response Program

This program will supply Company assistance by providing load management services by actively educating and providing assistance with the transition to market prices, load shaping, and participation in PJM markets. Contracting with customers for load reduction as well as assisting customers with entry into the real time energy markets will help control the demand during peak hours. A customer who participates in this program will receive incentives based on their actual hourly load reduction from their calculated baseline during events called by the Company for the top 100 hours of load reduction. Customers will have flexibility in selecting how many hours that they can participate with 50 hours being typical.

15.1 Program Updates

There were no program updates to this program in PY4.

15.2 Impact Evaluation Gross Savings

An Impact Evaluation was not conducted

15.3 Impact Evaluation Net Savings

Net To Gross research was not conducted

15.4 Process Evaluation

Process Evaluation was not conducted

15.5 Financial Reporting

A breakdown of the program finances is presented in Table 15-1.

Table 15-1 Summary of Customer Load Program Finances

	IQ (\$1,000)	PYTD (\$1,000)	CPITD (\$1,000)
EDC Incentives to Participants			\$ 15
EDC Incentives to Trade Allies			
Subtotal EDC Incentive Costs			\$ 15
Design & Development			\$ 88
Administration ^[1]	\$ 4	\$ 21	\$ 11
Management ^[2]			
Marketing ^[3]	\$ 0	\$ 1	\$ 3
Technical Assistance	\$ 0	\$ 1	\$ 130
Subtotal EDC Implementation Costs	\$ 4	\$ 23	\$ 232
EDC Evaluation Costs	\$ 8	\$ 10	\$ 25
SWE Audit Costs			
Total EDC Costs^[4]	\$ 13	\$ 33	\$ 271
Participant Costs^[5]			
Total TRC Costs^[6]	\$ 13	\$ 33	\$ 271
Total Lifetime Energy Benefits		0	0
Total Lifetime Capacity Benefits		0	0
Total TRC Benefits^[7]	N/A	0	0
TRC Ratio^[8]	N/A	0	0

NOTES

Per PUC direction, TRC inputs and calculations are required in the Annual Report only and should comply with the 2011 Total Resource Cost Test Order approved July 28, 2011. Please see the "Report Definitions" section of this report for more details.

[1] Includes the administrative CSP (rebate processing), tracking system, and general administration and clerical cost.

[2] Includes EDC program management, CSP program management, general management oversight, and major accounts.

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

[4] Per the 2011 Total Resource Cost Test Order, the Total EDC Costs refer to EDC incurred expenses only.

[5] Per the 2011 Total Resource Cost Test Order, the net Participant Costs are the costs for the end-use customer.

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

[7] Total TRC Benefits equals the sum of Total Lifetime Energy Benefits and Total Lifetime Capacity Benefits. Based upon verified gross kWh and kW savings. Benefits include: avoided supply costs, including the reduction in costs of electric energy, generation, transmission, and distribution capacity, and natural gas valued at marginal cost for periods when there is a load reduction.

[10] TRC Ratio equals Total TRC Benefits divided by Total TRC Costs.

APPENDIX A: Evaluation: Residential Lighting Top 100 Hour Contributions

Overview - Top 100 Hour Demand Calculations

The top 100 hour calculations for all demand response and energy efficiency programs are calculated in accordance with Section 4 of the 2012 PA TRM⁵⁰. To more accurately depict the load reductions associated with residential lighting, the Company presented additional evaluated load reductions for limited applicability during the top 100 hours of PY4. The additional evaluation results are referenced throughout this report as “Adjusted Top 100 hours MW Achieved”

Consistent with language in the TRMs supporting alternative evaluation methodologies⁵¹, ADM Associates developed evaluation methodology for residential lighting very similar to that outlined in the SWE’s guidance memo GM-004 for peak demand reduction calculations for nonresidential lighting. The approach used by West Penn Power for top 100 hour calculations is also in close alignment with updated protocols in the proposed 2014 TRM. Peak load reduction contributions of CFLs during the top 100 hours identified in accordance with Section 4 of the 2012 PA TRM are 24.6MW, based on evaluation results.

The evaluation approach:

- a) Uses residential lighting load shapes and actual top 100 hours for the West Penn Power system to define contributions of residential lighting during the summer of 2012,
- b) Includes the impact of lighting load reduction on cooling (i.e., interactive effects).

Guidance Memo GM-004

This memo was released by SWE in February 22, 2011, specifically to address the measurement of coincidence factor as it pertains to the top 100 demand reduction target. The memo states:

“Act 129 requires reduction of “annual system peak demand in the 100 hours of highest demand.” Because it is impossible to predict a priori the 100 hours of highest demand in any future year, the PA

⁵⁰ Consistent with Section 1.8 of the State of Pennsylvania’s *Technical Reference Manual*, published June 2012 allowing for correction or clarification of the TRM, the Company’s demand reduction impacts in this Annual Report listed as “TRM Corrected Top 100 Hour MW Achieved” are calculated with a CFL coincidence factor of 8.8% for all residential CFLs installed in Phase I, unless otherwise noted. This 8.8% coincidence factor corrects the inaccurately referenced value (5%) from the TRM source document, *RLW Analytics, “Development of Common Demand Impacts for Energy Efficiency Measures/Programs for the ISO Forward Capacity Market (FCM)”, prepared for the New England State Program Working Group (SPWG), March 25, 2007, p. IV*. Demand Reduction impacts calculated with the published 5% coincidence factor are referred to as “TRM Top 100 Hour MW Achieved.”

⁵¹ 2012 TRM Section 1.1: “The algorithms and methodologies set forth in this document must be used to determine EDC reported gross savings and evaluation measurement and verification (EM&V) verified savings, unless an alternative measurement approach or custom measure protocols is submitted and approved for use.”

TRM 2010 (hereafter referred to as the TRM) has established a period of 12pm to 8pm, weekdays from June through September as a proxy to represent the 100 hours of highest demand for calculating the Coincident Peak Demand Savings. The TRM does not, however, describe how to use this proxy period to calculate the peak demand for the baseline and efficient measures for calculating the Coincident Peak Demand Savings. “

The memo blends load shapes⁵² for lighting energy savings with likelihoods of top 100 hour loads for the hours of noon to 8 PM. The primary application of the memo is for large non-residential lighting projects where a coincidence factor is not provided by the TRM, but is often determined by metering lighting hours of usage.

Lighting Energy Efficiency Evaluation Best Practices

For these large lighting projects, the PA TRM (as supplemented by GM-004) accurately reflects peak demand reductions. The accuracy of the PA Act 129 protocols for nonresidential lighting projects that require site-specific data collection for hours of use and coincidence factor determination is attributable to the following factors:

1. As outlined in GM-004, the evaluation requires the construction of lighting load shapes
2. The evaluation protocol accounts for additional peak demand reductions for air conditioning associated with the reduction of “waste heat” generated by inefficient lighting fixture.

The above two attributes are considered to be best practices in the evaluation of demand impacts for all lighting measures Table 15-2. Summary of selected residential lighting evaluation protocols compares several evaluation protocols and technical resource manuals. Starting in 2014, the residential lighting demand reduction evaluation protocols in the PA TRM will be aligned with authoritative sources such as PJM, the Uniform Methods Projects, and, California’s Database for Energy Efficiency Resources.

⁵² A load shape as discussed in this document can be an End Use Load Shape or a Savings Load Shape. An End Use Load Shape is often normalized and reflects the likelihood that electric energy is utilized in a given hour for an end use. For lighting fixture retrofits, a given End Use Load Shape element is simply the likelihood that the light fixtures are utilized in the corresponding hour. In other words, it is the array of hourly coincidence factors. A Savings Load Shape has unit of energy and is the product of an End Use Load Shape and a connected load reduction. For example, if a 60W residential lamp has a 10% chance of being utilized in the hour ending 6 PM, then the End Use Load Shape element for that hour will be 0.1. If that lamp is replaced with a 15W CFL, then the Savings Load Shape element for that hour is $0.1 \times (60 \text{ W} - 15 \text{ W}) = 4.5 \text{ Watt-hours}$. Given that the two lamps in this example have comparable light outputs, essentially all of this energy difference ends up in the infrared radiation spectrum, this the term *waste heat*.

Table 15-2. Summary of selected residential lighting evaluation protocols

Evaluation Protocol	Uses Lighting Load Shape?	Use Waste Heat Factor for Demand?
PJM Manual 18b	Yes	Yes
Database for Energy Efficiency Resources (DEER, CA TRM)	Yes	Yes
Regional Technical Forum (RTF)	Yes	Yes, uses DEER simulation results
Uniform Methods Project	Possible	Yes
PA TRM 2009-2013	Yes	No
PA Proposed TRM 2014	Yes	Yes

West Penn Power’s evaluation of top 100 hour demand reduction impacts from residential CFLs uses the algorithm from the proposed 2014 PA TRM:

$$\Delta kW_{peak} = [(Watts_{base} - Watts_{CFL}) / 1000] \times (1 + IE_{kW}) \times CF \times ISR_{CFL}$$

Definition of Terms

$Watts_{base}$ = Wattage of baseline case lamp/fixture. For general service lamps prior to EISA 2007 standards, use equivalent incandescent bulb wattage. For general service lamps past EISA 2007 standards, use new standards to determine wattage.

$Watts_{CFL}$ = Wattage of CFL

IE_{kW} = HVAC Interactive Effect for demand

ISR_{CFL} = In-service rate per CFL

CF = Demand Coincidence Factor

Table 15-3. Summary of CFL Demand Reduction Calculation

Component	Type	Value	Sources
Watts _{base}	Variable	No change from TRM methods	
Watts _{CFL}	Variable	No change from TRM methods	Data Gathering
IF _{kw}	Variable	36%	Energy Plus simulations, diversified and calibrated to West Penn Power cooling End Use Load Shapes
ISR _{CFL}	Fixed	No change from Phase I TRM value of 84%	
CF	Calculated over West Penn's top 100 hours	11.77%	NMR/GDS/RLW NE 2009 Metering Study

CFL Load Shape

Several residential lighting metering studies were studied to find an appropriate end use load shape for residential CFLs. The studies are summarized below.

2009 Northeast Metering Study by NMR, RLW, and GDS

This study⁵³ metered 157 homes (657 loggers) in four states. The very large sample size enables the establishment of separate shapes for June, July, and August. It is noteworthy that this is the study that is cited for the 2.8 hours per day hours of use in the 2013 PA TRM and in the proposed 2014 TRM.

CA 2005 and 2010 CFL Metering Studies by KEMA and Cadmus

The residential lighting load shape has been metered extensively in the California CFL studies of 2005 and 2010. The 2005 study⁵⁴ installed meters in 375 homes while the 2010 study⁵⁵ installed meters in over 1200 homes. The load shape from the 2008 study is published in the report and is also available through California's DEER database. The sinusoidal fit that depicts the seasonality in CFL utilization is available from the 2010 metering study, but the report does not include an hourly load shape.

⁵³ *Residential Lighting Markdown Impact Evaluation* Nexus Market Research, RLW Analytics, and GDS Associates, <http://www.env.state.ma.us/dpu/docs/electric/09-64/12409nstrd2ae.pdf>

⁵⁴ *CFL Metering Study, Final Report* Prepared for PG&E, SGH&E, and SCE by KEMA.

⁵⁵ *Final Evaluation Report: Upstream Lighting Program Volume 1* Prepared for the CPUC Energy Division by KEMA

DEER 2008 Load Shape

The DEER 2008 CFL load shape results from adding heating and waste heat factors (IE_{kw}) to the KEMA 2005 load shape. Though inclusion of waste heat factor does boost peak demand savings by approximately 37%, the HCIF factors in DEER are specific to California’s air conditioning stock and climate. It is not assumed that the same HCIF can be applied to PA, although independent simulations and engineering calculations show that the IE_{kw} will result in a similar increase in peak demand reductions for West Penn Power participants during the top 100 hours in 2012.

Combination of the 2005/2010 Load Shapes by ADM

ADM has constructed a load shape that combines the hourly characteristics from the KEMA 2005 study with the sinusoidal profile taken from the KEMA 2010 report. The sinusoidal seasonal profile tends to increase usage in winter, and decrease usage in summer. The 2010 study shows lower lighting utilization in the summer period than the 2005 study. However, both studies support similar coincidence factors provided the load shapes are scaled to the same annual hours of use. This savings profile is essentially identical to the KEMA 2005 savings profile as far as summer top 100 hours impacts are concerned.

EMPower MD Residential Lighting Load Shape by Cadmus and Navigant

This study occurred in two waves, with 61 homes metered in June through October 2010 and 70 homes metered in June-September 2011. A total of 377 lighting loggers provided data for this study. Although the study is nearby and recent (and results in more than 3 hours/day CFL usage), it is by far the smallest study in terms of sample size.

The four available load shapes are summarized in *Table 15-4* below.

Table 15-4. Summary of relevant residential lighting load shapes

Load Shape Source	# Homes/# Loggers	Average Top 100 Coincidence Factor for 5 EDCs	Notes
DEER 2008 (J.J. Hirsch)	375/983	15.47%	IF_{kw} added by DOE2 simulations
Northeast 2009 (NMR/GDS/RLW)	157/657	11.84%	No IF_{kw} ; Source for 2.8 hours/day in 2013 TRM
CA 2005 (KEMA/Cadmus)	375/983	11.28%	No IF_{kw}
EMPower MD (Navigant/Cadmus)	131/377	8.60%	No IF_{kw}

West Penn Power uses the load shape from the NMR/GDS/RLW metering study from 2009 because it is based on a large and reputable metering study and because the data collection was recent and in a geographical area that is more closely aligned with Pennsylvania.

West Penn Power Specific Waste Heat Factor

The incremental demand reductions from cooling interaction are an important aspect of the overall CFL impacts. In CA, the DEER database update team has devoted considerable resources to calibrated simulations in DOE2. These simulations predict a 37% increase in demand reductions due to the interaction between lighting and cooling in the residential sector.

ADM developed a prototypical single family residence energy simulation in the EnergyPlus simulation framework. The prototypical model was developed based on data collected by the statewide evaluator (SWE) and presented in the *Pennsylvania Statewide Residential End-Use and Saturation Study*. Additional parameters were informed by the *Buildings Energy Data Book*, which is maintained by the US Department of Energy, and the residential prototypical models published by EnergyPlus. In addition to the data sources mentioned above, ADM utilized in-situ operating data for 16,000 participants in West Penn Power's residential demand reduction program to calibrate the prototypical model. Table 15-5 summarizes the main simulation inputs used in the residential prototypical model.

Although there is a single prototype, ADM achieved diversification by using several alternative HVAC and occupancy schedules, while keeping the cooling energy usage profile calibrated to primary data collected from West Penn Power's IDER program participants. The Energy Plus simulation engine is capable of performing hourly, and sub-hourly calculations. Hourly resolution is needed to characterize the dynamic nature of the waste heat interactive effect. The IF_{kw} factor, as determined by Energy Plus, is not a scalar multiplier, but is rather an hourly vector. This vector is combined with the CFL load shape to develop the top 100 hour impacts for residential lighting.

Table 15-5. Summary of ADM Simulation Inputs

Parameter	Value	Source
A/C Efficiency (SEER)	10.65	SWE Baseline Study (average for FirstEnergy EDCs)*
Wall Insulation R-Value	R-15	SWE Baseline Study (average for FirstEnergy EDCs)
Roof Insulation R-Value	R-26	SWE Baseline Study (average for FirstEnergy EDCs)
Floor Insulation R-Value	R-16	SWE Baseline Study (average for FirstEnergy EDCs)
Aspect Ratio	1.8:1	Residential EnergyPlus models developed for www.energycodes.gov
Square Footage	1,946	SWE Baseline Study (average for FirstEnergy EDCs)
Number of Occupants	2.4	SWE Baseline Study (average for FirstEnergy EDCs)
CFL Power Density	2 W/m ²	Engineering assumption based on experience*
Equipment Power Density	7 W/m ²	Engineering assumption based on experience*
Ventilation	Natural	Engineering assumption. **
Note that in large part the absolute magnitude of these parameters is less important than the shape of their hourly schedules (as it is the schedules that in large part dictate the end-use's coincidence with the air-conditioning equipment).		
Ventilation in the model is provided by windows opening when OA enthalpy is less than indoor enthalpy, the system is not running, and the OA temperature is within an appropriate range.		

Calculation of Incremental Savings from CFL Impact Assessment

To calculate the full contribution of residential CFLs to the top 100 hour compliance goal, all verified demand reductions from residential programs are multiplied by the ratio of the new coincidence factor (adjusted down to 15% for simplicity, which includes IF_{kW}) to the TRM's CF. The top 100 hour contributions from programs involving CFLs are reflected in the corresponding evaluated program results.

APPENDIX B: CFL Cross-Sector Sales

Impact of Cross Sector Sales

It is well known and reasonable that some CFLs in the upstream programs are purchased and installed in nonresidential settings. As a result, these CFLs experience higher annual hours of use and higher peak demand impacts. ADM conducted a “random digit dial” (RDD) telephone survey for residential customers to assess the impact of cross sector sales.

The extrapolation from the residential surveys is straightforward. Out of 827 respondents (12,232 CFLs over the last two years), 23 reported installing a total of (579) CFLs in commercial settings. The fraction of CFLs that are installed in commercial settings is $579/12,232=4.89$.

There are incremental demand reductions and incremental energy savings associated with the crossover of CFLs from the residential sector to the nonresidential sector. West Penn Power has not reported revised energy savings impacts for cross sector sales at this time. However, recognition of cross sector sales is necessary to report the full demand reduction impact of the upstream residential CFLs during the top 100 hours of 2012. The demand coincidence factor for CFLs rebated in the upstream program that crossed over to the nonresidential sector is 54%, and is taken from the PY3 metering and evaluation effort for nonresidential CFLs. Additionally, based on the facility types that the CFLs were reported to be installed in the surveys, ADM determined that at least 72% of the CFLs were installed in air conditioned spaces. The 2012 TRM’s demand interactive factor IF_{kw} (34%) as listed in Table 3-5 is applied to this portion of the CFLs.