WEST PENN POWER COMPANY
PROGRAM YEAR 6
ANNUAL REPORT

Program Year 6: June 1, 2014 – May 31, 2015

Presented to:

PENNSYLVANIA PUBLIC UTILITY COMMISSION

Pennsylvania Act 129 of 2008
Energy Efficiency and Conservation Plan

Prepared for:

West Penn Power Company

Docket No. M-2012-2334398

November 16, 2015

Prepared by:

ADM Associates, TetraTech MA, and West Penn Power Company

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ACRONYMS

C&I	Commercial and Industrial
CFL	Compact Fluorescent Lamp
Phase II Verified / (Phase II-VG)	Verified/ Ex-post Cumulative Program/Portfolio Phase II Inception to Date
Phase II Reported	Reported/ Ex-ante Cumulative Program/Portfolio Phase II Inception to Date
Phase II+CO	Cumulative Program/Portfolio Phase II Inception to Date including Carry Over Savings from Phase I (this is cumulative Phase II verified savings)
CSP	Conservation Service Provider or Curtailment Service Provider
DR	Demand Response
EDC	Electric Distribution Company
EE&C	Energy Efficiency and Conservation
EM&V	Evaluation, Measurement, and Verification
GNI	Government, Nonprofit, and Institutional
HVAC	Heating, Ventilating, and Air Conditioning
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
PUC	Pennsylvania Public Utility Commission
PY5	Program Year 2013, from June 1, 2013 to May 31, 2014
PY6	Program Year 2014, from June 1, 2014 to May 31, 2015
PY7	Program Year 2015, from June 1, 2015 to May 31, 2016
PY8	Program Year 2016, from June 1, 2016 to May 31, 2017
PYX QX	Program Year 6, Quarter X
PYTD	Program Year to Date
SEER	Seasonal Energy Efficiency Rating
SWE	Statewide Evaluator
TRC	Total Resource Cost
TRM	Technical Reference Manual

REPORT DEFINITIONS

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

REPORTING PERIODS

Phase I
Refers to the Act 129 programs implemented prior to June 1, 2013. Phase I carryover references verified gross Phase I savings in excess of Act 129 Phase I targets.

Phase II
Refers to the period of time from the start of Phase II Act 129 programs on June 1, 2013 through May 31, 2016. Phase II savings are calculated by totaling all program year results, including the current program year-to-date results and subtracting any Phase II savings that expired during the current program year. For example, Phase II results for PY7 Q3 is the sum of PY5, PY6, PY7 Q1, PY7 Q2, and PY7 Q3 results, minus any Phase II savings that expired during PY5, PY6 or PY7.

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 PY7 Q3 will include only results that occurred during PY7 Q1, PY7 Q2, and PY7 Q3; they will not include results from PY5 or PY6.

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 electric distribution company [EDC] or the program implementer). Also known as ex-ante, or "before the fact" savings (using the annual evaluation activities as the reference point for the post period).

Adjusted Ex-ante Gross
References to Adjusted Ex-ante Gross (or Adjusted Ex-ante) savings in this report refer to reported gross savings from the EDC's tracking system that have been adjusted, where necessary, to reflect differences between the methods used to record and track savings and the methods in the Technical Reference Manual (TRM), or to correct data capture errors. These corrections are made to the population, prior to EM&V activities. The adjusted ex-ante gross savings are then verified through EM&V activities.

Verified Gross
Refers to the verified gross savings results of the program or portfolio determined by the evaluation activities. Also known as ex-post, or "after the fact" savings (using the annual evaluation activities as the reference point for the post period).

Verified Net
The total change in load that is attributable to an energy efficiency program. This change in load may include, implicitly or explicitly, the effects of spillover, free-riders, energy efficiency standards, changes in the level of energy service, and other causes of changes in energy consumption or demand. Net savings are calculated by multiplying verified savings by a net-to-gross (NTG) ratio.

TOTAL RESOURCE COST COMPONENTS[1]

Administration, Management, and Technical Assistance Costs

Includes rebate processing, tracking system, general administration, EDC and CSP program management, general management and legal, and technical assistance.

EDC Costs

Per the Pennsylvania PUC 2013 Total Resource Cost (TRC) Test Order, the total EDC costs refer to EDC-incurred expenditures only. This includes, but is not limited to, administration, management, technical assistance, design & development of EE&C Plans and programs, marketing, evaluation, and incentives.

Participant Costs

Participant Costs as defined by the 2013 Total Resource Cost Test Order.

Total TRC Costs

Total TRC Costs as defined by the 2013 Total Resource Cost Test Order.

Total TRC Benefits

Benefits as defined by the 2013 Total Resource Cost Test Order.

[1] All Total Resource Cost definitions are subject to the Pennsylvania PUC 2013 Total Resource Cost Test Order.

1 OVERVIEW OF PORTFOLIO

Pennsylvania Act 129 of 2008, which was signed on October 15, 2008, mandated energy savings and demand reduction goals for the largest electric distribution companies (EDCs) in Pennsylvania for Phase I (2008 through 2013). In 2009, each EDC submitted energy efficiency and conservation (EE&C) plans pursuant to these goals, which were approved by the Pennsylvania Public Utility Commission (PUC). Each EDC filed new EE&C plans with the PUC in 2012 for Phase II (June 2013 through May 2016) of the Act 129 programs. These plans were approved by the PUC in 2013.

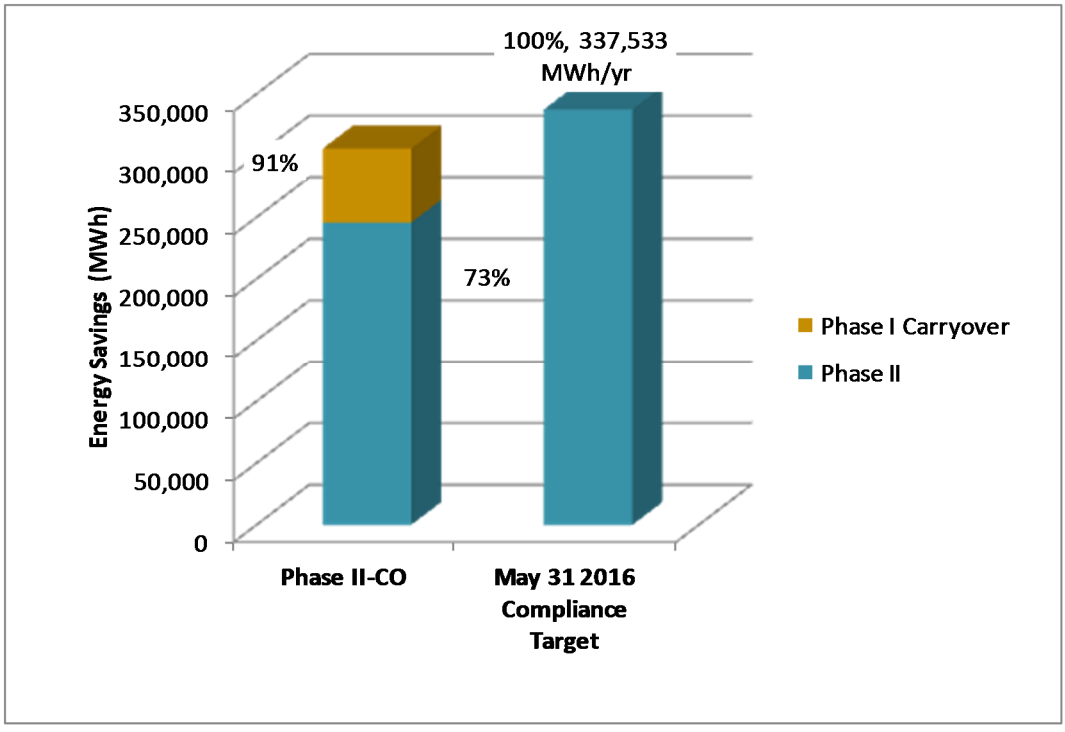
Implementation of Phase II Act 129 programs began June 1, 2013. This report documents the progress and effectiveness of the Phase II EE&C accomplishments for West Penn Power Company (West Penn Power or Company) in Program Year 6 (PY6), defined as June 1, 2014 through May 31, 2015, as well as the cumulative accomplishments of the programs since inception of Phase II. This report additionally documents the energy savings carried over from Phase I. The Phase I carry-over savings count toward EDC savings compliance targets for Phase II.

ADM Associates evaluated the programs, which included measurement and verification of the savings.

1.1 SUMMARY OF PROGRESS TOWARD COMPLIANCE TARGETS

West Penn Power has achieved 91 percent of the energy savings compliance target, based on cumulative portfolio Phase II inception to date including carryover savings from Phase I ("Phase II+CO") verified gross energy savings, as shown in Figure 1-1.

Figure 1-1: Cumulative Portfolio Phase II Inception to Date Verified Gross Energy Impacts



According to the Phase II Implementation Order, West Penn Power is allowed by the PUC to "carry over" into Phase II the Phase I verified energy savings that exceeded the Phase I compliance target. Table 1-1 shows the incremental annual MWh savings from Phase I West Penn Power that are carrying over into

Phase II. Table 1-2 shows the lifetime MWh savings from Phase I West Penn Power that are carried over into Phase II.

Table 1-1: Phase II Verified Gross Savings and Verified Gross Savings from PY4 Carried Into Phase II

Sector	PYTD Verified Gross Savings (MWh)	Phase II Verified Gross Savings (Cumulative Phase II MWh/Yr)	Verified Gross Savings Carried Over from Phase 1 (Cumulative Annual MWh/Yr)	Phase II+CO Verified Gross Savings (Cumulative MWh/Yr)
Residential (non Low Income)	80,228	135,519	NA	135,519
Residential (Low Income)	1,743	3,465	NA	3,465
Total Residential (Non Low Income Plus Low Income)	81,971	138,984	0	138,984
Commercial and Industrial	60,997	87,575	0	87,575
GNI	12,059	19,301	59,929	79,230
Total	155,026	245,859	59,929	305,788

Table 1-2: Phase II Verified Gross Lifetime Savings and Verified Gross Lifetime Savings from PY4 Carried Into Phase II

Sector	PYTD Verified Gross Savings (Lifetime MWh)	Phase II Verified Gross Savings (Lifetime MWh)	Verified Gross Savings Carried Over from Phase 1 (Lifetime MWh)	Phase II+CO Verified Gross Savings (Lifetime MWh)
Residential (non Low Income)	342,436	791,693	NA	791,693
Residential (Low Income)	11,523	24,049	NA	24,049
Total Residential (Non Low Income Plus Low Income)	353,959	815,741	0	815,741
Commercial and Industrial	726,656	1,083,911	0	1,083,911
GNI	150,224	230,345	747,715	978,060
Total	1,230,840	2,129,997	747,715	2,877,712

Table 1-3: Phase II Verified Net Savings and Verified Net Savings from PY4 Carried Into Phase II

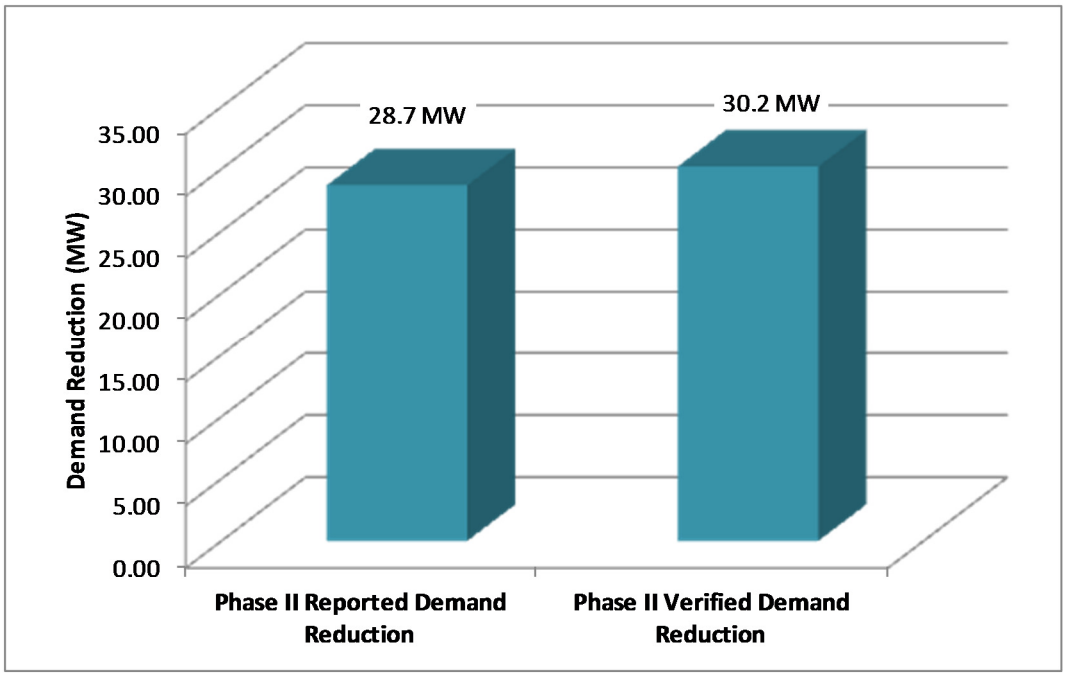
Sector	PYTD Verified Net Savings (MWh/year)	Phase II Verified Net Savings (Cumulative Phase II MWh/Yr)	Verified Net Savings Carried Over from Phase 1 (Cumulative Phase II MWh/Yr)	Phase II+CO Verified Net Savings (Cumulative Phase II MWh/Yr)
Residential (non Low Income)	54,111	81,278	NA	
Residential (Low Income)	1,743	3,465	NA	
Total Residential (Non Low Income Plus Low Income)	55,854	84,742	0	84,742
Commercial and Industrial	43,352	63,702	0	63,702
GNI	8,593	12,976	42,706	55,683
Total	107,799	161,420	42,706	204,126

Table 1-4: Phase II Verified Net Lifetime Savings and Verified Net Lifetime Savings from PY4 Carried Into Phase II

Sector	PYTD Verified Net Savings (Lifetime MWh)	Phase II Verified Net Savings (Lifetime MWh)	Verified Net Savings Carried Over from Phase 1 (Lifetime MWh)	Phase II+CO Verified Net Savings (Lifetime MWh)
Residential (non Low Income)	175,209	389,507	NA	
Residential (Low Income)	11,523	24,049	NA	
Total Residential (Non Low Income Plus Low Income)	186,731	413,556	0	413,556
Commercial and Industrial	525,384	798,070	0	798,070
GNI	107,733	167,323	548,768	716,091
Total	819,848	1,378,949	548,768	1,927,717

In addition, West Penn Power has achieved 30.2 MW of gross verified demand reduction during Phase II[2]. See Figure 1-2 below. Additional detail on achieved demand reduction by program can be found in Table 1-10 and Table 1-11 of this section.

Figure 1-2: Phase II Portfolio Reported and Verified Demand Reduction



There are 6 measures available at no cost to low-income customers. These measures offered to the low-income sector comprise 15 percent of the total measures offered. As required by the Phase II goal, 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 by 6.2 percent.[3] These values are shown in Table 1-5 and Table 1-6.

[2] Unlike Phase I, there is no compliance target for demand reduction in Phase II. The Commission, however, requires that demand reduction savings in Phase II be reported including line losses, as was one in Phase I.

[3] Act 129 includes a provision requiring electric distribution companies to offer a number of energy efficiency 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).

Table 1-5: Low-Income Sector Compliance (Number of Measures)

	Low-Income Sector	All Sectors	% Low-Income	Goal
# of Measures Offered	6	40	15%	8.8%

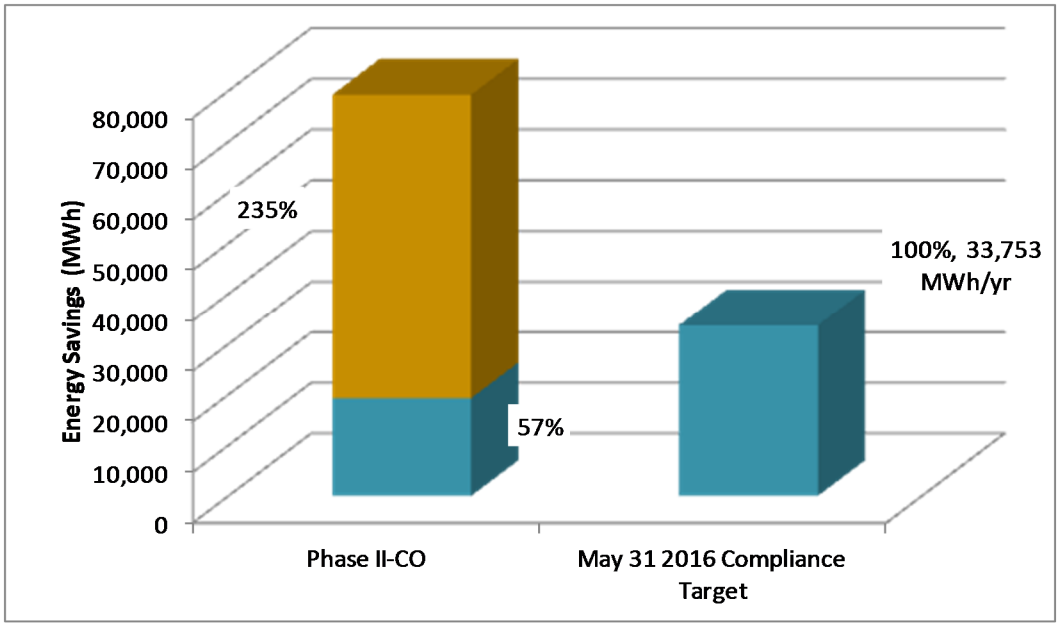
Table 1-6: Low-Income Sector Compliance (Percentage of Savings)

	Phase II Gross Verified
Low Income Verified Gross Savings from Low Income Programs (Incremental Annual MWh/Yr)	1,743
Low Income Verified Gross Savings from Other Residential Programs (Incremental Annual MWh/Yr)	22,703
All Low Income Verified Gross Savings [Sum of First Two Rows]	24,446
Progress Towards Low Income Goal [Previous Row divided by Phase II MWh Target]	161%
Goal (MWh/Yr)	15,189

The Phase II verified gross energy savings achieved through programs specifically designed for income-eligible customers are 1,743 MWh/yr and 22,703 MWh/year through other programs; this is 161 percent against the 4.5% Phase II total portfolio verified gross energy savings target for the low-income sector.

West Penn Power achieved 235 percent of the May 31, 2016 energy reduction compliance target for the government, nonprofit, and institutional sector based on cumulative program/portfolio savings from Phase II+CO verified gross energy savings achieved from the inception of Phase II through Program Year 6 and including carry-over savings from Phase I as shown in Figure 1-3.

Figure 1-3: Government, Nonprofit, and Institutional Sector Phase II Verified Gross Energy Impacts



A summary of the number of participants, Phase II verified gross energy savings (MWh/Yr), Phase II demand reduction (MW), and incentives paid ($1,000) are shown in Table 1-7.

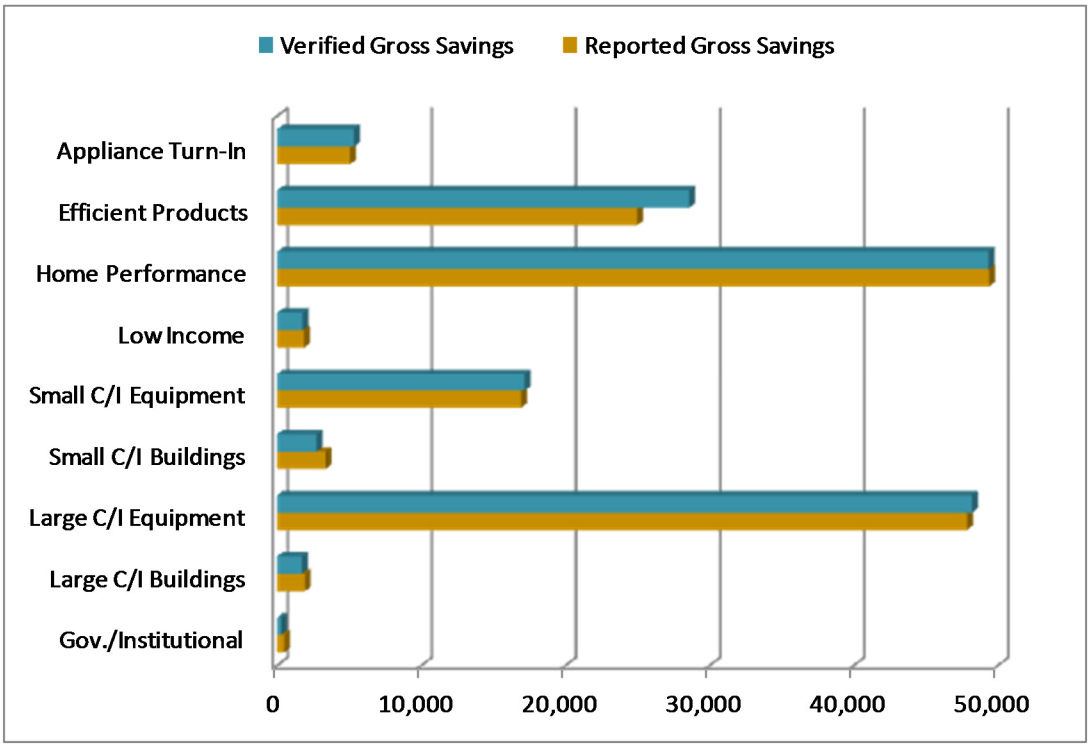
Table 1-7: Summary of Phase II Performance by Sector

Sector	Participants	Phase II Verified Gross Energy Savings (MWh/yr)	Phase II Verified Gross Demand Reduction (MW)	Incentives ($1,000)
Residential	764,933	135,519	14.97	8,901
Low-Income	10,876	3,465	0.30	0
Small Commercial and Industrial	6,269	32,546	5.81	2823
Large Commercial and Industrial	170	55,029	6.15	2710
Government, Nonprofit, and Institutional	1,059	19,301	2.97	690
Phase II Total	783,307	245,859	30.20	15,124

1.2 SUMMARY OF ENERGY IMPACTS

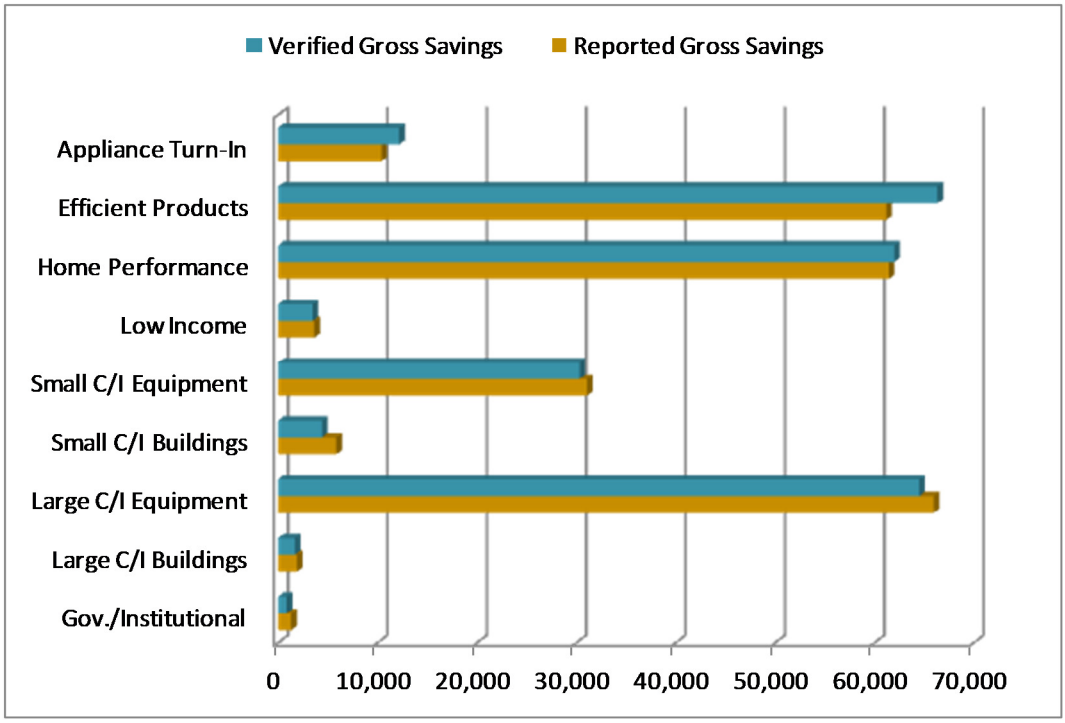
A summary of the reported and verified energy savings by program for Program Year 6 is presented in Figure 1-4.

Figure 1-4: PYTD Reported and Verified Gross Energy Savings by Program (MWh/yr)



A summary of the Phase II reported and verified energy savings by program is presented in Figure 1-5.

Figure 1-5: Phase II Reported and Verified Gross Energy Savings by Program (MWh/yr)



Summaries of energy impacts by program through Program Year 6 are presented in Table 1-8 and Table 1-9.

Table 1-8: Reported Participation and Gross Energy Savings by Program

Program	Participants		Reported Gross Impact (MWh/Yr)	
	PYTD	Phase II Verified Gross	PYTD	Phase II
Appliance Turn-In	7,062	14,321	5,051	10,398
Efficient Products	234,560	479,464	24,949	61,199
Home Performance	244,838	271,148	49,376	61,439
Low Income	5,261	10,876	1,849	3,641
Small C/I Equipment	543	944	16,906	31,092
Small C/I Buildings	3,582	6,203	3,342	5,854
Large C/I Equipment	106	189	47,843	65,968
Large C/I Buildings	132	132	1,911	1,911
Gov./Institutional	13	30	489	1,322
TOTAL PORTFOLIO	496,097	783,307	151,716	242,824

Table 1-9: Verified Gross Energy Savings by Program

Program	PYTD Reported Gross Energy Savings (MWh/Year)	PYTD Energy Realization Rate	PYTD Verified Gross Energy Savings (MWh/Year)	PYTD Achieved Precision[1]	Phase II Verified Gross Energy Savings (MWh/Year)	Phase II Achieved Precision[2]
Appliance Turn-In	5,051	105.6%	5,336	10.8%	12,199	8.2%
Efficient Products	24,949	114.5%	28,562	2.1%	66,362	1.2%
Home Performance	49,376	99.9%	49,346	14.2%	62,002	18.0%
Low Income	1,849	94.2%	1,743	6.4%	3,465	5.4%
Small C/I Equipment	16,906	101.6%	17,172	12.4%	30,337	11.1%
Small C/I Buildings	3,342	81.1%	2,710	12.7%	4,409	11.5%
Large C/I Equipment	47,843	100.7%	48,196	4.4%	64,515	5.9%
Large C/I Buildings	1,911	89.2%	1,706	4.2%	1,706	4.7%
Gov./Institutional	489	52.3%	255	10.2%	865	9.1%
TOTAL PORTFOLIO	151,716	102.2%	155,026	4.9%	245,859	5.0%
Phase 1 Carryover	n/a	n/a	n/a	n/a	59,929	n/a
Total Ph II+CO	n/a	n/a	n/a	n/a	305,788	n/a

1.3 SUMMARY OF FUEL SWITCHING IMPACTS

Per Commission Order, the EDCs are to report on the amount of electric to non-electric fuel switching in their annual reports. The following measure categories are those the Fuel Switching working group identified as potential "fuel switching measures":

- Water Heating
- Heating and Air Conditioning
- Clothes Drying
- Combined Heat and Power Distributed Generation
- Residential Micro Combined Heat and Power.

Solar Water Heaters are the only electric to non-electric fuel switching measure offered in the Company's approved EE&C Plan for the residential sector, but none were rebated in PY6. Absorption chillers and combined heat and power projects may also be eligible under the approved commercial and industrial equipment programs, but no associated rebate applications were approved in PY6.

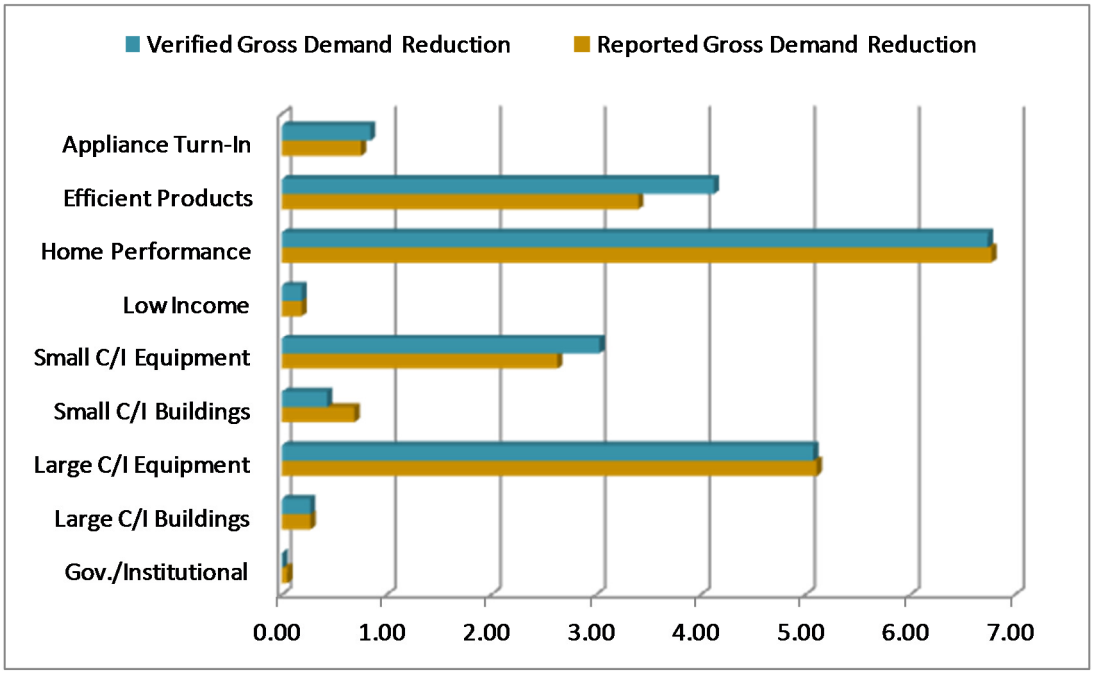
Measures that could possibly involve non-electric to electric fuel switching are Water Heating, Heating and Air Conditioning and Clothes Drying. The Company only provides incentives under its EE&C Plan for the purchase and installation of efficient electric heat pump water heaters and heat pumps which could involve customers switching from non-electric to electric technologies. The following summarizes participant responses to questions related to natural gas availability and possible non-electric to electric fuel switching during PY6:

- The reported availability of natural gas was limited for the heat pump water heater and heat pump HVAC participants.
- A total of 193 efficient electric water heaters were rebated in PY6. Of the customers surveyed for M&V purposes, 0% reported replacing a gas water heater.
- A total of 974 electric heat pumps were rebated in PY6. Of the customers surveyed for M&V purposes, 19% reported replacing a gas furnace or boiler.

1.4 SUMMARY OF DEMAND IMPACTS

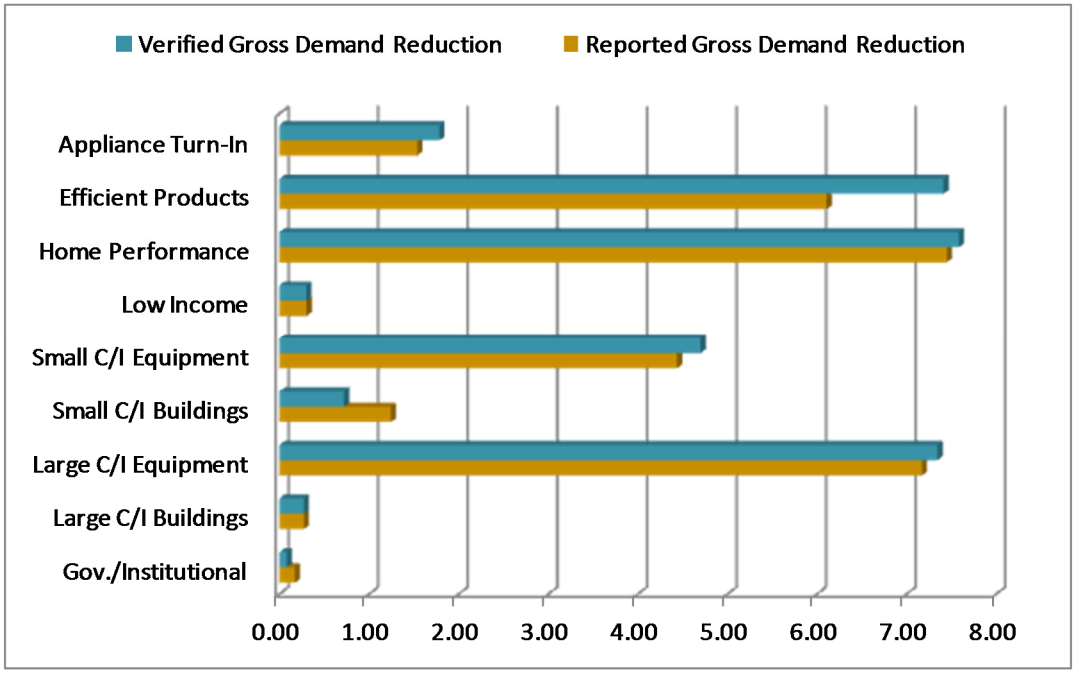
A summary of the reported and verified demand reduction by program for Program Year 6 is presented in Figure 1-6. The impacts below reflect the line loss factors shown in Table 1-14.

Figure 1-6: PYTD Reported and Verified Gross Demand Reduction by Program



A summary of the cumulative reported and verified demand reduction by program is presented in Figure 1-7.

Figure 1-7: Phase II Reported and Verified Gross Demand Reduction by Program



A summary of demand reduction impacts by program through Program Year 6 is presented in Table 1-10 and Table 1-11.

Table 1-10: Reported Participation and Gross Demand Reduction by Program

Program	Participants		Reported Gross Impact (MW)	
	PYTD	Phase II	PYTD	Phase II
Appliance Turn-In	7,062	14,321	0.76	1.54
Efficient Products	234,560	479,464	3.40	6.11
Home Performance	244,838	271,148	6.78	7.45
Low Income	5,261	10,876	0.19	0.30
Small C/I Equipment	543	944	2.63	4.44
Small C/I Buildings	3,582	6,203	0.69	1.24
Large C/I Equipment	106	189	5.11	7.17
Large C/I Buildings	132	132	0.27	0.27
Gov./Institutional	13	30	0.05	0.17
TOTAL PORTFOLIO	496,097	783,307	19.88	28.69

Table 1-11: Verified Gross Demand Reduction by Program

Program	PYTD Reported Gross Demand Savings (MW)	PYTD Demand Realization Rate	PYTD Verified Gross Demand Savings (MW)	PYTD Achieved Precision[1]	Phase II Verified Gross Demand Savings (MW)	Phase II Achieved Precision[2]
Appliance Turn-In	0.76	111.8%	0.84	9.4%	1.78	7.1%
Efficient Products	3.40	121.2%	4.13	2.6%	7.41	2.7%
Home Performance	6.78	99.5%	6.74	14.0%	7.58	20.1%
Low Income	0.19	99.0%	0.19	6.1%	0.30	5.5%
Small C/I Equipment	2.63	115.4%	3.03	11.8%	4.70	10.5%
Small C/I Buildings	0.69	62.6%	0.43	13.8%	0.72	12.1%
Large C/I Equipment	5.11	99.4%	5.07	4.3%	7.35	6.8%
Large C/I Buildings	0.27	99.2%	0.27	3.4%	0.27	3.9%
Gov./Institutional	0.05	12.5%	0.01	17.1%	0.08	11.0%
TOTAL PORTFOLIO	19.88	104.2%	20.72	5.0%	30.20	5.6%
Phase 1 Carryover	n/a	n/a	n/a	n/a	n/a	n/a
Total Ph II+CO	n/a	n/a	n/a	n/a	30.20	n/a

1.5 SUMMARY OF PROGRAM YEAR 6 NET-TO-GROSS RATIOS

Per the 2013 TRC Order, EDCs are required to conduct net-to-gross (NTG) research. NTG ratios are not used for compliance purposes, but are used for cost effectiveness reporting and future program planning purposes and should be applied to gross savings in order to calculate net verified energy and demand savings for Table 1-12. Table 1-12 presents a summary of NTG ratios by program. Note that Phase II NTG results are not yet available for all programs or program components as of this writing. The reported values are weighted to reflect the programs that have been evaluated in Phase II. The PY6 net verified savings in Table 1-12 will differ from the corresponding values in Table 1-3 because in Table 1-3 Phase I NTG values or evaluator estimates are used for program components that have not had NTG evaluations in Phase II.

Table 1-12: Program Year 6 NTG Ratios by Program.

Program Name	Free Ridership (%)	Spillover (%)	NTG Ratio Program Year 6	PY6 Verified Net Energy Savings (MWh/Yr)	PY6 Verified Net Demand Savings (MW/Yr)	NTG Categories Included[4]
Appliance Turn-In	68%	0%	68%	3,628	0.57	Freeridership
Efficient Products	54%	6%	52%	14,813	2.14	Freeridership, Participant Spillover
Home Performance	1%	1%	99%	48,882	6.68	Freeridership, Participant Spillover
Low Income	0%	0%	100%	1,743	0.19	n/a
Small C/I Equipment	39%	10%	71%	12,232	2.16	Freeridership, Participant Spillover
Small C/I Buildings	n/a	n/a	n/a	n/a	n/a	n/a
Large C/I Equipment	34%	8%	73%	35,286	3.72	Freeridership, Participant Spillover
Large C/I Buildings	n/a	n/a	n/a	n/a	n/a	n/a
(Weighted by program savings for programs reporting NTG Ratios)	37%	11%	73%	185	0.00	Freeridership, Participant Spillover

[4] For example, free-ridership, nonparticipant spillover, and participant spillover.

1.6 SUMMARY OF PORTFOLIO FINANCES AND COST-EFFECTIVENESS

A breakdown of the portfolio finances is presented in Table 1-13.

Table 1-13: Summary of Portfolio Finances

Row #	Cost Category	Actual PYTD Costs ($1,000)	Actual Phase II Costs ($1,000)
1	Incremental Measure Costs (Sum of rows 2 to 4)	$23,798	$31,846
2	EDC Incentives to Participants	$5,922	$11,045
3	EDC Incentives to Trade Allies	$0	$0
4	Participant Costs (net of incentives/rebates paid by utilities)	$17,876	$20,801
5	Program Overhead Costs (Sum of rows 6, 7, 8, 9, 10)	$10,890	$24,613
6	Design & Development	$53	$161
7	Administration, Management, and Technical Assistance[1]	$8,906	$20,539
8	Marketing[2]	$1,021	$2,072
9	EDC Evaluation Costs	$593	$774
10	SWE Audit Costs	$317	$1,067
11	Increases in costs of natural gas (or other fuels) for fuel switching programs	$0	$0
12	Total TRC Costs[3] (Sum of rows 1, 5 and 11)	$34,688	$56,458
13	Total NPV Lifetime Energy Benefits	$54,215	$66,157
14	Total NPV Lifetime Capacity Benefits	$6,245	$7,541
15	Total NPV TRC Benefits[4]	$60,459	$73,699
16	TRC Benefit-Cost Ratio[5]	1.74	1.31

NOTES

Per PUC direction, TRC inputs and calculations are required in the Annual Report only and should comply with the 2013 Total Resource Cost Test Order. Please see the "Report Definitions" section of this report for more details.

[1] Includes rebate processing, tracking system, general administration, EDC and CSP program management, general management and legal, and technical assistance.
[2] Includes the marketing CSP and marketing costs by program CSPs.
[3] Total TRC Costs includes Total EDC Costs and Participant Costs.
[4] 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. NOTE: Savings carried over from Phase I are not to be included as a part of Total TRC Benefits for Phase II.
[5] TRC Ratio equals Total NPV TRC Benefits divided by Total NPV TRC Costs.

1.7 SUMMARY OF COST-EFFECTIVENESS BY PROGRAM

TRC benefit-cost ratios are calculated by comparing the total NPV TRC benefits and the total NPV TRC costs. Table 1-14 shows the TRC ratios by program and other key factors used in the TRC ratio calculation for Phase II programs.

Table 1-14: PYTD TRC Ratios by Program[5]

Program	TRC NPV Benefits ($1000)	TRC NPV Costs ($1000)	TRC Benefit-Cost Ratio	Discount Rate	Energy Line Loss Factor	Demand Line Loss Factor
Appliance Turn-In	2,387	1,123	2.12	9.15%	9.10%	9.10%
Efficient Products	12,742	8,093	1.57	9.15%	9.10%	9.10%
Home Performance	4,661	4,826	0.97	9.15%	9.10%	9.10%
Low Income	664	2,124	0.31	9.15%	9.10%	9.10%
Small C/I Equipment	9,356	8,865	1.06	9.15%	9.10%	7.90%
Small C/I Buildings	840	1,224	0.69	9.15%	9.10%	7.90%
Large C/I Equipment	28,531	6,649	4.29	9.15%	7.90%	7.90%
Large C/I Buildings	1,154	1,263	0.91	9.15%	7.90%	7.90%
Gov./Institutional	125	522	0.24	9.15%	9.10%	7.90%
TOTAL	60,459	34,688	1.74	9.15%	8.50%	8.36%

1.8 COMPARISON OF PROGRAM YEAR 6 PERFORMANCE TO APPROVED EE&C PLAN

Table 1-15 below shows Program Year 6 expenditures compared to the budget estimates set forth in the EE&C plan.

Table 1-15: Comparison of PY6 Program Expenditures to PY6 EE&C Plan

Program	PY6 Budget from EE&C Plan	PY6 Actual Expenditures	% Difference from PY6 EE&C Plan [(Actual – Planned)/Planned]
Appliance Turn-In	$1,526,052	$1,123,467	-26%
Efficient Products	$3,781,969	$2,767,705	-27%
Home Performance	$4,787,839	$3,745,541	-22%
Low Income	$2,400,585	$2,123,751	-12%
Small C/I Equipment	$4,520,404	$2,628,178	-42%
Small C/I Buildings	$1,867,784	$772,787	-59%
Large C/I Equipment	$2,361,182	$2,930,748	24%
Large C/I Buildings	$1,326,916	$352,446	-73%
Gov./Institutional	$979,819	$367,317	-63%
TOTAL	$23,552,549	$16,811,940	-29%

[5] For reporting purposes, PYTD TRC Ratios by Program should be reported based on the gross verified energy and demand savings.

Table 1-16 shows Program Year 6 program savings compared to the energy and demand savings estimates filed in the EE&C plan.

Table 1-16: Comparison of PY6 Actual Program Savings to EE&C Plan for PY6

Program	PY6 MWh Savings Projected in EE&C Plan	Actual Reported PY6 MWh Savings	% Difference [(PY6 Actual – PY6 Planned)PY6 /Planned]	PY6 MW Savings Projected in EE&C Plan	Actual Reported PY6 MW Savings	% Difference [(PY6 Actual – PY6 Planned)PY6 /Planned]
Appliance Turn-In	5,567	5,051	-9%	0.58	0.76	30%
Efficient Products	23,347	24,949	7%	0.85	3.40	302%
Home Performance	21,748	49,376	127%	1.87	6.78	262%
Low Income	1,426	1,849	30%	0.37	0.19	-49%
Small C/I Equipment	24,996	16,906	-32%	3.02	2.63	-13%
Small C/I Buildings	6,751	3,342	-50%	0.82	0.69	-16%
Large C/I Equipment	23,232	47,843	106%	3.09	5.11	65%
Large C/I Buildings	7,641	1,911	-75%	0.81	0.27	-67%
Gov./Institutional	1,372	489	-64%	0.16	0.05	-67%
TOTAL	116,080	151,716	31%	11.59	19.88	72%

The portfolio as a whole met the Company's projections for PY6. Overall, energy savings exceeded targets while costs were below EE&C plan projections. Note, however, that the impacts associated with Home Energy Report are not additive from year to year, and this largely accounts for the apparent over performance for the Home Performance Program. Some of the programs with small budgets and corresponding expected participation rates will have significant variation in participation rates form year to year. The Efficient Buildings programs and the Government and Institutional Program fall in that category. Overall, program participation rates and cost effectiveness values are reasonable and indicate that Phase II Act 129 targets will be met. Program TRC ratios are consistent with EE&C plan projections to a satisfactory level. The smaller programs still exhibit low TRC ratios largely because they have not achieved the scale necessary to dilute the fixed costs associated with program implementation.

1.9 PORTFOLIO LEVEL/CROSS-CUTTING PROCESS AND IMPACT EVALUATION SUMMARY FOR PROGRAM YEAR 6

PY6 Process evaluation activities included:

1. In-depth interviews with program staff to understand current programs logic, operations, delivery and changes, and to identify research objectives.
    a. FirstEnergy program staff, n=10 plus (did not track individual follow-up calls as needed)
    b. ICSP, n=3 group interviews
2. Interviews and surveys with trade allies to assess program operations and effectiveness (including influence on stocking practices and recommendations), and their experiences with the programs.
    a. HVAC contractors semi-structured interviews, n=4
    b. HVAC contractors surveys, n=51
    c. Low Income contractors and auditors in-depth interviews, n=5
3. Participant surveys to assess program experiences and the influence of programs on energy efficiency decisions.

a. Appliance Turn-in, n=51
b. Energy Efficient Products, n=131
c. Low Income, n=148
d. Small Commercial & Industrial Equipment, n=63
e. Large Commercial & Industrial Equipment, n=43
f. Government & Institutional, n=7

4. Program documentation and website reviews, including rebate forms and marketing materials, and Benchmarking reviews

Table 1-17: Phase II Process and Impact Evaluation Recommendations from PY6 Evaluations

Applicability	Recommendations
Portfolio Level	Remove references to EDC in equipment descriptions in the T&R system.
Energy Efficient Products	For upstream lighting, report lamp source type, lamp type, wattage, lumens in the T&R system.
Residential Home Performance	For the New Home component, flag homes with greater than 20,000 kWh for a REMRate baseline heating loads vs. heating energy usage review.
Residential Appliance Turn-In	
Residential Low Income	
C/I Small Energy Efficient Equipment	Continue conducting outreach with trade allies and contractors to promote the program when working with commercial customers, and continue incorporating case studies and testimonials into marketing materials provided to customers and trade allies. Seek opportunities to provide contractors and targeted customers with additional literature and marketing materials they can use to convey benefits of the program to management staff.
C/I Small Efficient Buildings	
C/I Large Energy Efficient Equipment	
C/I Large Energy Efficient Buildings	
Governmental and Institutional	Consider using a deemed hours of use of 1,000 hours per year for all comprehensive lighting upgrades at volunteer fire departments.

2 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.

2.1 PROGRAM UPDATES

No changes to this program during PY6.

2.1.1 Definition of Participant

The participant counts are based on the number of unique account numbers, while measure counts correspond to the number of removed refrigerators, freezers, and RACs.

2.2 IMPACT EVALUATION GROSS SAVINGS

2.2.1 Evaluation Methodology

The reported impacts for this program are based on the energy savings associated with the removal of working refrigerators, freezers and RACs out of service. The gross impact evaluation method includes the following steps:

1) Through customer verification surveys, determine the fraction of refrigerators, freezers and RACs that were drawing power from the grid prior to retirement.
2) For refrigerators and freezers, also determine the fraction of recycled units that were replaced with Energy Star qualified units, and the fraction that were replaced with standard efficiency units.

The first step above is a basic verification step: Zero savings are credited if an appliance was reported to be non-functional (unable to draw power from the grid) prior to pick-up. The second step helps to select the proper path in the TRM algorithm, as the energy usage of the replacement unit is subtracted from the energy use of the recycled unit. 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 that recycled a refrigerator or freezer, and also received rebates for Energy Star refrigerators or freezers during the same program year. The savings associated with the Energy Star refrigerators or freezers were then subtracted from the gross verified savings for the program

The Company updated the reported per-unit savings for refrigerators and freezers by blending the impacts that result from “recycling without replacement” and “recycling with replacement” scenarios. The reported energy savings are heavily weighted to the “recycling with replacement” scenario, to be consistent with past impact evaluation findings. The realization rate for the program is attributable almost entirely to the differences between the ex-ante and ex-post weights for the three replacement type scenarios.

2.2.2 Program Sampling

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

Table 2-1: Phase II Residential Appliance Turn-In Reported Results by Customer Sector

Sector	Participants	Reported Gross Energy Savings (MWh/yr)	Reported Gross Demand Reduction (MW)	Incentives ($1,000)
Residential	14,321	10,398	1.54	714
Low-Income	0	0.0	0.00	0
Small Commercial and Industrial	0	0.0	0.00	0
Large Commercial and Industrial	0	0.0	0.00	0
Government, Non-Profit, and Institutional	0	0.0	0.00	0
Phase II Total	14,321	10,398	1.54	714

Table 2-2: Residential Appliance Turn-In Sampling Strategy for Program Year 6

Stratum	Population Size	Target Levels of Confidence & Precision	Target Sample Size	Achieved Sample Size	Evaluation Activity
Refrigerators	5,444	12.1%	35	31	CR,S,X
Freezers	1,325	16.0%	20	16	CR,S,X
RACs	293	18.1%	15	15	CR,S
Program Total	7,062	9.9%	70	62	

CR=TRM Calculation Review, S=Survey, X=Cross-check against EE Products to identify potential double-counting of savings for Energy-Star refrigerators and freezers.

Table 2-3: Program Year 6 Residential Appliance Turn-In Summary of Evaluation Results for Energy

Refrigerators	Reported Gross Energy Savings (MWh/yr)	Energy Realization Rate (%)	Verified Gross Energy Savings (MWh/yr)	Observed Coefficient of Variation (C_v) or Proportion in Sample Design	Relative Precision at 85% C.L.
Refrigerators	3,865	108.6%	4,199	0.5	12.9%
Freezers	1,113	98.2%	1,093	0.5	17.9%
RACs	73	59.8%	44	0.5	18.1%
Program Total	5,051	105.6%	5,336		10.8%

Table 2-4: Program Year 6 Residential Appliance Turn-In Summary of Evaluation Results for Demand

Stratum	Reported Gross Demand Savings (MW)	Demand Realization Rate (%)	Verified Gross Demand Savings (MW)	Observed Coefficient of Variation (C_v) or Proportion in Sample Design	Relative Precision at 85% C.L.
Freezers	0.44	119.8%	0.52	0.5	12.9%
RACs	0.13	102.4%	0.14	0.5	17.9%
Refrigerators	0.19	100.0%	0.19	0.5	18.1%
Program Total	0.76	111.8%	0.84		9.4%

2.2.3 On Site Inspections

No on-site inspections were performed for this program in PY6, because the appliances are removed from customers' homes. ADM performs online and telephone verification surveys with program participants. The verification rate from these surveys are typically above 98%, and variation between reported and

verified impacts primarily is due to differences between ex-ante assumptions and ex-postmeasurements regarding the fraction of appliances that were replaced.

2.3 IMPACT EVALUATION NET SAVINGS

The evaluation team assessed free ridership using the *Common Approach for Measuring Net Savings for Appliance Retirement Programs* approach. The data collection effort for this evaluation was done in conjunction with the ADM verification survey for impact evaluation. Spillover was not assessed during this effort. The evaluation team plans to conduct this research for this program in PY7.

Table 2-5: Residential Appliance Turn-In Sampling Strategy for Program Year 6 NTG Research

Stratum	Stratum Boundaries	Population Size[6]	Assumed CV or Proportion in Sample Design	Assumed Levels of Confidence & Precision	Target Sample size	Achieved Sample Size	Percent of Sample Frame Contacted[7] to Achieve Sample
Appliance Turn-In	All Measures	7,062	P=0.5	85/15	50	51	5% (N=361)
Program Total		7,062	P=0.5	85/15	50	51	5% (N=361)

Table 2-6: Program Year 6 Residential Appliance Turn-In Summary of Evaluation Results for NTG Research

Target Group or Stratum (if appropriate)	Estimated Free Ridership	Estimated Participant Spillover	NTG Ratio	Observed Coefficient of Variation or Proportion	Relative Precision
Appliance Turn-In	68%	0%	32%	0.5	10.0%
Program Total[8]	68%	0%	32%	0.5	10.0%

2.4 PROCESS EVALUATION

A robust process evaluation was conducted for this program twice in Phase I. There were no issues identified in those efforts and the program design has not changed for Phase II. Additionally, the FirstEnergy staff in-depth interviews did not reveal any useful researchable topics or issues to pursue. Therefore, a limited process evaluation was conducted for Phase II to assess key participant interactions and to identify if additional research is warranted.

Participating Customer (Household) Surveys

ADM included questions on their impact verification survey to assess:

- Program awareness and marketing.
- Customer satisfaction.
- Decision-making considerations (free-ridership) when recycling equipment.

[6] The values in this column represent the population as of the time that the process and NTG samples were drawn, and are generally smaller than the end-of-year values shown in the gross impact evaluation tables above.

[7] Sample frame is a list of contacts that have a chance to be selected into the sample. Percent contacted means of all the sample frame how many were called to get the completes.

[8] NTG ratio at program level should be developed using stratum weight and stratum NTG ratios.

Table 2-7: Residential Appliance Turn-In Sampling Strategy for Program Year 6

Target Group or Stratum (if appropriate)	Stratum Boundaries (if appropriate)	Population Size	Assumed Proportion or CV in Sample Design	Assumed Levels of Confidence & Precision	Target Sample Size	Achieved Sample Size	Percent of Population Frame Contacted to Achieve Sample	Used For Evaluation Activities (Impact, Process, NTG)
Appliance Turn-In	All Measures	7,062	P=0.5	85/15	50	51	5% (N=361)	Process, NTG
Program Total		7,062	P=0.5	85/15	50	51	5% (N=361)	

Key Findings

1) Bill inserts continue to be the most common source of program information. Over 60 percent (106 out of 168) of respondents indicated bill inserts as a source of program information. For the self-identified low-income subgroup of respondents, almost three-quarters (34 out of 46) indicated bill inserts as a source of program information.
2) Program satisfaction remains high. Over 80 percent (138 out of 170) of respondents reported they were "Very Satisfied" with program overall, with a mean score of 4.7 out of 5.
3) Net-to-Gross for the program is 46 percent. NTG values for individual FirstEnergy EDCs range from 32–57 percent

2.5 STATUS OF RECOMMENDATIONS FOR PROGRAM

The following recommendations resulted from the process and impact evaluation effort.

Table 2-8: Residential Appliance Turn-In Status Report on Process and Impact Recommendations

Recommendations	EDC Status of Recommendation (Implemented, Being Considered, Rejected AND Explanation of Action Taken by EDC)
Reduce reported savings for RACs to 150 kWh per unit.	Accept
Consider using bill inserts to address recycling concerns outside of the program.	Rejected
Consider adding a message to the rebate check that provides information about other FirstEnergy programs.	Under Consideration

2.6 FINANCIAL REPORTING

A breakdown of the program finances (by program) is presented in Table 2-9.

Table 2-9: Summary of Program Finances

Row #	Cost Category	Actual PYTD Costs	Actual Phase II Costs
		($1,000)	($1,000)
1	Incremental Measure Costs (Sum of rows 2 to 4)	$312	$680
2	EDC Incentives to Participants	$312	$680
3	EDC Incentives to Trade Allies	$0	$0
4	Participant Costs (net of incentives/rebates paid by utilities)	$0	$0
5	Program Overhead Costs (Sum of rows 6, 7, 8, 9, 10)	$812	$1,772
6	Design & Development	$5	$14
7	Administration, Management, and Technical Assistance[1]	$593	$1,278
8	Marketing[2]	$170	$365
9	EDC Evaluation Costs	$16	$23
10	SWE Audit Costs	$27	$92
11	Increases in costs of natural gas (or other fuels) for fuel switching programs	$0	$0
12	Total TRC Costs[3] (Sum of rows 1, 5 and 11)	$1,123	$2,451
13	Total NPV Lifetime Energy Benefits	$2,110	$2,751
14	Total NPV Lifetime Capacity Benefits	$278	$364
15	Total NPV TRC Benefits[4]	$2,387	$3,116
16	TRC Benefit-Cost Ratio[5]	2.12	1.27

NOTES

Per PUC direction, TRC inputs and calculations are required in the Annual Report only and should comply with the 2013 Total Resource Cost Test Order. Please see the "Report Definitions" section of this report for more details.

[1] Includes rebate processing, tracking system, general administration, EDC and CSP program management, general management and legal, and technical assistance.
[2] Includes the marketing CSP and marketing costs by program CSPs.
[3] Total TRC Costs includes Total EDC Costs and Participant Costs.
[4] 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. NOTE: Savings carried over from Phase I are not to be included as a part of Total TRC Benefits for Phase II.
[5] TRC Ratio equals Total NPV TRC Benefits divided by Total NPV TRC Costs.

3 ENERGY EFFICIENT PRODUCTS PROGRAM

Through the Residential Energy Efficient Products Program, customers receive incentives for installing ENERGY STAR® qualified appliances, energy efficient HVAC equipment, and energy efficient water heaters. The program also provides incentives to retailers for point of sale price cuts for customers purchasing energy efficient light bulbs. Qualifying appliances include items such as clothes washers, dehumidifiers, and refrigerators. HVAC equipment qualifying as part of the program include central air conditioners, air source heat pumps, ground source heat pumps, and mini-split heat pumps. The program also provides incentives to customers for the maintenance (tune-ups) of existing HVAC equipment. Water heaters rebated under the program include heat pump water heaters and solar water heaters.

3.1 PROGRAM UPDATES

During PY6, room air conditioners were moved into the upstream portion of the program.

3.1.1 Definition of Participant

The count of participants differs from the count of measures for this program. The participant count is the unique account numbers in the PY6 tracking and reporting data. The measure count typically exceeds the participant count as some participants complete multiple qualifying measures.

3.2 IMPACT EVALUATION GROSS SAVINGS

3.2.1 Evaluation Methodology

The program can be broadly divided in five components: Upstream Lighting, Upstream Electronics, Efficient HVAC Equipment, HVAC Tune-Ups, and Energy Star Appliances. The details of the methodologies are described in the subsections below.

Gross Impact Evaluation for Upstream Products

The lighting and consumer electronics program components are similar in structure. Both program components provide retailers incentives for point of sale purchases on energy efficient products. The efficient lighting products are discounted to the customers, while consumer electronics are not required to be discounted to the customers by program design. From a gross impact evaluation perspective, the salient shared characteristic between the two program components is that customer contact information is not available.

The similar nature of these programs allows for a similar evaluation approach for consumer electronics and efficient lighting products. The following verification elements were applied to these two program components:

Review of Sales Invoices

ADM conducted a review and obtained invoices for the CFLs, LEDs, LED holiday lights, desktop computers, smart strips, monitors, and televisions sold by participating retailers. These invoices are matched to the tracking and reporting (T&R) system to confirm proper counts and characteristics of the lighting and consumer electronic equipment. For all of the measures discussed in this section, the information in the T&R system was found to be consistent with both the reviewed invoices.

General Review of Tracking and Reporting System
ADM reviewed the T&R system to assure there are no duplicate entries and that all equipment model types are eligible for being counted toward PY6 achievements based on sales dates.

Impact Calculations for Lighting Products
ADM developed an *ex-ante* wattage equivalency map for use by the ICSP. The wattage equivalency was not make/model specific, but was rather designed to facilitate accurate if somewhat conservative, reporting of MWh and MW impacts for the upstream program.
To calculate verified impacts, ADM developed a make/model specific wattage equivalency map. For each unique stock keeping unit (SKU) description, ADM determined the lamp type as one of the following:

General Service.
Reflector (with subcategories having different lumen to baseline wattage mappings),
Globe,
Decorative,
3-Way,
LED Holiday Lights

For each category, the baseline wattage was determined, according to the TRM, as a function of the efficient lamp's lumen output. With the baseline and efficient watts determined, the impacts for all lamps are determined through TRM algorithms. Cross sector sales adjustments apply to residential lighting. Cross-sector sales determination and the associated adjustments to verified impacts and incentives are discussed in detail in Appendix D.

Impact Calculations for Upstream Electronics
ADM reviewed upstream electronics manufacturer names and model numbers to verify that the models are in the ENERGY STAR® database and to check the ENERGY STAR tier. In the 2014 TRM, the diagonal screen size is a key parameter in the partially deemed savings algorithm for televisions. ADM verified the diagonal screen size and calculated TRM-specified energy and demand impacts, accordingly. ADM applied the protocols of the TRM version that was in effect when the units were sold.

Gross Impact Evaluation for Appliances
The gross impact evaluation for appliances includes the following components:

Invoice and Application Review
ADM obtained invoices and applications from the Company. For each application, ADM verified that the manufacturer name and model number in the T&R system matches those on the invoice and rebate application. In general, all sampled appliances were matched to the qualifying ENERGY STAR® product lists[9]. ADM independently retrieved the attributes necessary for TRM calculations from the ENERGY STAR® database. In certain cases, the make or model numbers were entered in with minor typographic errors or with missing or inserted dashes, spaces, or other delimiting characters. Such occurrences do not pose an evaluation difficulty as ADM concentrates the verification effort on a random sample of rebated appliances, rather than the entirety of the database.

[9] The only exception involved one water heater for Penelec, which was found to be a standard efficiency model.

Customer Verification Surveys
ADM performed telephone and online surveys on a random sample of customers selected from the T&R data. Nearly all contacted customers verified that they have purchased and installed the stated appliances. The verification rates are used, in part, to inform measure-level realization rates.

Review of Energy Savings and Demand Reduction Calculations
For appliance 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, market average values for capacity, efficiency, are used rather than appliance-specific values. For clothes washers, TRM default fractions of electric water heating and clothes drying are used. In general, the per-unit savings reported by the ICSP are rather conservative (the assumed average efficiency levels or capacities are lower than actual average values). For all reviewed records, ADM used site-specific attributes to calculate "On-TRM" impacts.

Gross Impact for Evaluation HVAC Equipment and Tune-Ups
The gross impact evaluation approach for HVAC equipment is similar to that of appliances. The process involves invoice and application reviews, telephone verification surveys, and independent TRM-specific gross impact calculations for sampled items. The three activities are described in more detail below.

Invoice and Application Review
ADM obtained invoices and applications from the Company. For each application, ADM verified that the manufacturer name and model number in the T&R system matches those on the invoice and rebate application. In general, the sampled equipment were verified as more efficient than standard HVAC systems. ADM independently retrieved the attributes necessary for TRM calculations from the AHRI database. In certain cases, the make or model numbers were entered in with minor typographic errors or with missing or inserted dashes, spaces, or other delimiting characters. Such occurrences do not pose an evaluation difficulty as ADM concentrates the verification effort on a random sample of rebated appliances, rather than the entirety of the database. Verified impacts for tune-ups are determined through verification rates from telephone surveys, coupled with average cooling and heating capacities determined from application and invoice reviews.

Customer Verification Surveys
ADM performed telephone and online surveys on a random sample of customers selected from the T&R data. All contacted customers verified that they have purchased and installed the stated HVAC equipment, and all tune-up participants recalled the tune-up event. The telephone surveys are also an opportunity to collect additional data that are exclusive to the T&R system. For example, the installation space and baseline HVAC system types were determined through customer surveys for ductless mini-split heat pumps.

Review of Energy Savings and Demand Reduction Calculations
As with appliances, the ICSP reports energy savings due to market average values for capacity and efficiency, rather than project-specific attributes. The default parameters used in the savings estimations are conservative in the sense that the ICSP systematically underestimates reported impacts. This is particularly true for ground source heat pumps, air source heat pumps, and tune-ups.
For all reviewed records, ADM used site-specific attributes to calculate "On-TRM" impacts. The process is somewhat more involved in that the make/model lookups involve the Air Conditioning, Heating, and Refrigeration Institute (AHRI) certification directory along with using the TRM's zip-code to archetypal city map to establish equivalent full load hours. For ductless mini-split heat pumps, customer surveys are required to establish equivalent full load hours of operation and a baseline system type. Although there

are at times significant variations between reported and verified savings, the overall variance is insignificant at the program level.

3.2.1 Program Sampling

For the upstream lighting and consumer electronics program components, the census of shipment invoices and 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.

The sampling approach for the appliance and HVAC program components is stratified random sampling with the stratification defined by measure types. Note that sample sizes may be small for certain small strata, but the overall number of sample points, exclusive of the upstream program components, is sufficient to achieve 90/10 confidence/precision[10]. The impacts of certain measures that have an insignificant number of applications such as solar water heaters and mini-split ACs are not verified through surveys or invoice applications, but are rather passed through to verified impacts provided that the per-unit savings are consistent with values from the PA TRM.

Table 3-1: Energy Efficient Products Reported Results by Customer Sector

Sector	Participants	Reported Gross Energy Savings (MWh/yr)	Reported Gross Demand Reduction (MW)	Incentives ($1,000)
Residential	457,481	55,457	4.85	3,083
Low-Income	0	0	0.00	0
Small Commercial and Industrial	21,983	5,742	1.25	62
Large Commercial and Industrial	0	0	0.00	0
Government, Non-Profit, and Institutional	0	0	0.00	0
Phase II Total	479,464	61,199	6.11	3,145

[10] The measure-level sampling stratification results in certain strata with insignificant reported impacts (less than one *per mil* of program impacts). The reported impacts for these strata passed through to verified impacts provided that the per-unit savings are consistent with values from the PA TRM. The associated evaluation activity is designated as "PT" in Table 2-2.

Table 3-2: Energy Efficient Products Program Sampling Strategy for Program Year 6

Stratum	Population Size	Target Levels of Confidence & Precision	Target Sample Size	Achieved Sample Size	Evaluation Activity
Upstream Lighting	190,758	0%	190,758	190,758	CR,IR,AR,S*
Upstream Televisions	26,504	0%	26,504	26,504	CR,IR,AR
Refrigerators / Freezers	4,442	11%	45	38	CR,IR,AR,S
Upstream Computers/Monitors	2,372	0%	2,372	2,372	CR,IR,AR
Heat Pump Water Heaters	144	38%	13	13	CR,IR,AR,S
ASHP	665	13%	30	30	CR,IR,AR,S
Clothes Washers	3,259	13%	32	29	CR,IR,AR,S
GSHP	93	37%	13	12	CR,IR,AR,S
HVAC Tune-Ups	2,206	9%	63	58	CR,IR,AR,S
Dehumidifiers	1,822	16%	20	18	CR,IR,AR,S
CAC	574	27%	7	6	CR,IR,AR,S
MiniSplit HP	216	10%	41	34	CR,IR,AR,S
Room AC	1,058	n/a	0	0	CR
Smart Strips	344	0%	344	344	CR,IR,AR
Whole House Fan	0	n/a	0	0	CR,IR,AR
Electric Resistance Water Heaters	49	40%	3	3	CR,IR,AR,S
Solar Water Heaters	0	n/a	0	0	n/a
ECM Fans	37	71%	1	1	PT
MiniSplit AC	15	n/a	0	0	PT
Pool Pump Motors	2	n/a	0	0	PT
Program Total	234,560		220,246	220,220	

CR=Calculation Review, IR=Invoice Review, AR=Application Review, S=Survey
S*: Surveys for upstream lighting are used to estimate cross sector sales and low-income participation.
PT=Pass Through (certain measures that account for less than 0.1% of reported impacts are passed through to verified impacts, on the condition that the reported savings per unit are reasonably close to TRM values.)

Table 3-3: Program Year 6 Energy Efficient Products Program Summary of Evaluation Results for Energy

Stratum	Reported Gross Energy Savings (MWh/yr)	Energy Realization Rate (%)	Verified Gross Energy Savings (MWh/yr)	Observed Coefficient of Variation (C_v) or Proportion in Sample Design	Relative Precision at 85% C.L.
Upstream Lighting	20,818	112.8%	23,475	0.5	2.3%
Upstream Televisions	1,442	83.3%	1,201	0.5	0.0%
Refrigerators / Freezers	533	105.2%	561	0.5	11.6%
Upstream Computers/Monitors	91	100.1%	91	0.5	0.0%
Heat Pump Water Heaters	214	140%	300	1.0	38.1%
ASHP	397	114%	453	0.5	12.8%
Clothes Washers	294	202%	594	0.5	13.3%
GSHP	263	216%	568	1.0	38.8%
HVAC Tune-Ups	286	86%	246	0.5	9.3%
Dehumidifiers	297	86%	255	0.5	16.9%
CAC	88	80%	71	0.5	29.2%
MiniSplit HP	161	428%	688	0.5	11.3%
Room AC	15	93%	14	0.5	100.0%
Smart Strips	25	92.8%	23	0.5	0.0%
Whole House Fan	0	n/a	0	0.5	100.0%
Electric Resistance Water Heaters	7	44%	3	0.5	40.3%
Solar Water Heaters	0	n/a	0	0.5	100.0%
ECM Fans	17	n/a	17	0.5	71.0%
MiniSplit AC	0	n/a	0	0.5	100.0%
Pool Pump Motors	2	n/a	2	0.5	100.0%
Program Total	24,949	114%	28,562	n/a	2.1%

Table 3-4: Program Year 6 Energy Efficient Products Summary of Evaluation Results for Demand

Stratum	Reported Gross Demand Savings (MW)	Demand Realization Rate (%)	Verified Gross Demand Savings (MW)	Observed Coefficient of Variation (C_v) or Proportion in Sample Design	Relative Precision at 85% C.L.
Upstream Lighting	2.179	137.2%	2.990	0.5	2.3%
Upstream Televisions	0.220	83.5%	0.184	0.5	0.0%
Refrigerators / Freezers	0.061	108.6%	0.066	0.5	11.6%
Upstream Computers/Monitors	0.009	143.6%	0.012	0.5	0.0%
Heat Pump Water Heaters	0.019	132%	0.025	1.0	38.1%
ASHP	0.072	220%	0.158	0.5	12.8%
Clothes Washers	0.048	100%	0.048	0.5	13.3%
GSHP	0.054	90%	0.049	1.0	38.8%
HVAC Tune-Ups	0.534	57%	0.302	0.5	9.3%
Dehumidifiers	0.040	63%	0.025	0.5	16.9%
CAC	0.062	193%	0.120	0.5	29.2%
MiniSplit HP	0.036	212%	0.075	0.5	11.3%
Room AC	0.062	100%	0.062	0.5	100.0%
Smart Strips	0.002	98.3%	0.002	0.5	0.0%
Whole House Fan	0.000	n/a	0.000	0.5	100.0%
Electric Resistance Water Heaters	0.001	40%	0.000	0.5	40.3%
Solar Water Heaters	0.000	n/a	0.000	0.5	100.0%
ECM Fans	0.004	n/a	0.004	0.5	71.0%
MiniSplit AC	0.002	n/a	0.002	0.5	100.0%
Pool Pump Motors	0.000	n/a	0.000	0.5	100.0%
Program Total	3.405	121%	4.126	n/a	2.6%

3.2.1 On-Site Inspections

The program ICSP, Honeywell, conducts on-site inspections for rebated HVAC units. Honeywell randomly selects approximately 5% of rebated HVAC units for on-site inspections. Inspections are also performed on the first 2 installations by a newly enrolled contractor, units installed by a non-participating contractor, self-installs, and multiple unit installations. There are three possible outcomes of the on-site inspection:

Case 1: The reported HVAC unit is found to be installed as described in rebate application materials
Case2: A new, efficient HVAC unit is found, but there are discrepancies related to specific model number, capacity, or efficiency of the unit
Case 3: No efficient HVAC unit is installed at the residence

The on-site inspections occur prior to rebate approval. The great majority (95%)[11] of QA/QC inspections correspond to Case 1 above. Approximately 4% of on-site inspections result in a "Case 2" finding. In such cases, the application materials are updated to reflect the as-found equipment, and the rebate application is processed accordingly. This may involve an adjustment to the rebate amount, if the equipment is found to be in a higher or lower efficiency tier. If there is a failure to verify the equipment, the rebate application is not approved. Based on Honeywell's historical records, this scenario occurs approximately 1% of the time.

3.3 IMPACT EVALUATION NET SAVINGS

The NTG research was conducted in conjunction with the process evaluation effort for the PY6 sample frame.

The program downstream measure categories – HVAC and water-heating, and appliances - were evaluated using the *Common Framework for Downstream NTG Evaluation* self-report method and assessed free ridership and spillover. We targeted 35 participating household completed surveys for each of the two strata: (1) HVAC and water heating, and (2) appliances. This was more than sufficient to meet a minimum confidence and precision requirement of 85% ±15% at the program level. In addition to the household surveys, we also conducted HVAC contractor in-depth interviews and surveys. This qualitative information was used in conjunction with the HVAC household surveys to assess program influence on the household decision to purchase more energy efficient equipment.

The program upstream lighting and midstream consumer electronics measure categories evaluation is currently underway and will not be completed for this Annual report. Therefore, the program level free ridership, spillover, and NTG values in Table 2-6 represent only those strata for which NTG research has been completed thus far in Phase II.

Table 3-5: Energy Efficient Products Program
Sampling Strategy for Program Year 6 NTG Research

Stratum	Population Size[12]	Assumed CV or Proportion in Sample Design	Assumed Levels of Confidence & Precision	Target Sample size	Achieved Sample Size	Percent of Sample Frame Contacted[13] to Achieve Sample
HVAC & Water Heating	1,587	P=0.5	85/15	70	68	14% (N=224)
Appliance	5,366	P=0.5	85/15	70	63	4% (N=225)
Program Total	6,953	P=0.5	85/15	140	131	6% (N=449)

[11] Percentages here apply to all four FirstEnergy Pennsylvania EDCs.

[12] The values in this column represent the population as of the time that the process and NTG samples were drawn, and are generally smaller than the end-of-year values shown in the gross impact evaluation tables above.

[13] Sample frame is a list of contacts that have a chance to be selected into the sample. Percent contacted means of all the sample frame how many were called to get the completes.

Table 3-6: Program Year 6 Energy Efficient Products Program Summary of Evaluation Results for NTG Research

Target Group or Stratum (if appropriate)	Estimated Free Ridership	Estimated Participant Spillover	NTG Ratio	Observed Coefficient of Variation or Proportion	Relative Precision
Upstream Lighting	n/a	n/a	n/a	n/a	n/a
Upstream Electronics	n/a	n/a	n/a	n/a	n/a
HVAC and Water Heating	57.3%	7.6%	50.3%	40.6%	7.1%
Appliances	46.9%	2.0%	55.1%	51.5%	9.4%
Program Total[14]	53.9%	5.8%	51.9%		5.7%

3.4 PROCESS EVALUATION

For the EEP downstream measure categories process evaluation – HVAC and water-heating, and appliances – the evaluation team conducted the following activities:

FirstEnergy and Program Implementer Staff In-depth Interviews
Tetra Tech and ADM conducted in-depth interviews with program staff at FirstEnergy to discuss Phase II design and implementation updates, program goals, and key researchable issues of interest for the Phase II evaluation. The interviews assessed the effectiveness of the program's current operations, detailed program implementation practices, and identified key researchable topics.

Participating Customer (Household) Surveys
Tetra Tech conducted a quantitative participant survey effort by phone and by web for this evaluation for the Year 5 (PY5) sample frame. The surveys collected feedback on the following key researchable areas:

- Program infrastructure and participating household satisfaction
- Program communication and processes
- Free-ridership and spillover
- Demographics.

Table 3-7: Energy Efficient Products Program Sampling Strategy for Program Year 6

Target Group or Stratum (if appropriate)	Population Size	Assumed Proportion or CV in Sample Design	Assumed Levels of Confidence & Precision	Target Sample Size	Achieved Sample Size	Percent of Population Frame Contacted to Achieve Sample	Used For Evaluation Activities (Impact, Process, NTG)
HVAC & Water Heating	1,587	P=0.5	85/15	70	68	14% (N=224)	Process, NTG
Appliance	5,366	P=0.5	85/15	70	63	4% (N=225)	Process, NTG
Program Total	6,953	P=0.5	85/15	140	131	6% (N=449)	

[14] NTG ratio at program level should be developed using stratum weight and stratum NTG ratios.

Participating HVAC Contractor Web Surveys and In-depth Interviews

The focus of the contractor web survey was to assess how the program is working for contractors from their perspectives. The following key researchable areas were assessed:

- Program Infrastructure and participating contractor satisfaction
- Program communication and processes
- Program influence
- Firmographics.

Contractors were selected at random from the list of participating contractors provided by the ICSP and 51 contractors completed the web survey. We also completed four in-depth interviews with participating contractors.

Key Findings

Participating Households

1) Participants are highly satisfied with the program overall with a mean score greater than 4 on a 1-point to 5-point scale. Most HVAC and Appliance subprogram components also had a mean score of 4 or higher on this scale.
2) Almost half of participants in the Appliance subprogram are hearing about program rebates from the retailer and about half the HVAC subprogram participants are hearing about program rebates from the contractor. When asked to identify several preferred methods to hear about programs in the future, customers identified utility mail and web contact as the most preferred approaches, with 76 percent and 34 percent support respectively.
3) Participants largely understand program eligibility requirements, but about 7 percent of HVAC participants do not understand the HVAC tune-up or heat pump requirements.

Participating program contractors (HVAC subprogram only)

1) Contractors have a slightly lower mean score for overall program satisfaction (3.7) than program participants. Contractors scored their mean satisfaction the lowest on Technical Support (3.1) and Program Training (3.1). In-depth interviews with contractors suggested they prefer to receive program information through more personalized means, such as one-on-one meetings or direct calls with their ICSP representative. Contractors value these one-on-one program interactions with their ICSP representative.
2) Twenty percent (11) of surveyed contractors rate the paperwork requirements as “difficult” and eight percent (4) voiced concern about the time between their submission of rebate paperwork and the notification when the ICSP determined that paperwork submitted was incomplete and required contractor follow-up.
3) Only about half of the contractors responding to the survey report receiving the contractor newsletter and only three were aware of the ICSP contractor portal.
4) Contractors are the primary vehicle for communicating the HVAC subprogram to customers. Nearly half of the HVAC participants report hearing about the program from their contractor; contractors estimate less than 25 percent of their customers know about the program before he or she introduces the customer to program options.

3.5 STATUS OF RECOMMENDATIONS FOR PROGRAM

The following recommendations resulted from the process and impact evaluation effort.

Table 3-8: Energy Efficient Products Program Status Report on Process and Impact Recommendations

Recommendations	EDC Status of Recommendation (Implemented, Being Considered, Rejected AND Explanation of Action Taken by EDC)
Review rebate paperwork processes to identify opportunities to streamline documentation requirements and notify contractors and/or customers more quickly if project documentation is incomplete.	Being Considered
Increase one-on-one communication and improve response time between participating program contractors and their ICSP representative.	Being Considered
Use one-on-one communication to increase contractor awareness of program communication tools – such as the newsletter and/or portal – that already exist.	Being Considered
Consider annual or bi-annual calls or meetings with participating contractors – in lieu of or in addition to webinars – to provide specific information on program offerings and/or changes that are relevant to them, and provide the opportunity for contractor feedback.	Being Considered
Continue to use individual Appliance and HVAC subprogram NTG ratios during planning, rather than the overall program NTG ratio.	Implemented
For upstream lighting, report lamp source type, lamp type, wattage, lumens in the T&R system.	Being Considered
Remove the EDC name from equipment descriptions	Being Considered

3.6 FINANCIAL REPORTING

A breakdown of the program finances (by program) is presented in Table 3-9.

Table 3-9: Summary of Energy Efficient Products Program Finances

Row #	Cost Category	Actual PYTD Costs ($1,000)	Actual Phase II Costs ($1,000)
1	Incremental Measure Costs (Sum of rows 2 to 4)	$6,797	$9,061
2	EDC Incentives to Participants	$1,472	$3,145
3	EDC Incentives to Trade Allies	$0	$0
4	Participant Costs (net of incentives/rebates paid by utilities)	$5,325	$5,917
5	Program Overhead Costs (Sum of rows 6, 7, 8, 9, 10)	$1,295	$3,398
6	Design & Development	$6	$19
7	Administration, Management, and Technical Assistance[1]	$962	$2,752
8	Marketing[2]	$204	$400
9	EDC Evaluation Costs	$87	$104
10	SWE Audit Costs	$36	$123
11	Increases in costs of natural gas (or other fuels) for fuel switching programs	$0	$0
12	Total TRC Costs[3] (Sum of rows 1, 5 and 11)	$8,093	$12,459
13	Total NPV Lifetime Energy Benefits	$11,222	$15,566
14	Total NPV Lifetime Capacity Benefits	$1,521	$1,881
15	Total NPV TRC Benefits[4]	$12,742	$17,447
16	TRC Benefit-Cost Ratio[5]	1.57	1.40

NOTES

Per PUC direction, TRC inputs and calculations are required in the Annual Report only and should comply with the 2013 Total Resource Cost Test Order. Please see the "Report Definitions" section of this report for more details.

[1] Includes rebate processing, tracking system, general administration, EDC and CSP program management, general management and legal, and technical assistance.
[2] Includes the marketing CSP and marketing costs by program CSPs.
[3] Total TRC Costs includes Total EDC Costs and Participant Costs.
[4] 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. NOTE: Savings carried over from Phase I are not to be included as a part of Total TRC Benefits for Phase II.
[5] TRC Ratio equals Total NPV TRC Benefits divided by Total NPV TRC Costs.

4 RESIDENTIAL HOME PERFORMANCE PROGRAM

Through the Residential Home Performance Program, customers incentivized to improve the energy efficiency performance of their homes. The home performance program components includes a whole house direct install component, direct delivery of energy conservation kits (including a new school education component), efficient residential new home, and home energy usage reports. Through the whole house direct install program component, customers receive diagnostic assessments, followed by the direct installation of low-cost measures or incentivized installation of building shell measures. Customers that received energy efficiency kits either completed an online audit, phone audit, or submitted an online or telephonic request. The new home component provides incentives to builders that choose to build new homes to higher efficiencies through the installation of efficient building shell measures, HVAC systems, appliances, lighting, or other features. The home energy reports provide customers with comparative electric energy usage data and offer tips and advice on behavioral and low-cost energy saving measures.

4.1 PROGRAM UPDATES

In PY6 Residential New Homes program added a new rebate tier which allowed incentives for non-ENERGY STAR homes in the program if they were built at 30% or more above code.

4.1.1 Definition of Participant

The participant counts for this program are determined based on the unique customer receiving a kit or the unique rebate number in the T&R database for the other program components.

4.2 IMPACT EVALUATION GROSS SAVINGS

4.2.1 Evaluation Methodology

The gross Evaluation Methodology for each program component is discussed below.

Gross Impact Evaluation for Home Energy Audit Conservation Kits

Two separate types of 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, and an energy saving showerhead. The kit provided to customers with non-electric water heating consists of CFLs, LED night lights, a furnace whistle.

In evaluating the gross impact analysis for the energy conservation kits in PY6, 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 PY6,
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 2014 TRM. The second item, the total number and type of kits mailed to customers in PY6 is determined by reviewing the program T&R system.

The third item, installation rates, are determined through online customer, except for CFLs which are given “deemed” installation rates of 0.97 (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[15]. In particular, faucet aerators and energy saving showerheads are only counted as "installed" if they are installed in a home that has electric water heating.

The final item, the delivery rate is determined through the online and phone survey instrument. Online and phone survey respondents are asked to indicate whether they received the conservation kit that was mailed to them. 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.

The 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 survey instrument was verified in prior program years through supplementary on-site data collection activities of a nested sample of the 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 survey instrument, as it allows for a large sample size not easily obtained through on-site data collection. As with the Low-Income kits and the Schools kits, the average kit receipt rates and measure-level in service rates are closely correlated across all four FirstEnergy PA EDCs. EDC-specific variations are explicable primarily due to statistical variation in survey responses, which may account for a ±10% uncertainty in final verified impacts at the EDC-level. Due to this, average statewide in service rates are used for all four FirstEnergy EDCs. This reduces the likelihood that one particular EDC will receive an unusually high or low realization rate due solely to statistical fluctuations, and is generally consistent with the PA TRM's treatment of in-service rates, which are uniform across the state. The statistical precision for this program component is based on the EDC-specific number of customers that completed survey responses.

Gross Impact Evaluation for Schools Kits

The Schools kit program component is similar in construct to the Home Energy Audit conservation kit component, but the program is targeted to families with children who attend schools in the Company's service territory. The school kits contents include CFLs and LED night lights. The information available for review includes invoices, shipment lists, and results from a survey that was included in the kit. The invoices and shipment lists were reviewed to verify the accuracy of the T&R system, and were all found to be consistent. The surveys included in the kits were found to be appropriate for M&V purposes, with one minor modification discussed below. The survey results were analyzed for program measure installation practices and were found to be consistent with ADM's survey results for the Home Energy Audit conservation kits. However, ADM made one modification to the survey results. The "kit receipt rate" could not be used, as only those who received the kit would receive the survey invite. Due to the similarity of the programs and the consistency of the results of both surveys, the energy conservation kit receipt rate of 97.1% was applied to the school kits program.

Gross Impact Evaluation for New Home

This program contributes a relatively small portion of the program level savings for PY6. For the PY6 evaluation, ADM focused on conducting engineering reviews of a sample of projects. The engineering review involved inspection of the REM/Rate models associated with the rebated buildings. For each sampled home, ADM analysts ran the REM/Rate input files and made the following considerations:

[15] LED night lights are the only exception to this rule. If a nightlight is reported to be installed, the night light ISR may take on a value of 1 if the night light replaces a preexisting incandescent model, a 0 if the night light is a new installation, and a 0.5 if the customer reports to have installed the nightlight, but does not specify whether it supplanted an incandescent night light.

1. Are the baseline specifications in accordance to those in the 2014 PA TRM?
2. Are the claimed impacts attributable to improved construction practices and premium efficiency HVAC systems and appliances, or do they result from modifications that are not supportable by the PA TRM[16]
3. Is the REM/Rate modeling performed correctly and does it provide accurate results[17]?
4. Are the participating HERS raters accurately describing the homes in the REM/Rate models and HERS ratings?

The first three topics can be resolved through a REM/Rate model review. To determine the correspondence of the model inputs to actual building characteristics, ADM reviews detailed notes, photographs, and measurements from the ICSP's on-site Quality Assurance/ Quality Control (QA/QC) inspections.
For each sampled project, ADM recalculates energy and demand impacts if the above steps result in adjustments to model parameters.

Gross Impact Evaluation for Whole House Direct Install Measures
This program component is divided into three sub-components for evaluation purposes. Most participants in the direct install component receive an initial home audit which includes installation of low-cost measures by the auditor. The auditor may also recommend capital cost energy savings improvements, and a relatively small number of customers follow through with comprehensive measures that include attic insulation, air sealing, and replacement of HVAC and water heating equipment. Most of the impacts associated with whole house component are attributable to measures such as CFLs, low-flow showerheads and faucet aerators, and hot water pipe insulation. For these "light measures", ADM reviewed a sample of applications and invoices were reviewed for accuracy and also reviewed the T&R system to verify that the proper TRM algorithms are applied. Customers that received comprehensive measures were placed into to savings strata: Those with reported savings above 2.0 MWh and those with reported savings below 2.0 MWh. ADM performed an exploratory billing analysis for the former set. The main intention of the billing analysis is to provide a feasibility check against a small number of customers that are reported to save well over 5.0 MWh. Although the small sample size results in significant uncertainties in the billing analysis results, the main conclusion for the high-savings homes is that the apparent bill reductions are large and significant, but are also somewhat lower than reported savings amount. The second stratum of comprehensive measure customers - those with savings below 2.0 MWh, account for about one *per mil* of reported program savings. The reported impacts for these customers are passed through to verified impacts.

Gross Impact Evaluation for Home Energy Reports
This program component results in significant energy savings, but has a one-year measure life. The savings reported in PY6 do not contribute to the achievement against the May 31, 2016 compliance target. ADM's subcontractor, NMR Group, Inc. (NMR) conducted an independent billing analysis in PY6. The billing analysis focused solely on customers that were added in late PY5[18], and therefore are not directly

[16] For example, it would not be appropriate to claim energy savings based on differences in the 'reference' and 'as built' models' thermostat settings, or by virtue of using different heating or cooling degree days in the two models.

[17] There can be relatively minor variations in savings because the HERS raters may have different versions of REM/Rate. ADM used version 14.4.1 to conduct the simulation for most model reviews.

[18] These customers are referred to here as "Wave 2" customers, while "Wave 1" customers were enrolled at the start of Phase II.

comparable to the ICSP's (OPower) M&V results, which include all Phase II customers. NMR's independent billing analysis verified that the ICSP's M&V results are reasonable and that the customers added in late PY5 are likely to achieve the targeted energy savings during PY7. ADM also conducted a billing analysis of the entire set of Phase II participants. The analysis was conducted independently, although the underlying dataset was the same dataset used by OPower to report results, and thus had been prepared by OPower[19]. The combination of the ADM and NMR billing analyses was generally consistent with the results reported by OPower, with EDC-specific results agreeing within at most 7%, and 1% agreement if data from all four PA EDCs are pooled together.

The impacts as reported by the ICSP are accepted for the PY6 annual report, with the understanding that the impacts are reset to zero each year for Phase II compliance purposes. The independent billing analysis for PY7 will include all active Phase II customers and will result in a formal realization rate for this program component.

4.2.2 Program Sampling

The five program components are treated as separate sub-programs, each with distinct populations, samples, and realization rates.

Home Energy Audit Conservation Kits

The sampling approach for the Home Energy Audits energy conservation kits program component is random sampling. Randomly selected customers are invited to complete online surveys, with gift cards offered to the first 200 to complete surveys.

Stratification by kit type was done to ensure that appropriate realization rates are determined for the two individual kit types. The sample size for verification surveys was sufficiently large to determine gross impact with ±10% relative precision at the 90% confidence level. This large sample size is motivated by the fact that installation rates for some items in the kit are relatively low that only a large sample can accurately capture a true estimate of the installation rate. This is the main advantage of a survey instrument as compared to on-site data collection for this program.

Schools Conservation Kits

There is no direct sampling effort for the Schools energy conservation kits program: All recipients are invited to complete the survey. As discussed above the Schools Conservation Kit survey results are in excellent agreement with the Home Energy Audit kit survey results, despite the different survey design and recruitment practices.

New Home

The sampling approach for this program is simple random sampling. The sample size is sufficient to determine this program's gross impact with ±35% relative precision at the 85% confidence level. ADM sampled homes that been selected for quality control inspections by the program implementer. It is important to note that the implementer does not overwrite the energy savings for homes that undergo the QC process. This facilitates ADM's evaluation effort because the both the ex-ante savings estimates before and after the QA/QC process are both available. The program's realization rates generally use the ex-ante values that were available prior to QA/QC in the denominator.

Whole House Direct Install

There were very few whole house projects completed in PY6. As described in the methodology section, the projects under this program component are placed into three categories. Projects that solely

[19] Data preparation involves 'truing-up' estimated reads as actual meter reads become available, removing severe data outliers (e.g. 100MWh usage per month), and creating data fields that summarize each home's energy usage during the heating and cooling seasons in the benchmarking period.

involve low-cost measures are tracked by measure in the T&R system, and ADM performs calculation review on the census of projects. Comprehensive upgrade projects are placed into two strata, with the high-savings stratum evaluated by billing analysis, and the low-savings stratum evaluated solely through a T&R system review[20].

Home Energy Reports

Sampling is not required for this program's evaluation. Essentially all participant and control group households are considered by the billing analysis.

Table 4-1: Phase II Home Performance Program Reported Results by Customer Sector

Sector	Participants	Reported Gross Energy Savings (MWh/yr)	Reported Gross Demand Reduction (MW)	Incentives ($1,000)
Residential	271,148	61,439	7.45	1,777
Low-Income	0	0.0	0.00	0
Small Commercial and Industrial	0	0.0	0.00	0
Large Commercial and Industrial	0	0.0	0.00	0
Government, Non-Profit, and Institutional	0	0.0	0.00	0
Phase II Total	271,148	61,439.5	7.45	1,256

Table 4-2: Home Performance Program Sampling Strategy for Program Year 6

Stratum	Population Size	Target Levels of Confidence & Precision	Target Sample Size	Achieved Sample Size	Evaluation Activity
HEA Kits	4,476	10.0%	100	79	CR,S
School Kits	578	10.0%	50	287	CR,S
New Home	490	50.0%	7	7	CR,DR/OS
Direct Install, Prescriptive Measures	70	10.0%	70	70	CR
Weatherization, > 2MWh	9	100.0%	9	8	B
Weatherization, < 2MWh	10	100.0%	10	10	PT
Home Energy Reports*	239,205	100.0%	239,205	239,205	EBA*
Program Total	244,838	0.3%	239,451	239,666	

CR=TRM Calculation Review, S=Survey, DR/OS=Desk Review of REM/Rate Models, On-Site QA/QC findings, PT=Pass Through to Verified, EBA=Exploratory Billing Analysis – reported results not adjusted.
*Home Energy Reports have 1-year measure life, the impacts are reported here, but are not included in the table sums because they do not contribute to the compliance metric associated with the May 31 2016 gross verified energy savings target.

[20] This evaluation stratum accounts for less than 0.02% of program impacts.

Table 4-3: Program Year 6 Home Performance Program Summary of Evaluation Results for Energy

Stratum	Reported Gross Energy Savings (MWh/yr)	Energy Realization Rate (%)	Verified Gross Energy Savings (MWh/yr)	Observed Coefficient of Variation (C_v) or Proportion in Sample Design	Relative Precision at 85% C.L.
HEA Kits	1,503	95.0%	1,428	0.5	8.0%
School Kits	192	107.4%	206	0.5	3.0%
New Home	982	107.0%	1,052	0.5	27.0%
Direct Install, Prescriptive Measures	78	87.2%	68	0.5	0.0%
Weatherization, > 2MWh	68	56.8%	39	1.0	18.3%
Weatherization, < 2MWh	7	100.0%	7	0.5	100.0%
Home Energy Reports	46,546	100.0%	46,546	n/a	15.0%
Program Total	49,376	99.9%	49,346		14.2%

Table 4-4: Program Year 6 Home Performance Program Summary of Evaluation Results for Demand

Stratum	Reported Gross Demand Savings (MW)	Demand Realization Rate (%)	Verified Gross Demand Savings (MW)	Observed Coefficient of Variation (C_v) or Proportion in Sample Design	Relative Precision at 85% C.L.
HEA Kits	0.16	100%	0.16	0.5	8.0%
School Kits	0.02	91.5%	0.02	0.5	3.0%
New Home	0.18	92%	0.19	0.5	27.0%
Direct Install, Prescriptive Measures	0.01	92%	0.01	0.5	0.0%
Weatherization, > 2MWh	0.10	92%	0.06	1.0	18.3%
Weatherization, < 2MWh	0.01	92%	0.01	0.5	100.0%
Home Energy Reports	6.30	100%	6.30	n/a	15.0%
Program Total	6.78	100%	6.74		14.0%

4.2.1 One Site Inspections

The ICSP for the Residential Energy Audits and New Home program components, Performance Systems Development (PSD) conducts on-site QA/QC inspections for both program components. The QA/QC processes for each component is descried below.

Whole House Comprehensive Audits

The intent of QA/QC inspections is to ensure work performed under FirstEnergy's Residential Energy Audit Program conforms to program requirements and BPI technical standards related to health and safety requirements, improvement installation, and energy efficiency analysis. PSD reviews all electronic files submitted to the program by participating contractors. PSD also conducts a variety of onsite assessments for each contractor throughout the program year:

- SA = Shadow Audit with contractor during audit for 1 of first 5 audits for program

- QC = Quality Control inspection performed post-audit prior to installation for 5% of audits
- QA = Quality Assurance inspection performed post-installation of major measure improvements for 10% of jobs

Substantial issues found during an electronic file review or an onsite assessment will lead to increased inspection levels for the associated contractor. PSD assigns a QA score that ranges from 0 to 4, with "0" requiring immediate corrective action and "4" given to jobs that meet or exceed all required standards.

PSD's QA/QC site visit reports contain Pass or Fail scores in the following broad categories:

- Verification of Direct-Install Measures
- Review of auditor recommendations
- Building model accuracy
- Health and safety

ADM reviewed 45 QA/QC visit inspection forms from PSD, distributed among the four FirstEnergy PA Companies and found that 41 of them resulted in general verification of measure installation[21]. The average AQ/QC score for these 45 sites was 3.4 on a scale of 0 to 4.

Residential New Homes

The intent of QA/QC inspections is to ensure work performed under FirstEnergy's Energy Efficient New Homes Program conforms to program requirements and RESNET standards for energy efficiency analysis. PSD reviews all electronic rating files (including REM-Rate simulation models) submitted by participating raters and conducts on-site QA inspections of at least 10 percent of each rater's submissions. PSD conduct two types of onsite inspections.

- Visual Inspections – Inspection focuses on RESNET minimum rated features including, but not limited to, building dimensions; insulation type and thickness (where accessible); fixture lighting types; appliance efficiencies; and mechanical equipment efficiencies for 8% of all annual submissions. The high frequency of inspections leads to program visibility and opportunities for program participant interaction with PSD technical staff.
- Diagnostic Inspections–Inspections are comprehensive and include visual inspection components as well as building performance measurements using a blower door, duct pressurization, and ventilation airflow devices for 2% of all annual submissions. The lower frequency of inspections allows for a deeper evaluation of performance testing criteria.

Substantial issues found during electronic file review or on-site inspection will lead to increased levels of QA for the associated contractor. PSD assigns a QA score that ranges from 0 to 4, with "0" requiring immediate corrective action and "4" being given to jobs that meet or exceed all required standards.

PSD's QA/QC site visit reports contain Pass or Fail scores in the following broad categories:

- Non-compliance with program standards
- Building model accuracy

[21] It is important to note that a "Pass" score is awarded only if the entirety of the project is verified. ADM found examples of inspections where measures such as insulation and duct sealing were verified, but CFLs were not found to be installed. ADM would categorize this job as "mostly installed" while PSD gave the contractor a failing score. The QA/QC process for the Residential Energy Audits does not affect or inform the gross realization rate for the program, as ADM's verified impacts are based on calculation reviews and billing analyses.

ADM reviewed a total of 19 QA/QC site inspection reports from PSD, distributed among the four FirstEnergy PA Companies. The average AQ/QC score for these 19 sites was 3.2 on a scale of 0 to 4. Importantly, PSD retains both initial and post-QC reported impacts for each home. This enables ADM to include the results of PSD's on-site QA/QC findings in the gross impact evaluation effort. Only one of 19 reviewed homes required a formal update to ex-ante savings prior to project approval.

4.3 IMPACT EVALUATION NET SAVINGS

The NTG research for the In-Home Energy Audit, On-line Audit, Opt-in Kits, and School Kits components of the Home Performance Program were conducted in conjunction with the process evaluation effort for the PY6 sample frame.

The NTG research used the *Common Framework for Downstream NTG Evaluation* self-report method and assessed free ridership and spillover. We targeted 35 participating household completed web surveys for the On-line Audit, Opt-in Kits, and School Kits program components and 30 completed surveys for the In-Home Energy Audit component. This was more than sufficient to meet a minimum confidence and precision requirement of 85% ±15% at the program level.

The Home Energy Reports program component impact evaluation produces net verified savings; therefore, net-to-gross research is not required. The Home Performance New Homes component evaluation is currently underway and results are not available for the PY6 annual report. Therefore, the program level free ridership, spillover, and NTG values in represent only those strata for which NTG research has been completed thus far in Phase II. Also in Table 4-6, the HEA Kits combine the Opt-in Kits and Online Audit Kits components for reporting and cost effectiveness assessment.

Table 4-5: Home Performance Program
Sampling Strategy for Program Year 6 NTG Research

Stratum	Population Size[22]	Assumed CV or Proportion in Sample Design	Assumed Levels of Confidence & Precision	Target Sample size	Achieved Sample Size	Percent of Sample Frame Contacted[23] to Achieve Sample
Residential In-Home Audit	100	P=0.5	85/15	30	33	21%
Online Audit	1,705	P=0.5	85/15	35	38	4%
Opt-In Kit	959	P=0.5	85/15	35	39	<1%
School Kit	410	P=0.5	85/15	35	49	53%
Program Total	3,174	P=0.5	85/15	135	159	2%

[22] The values in this column represent the population as of the time that the process and NTG samples were drawn, and are generally smaller than the end-of-year values shown in the gross impact evaluation tables above.

[23] Sample frame is a list of contacts that have a chance to be selected into the sample. Percent contacted means of all the sample frame how many were called to get the completes.

Table 4-6: Program Year 6 Energy Efficient Products Program Summary of Evaluation Results for NTG Research

Target Group or Stratum (if appropriate)	Estimated Free Ridership	Estimated Participant Spillover	NTG Ratio	Observed Coefficient of Variation or Proportion	Relative Precision
HEA Kits	38.9%	15.6%	76.7%	0.50	8.2%
School Kits	36.0%	3.0%	67.0%	0.29	6.0%
New Construction	n/a	n/a	n/a	n/a	n/a
In-Home Audits	39.0%	12.0%	73.0%	0.33	8.3%
Home Energy Reports	0.0%	0.0%	100.0%	n/a	0.0%
Program Total[24]	1.5%	0.5%	99.1%		6.7%

4.4 PROCESS EVALUATION

For the In-Home Energy Audit, On-line Audit, Opt-in Kits, and School Kits components of the Home Performance Program, the evaluation team conducted the following activities:

FirstEnergy and Program Implementer Staff In-depth Interviews

Tetra Tech and ADM conducted in-depth interviews with program staff at FirstEnergy to discuss Phase II design and implementation updates, program goals, and key researchable issues of interest for the Phase II evaluation. The interviews assessed the effectiveness of the program's current operations, detailed program implementation practices, and identified key researchable topics.

Participating Customer (Household) Surveys

Tetra Tech conducted a quantitative participant survey effort by web for this evaluation for the Year 6 (PY6) sample frame. The surveys collected feedback on the following key researchable areas:

- Program infrastructure and participating household satisfaction
- Program communication and processes
- Free-ridership and spillover
- Familiarity with LED bulbs
- Demographics.

The Home Performance New Homes component evaluation is currently underway and results are not available for the PY6 annual report. The Home Energy Reports component underwent a robust process evaluation in Phase I and is not scheduled for a process evaluation in Phase II. A robust process evaluation is planned for Phase III.

[24] NTG ratio at program level should be developed using stratum weight and stratum NTG ratios.

Table 4-7: Home Performance Program Sampling Strategy for Program Year 6

Target Group or Stratum (if appropriate)	Population Size	Assumed Proportion or CV in Sample Design	Assumed Levels of Confidence & Precision	Target Sample Size	Achieved Sample Size	Percent of Population Frame Contacted to Achieve Sample	Used For Evaluation Activities (Impact, Process, NTG)
Residential In-Home Audit	100	P=0.5	85/15	30	33	100%	Process, NTG
Online Audit	1,705	P=0.5	85/15	35	38	7%	Process, NTG
Opt-In Kit	959	P=0.5	85/15	35	39	12%	Process, NTG
School Kit	410	P=0.5	85/15	35	49	29%	Process, NTG
Program Total	3,174	P=0.5	85/15	135	159	14%	Process, NTG

Participating Home Energy Auditor In-depth Interviews

Tetra tech completed 9 in-depth interviews with participating energy auditors. The focus of the Auditor interviews was to assess how the program is working for auditors from their perspectives. The following key researchable areas were assessed:

- Program infrastructure
- Participating auditor experiences
- Program measures and goals.

Program Material Review

Program documentation reviews included program plans, the program website, and enrollment e-mail communications.

Key Findings

Program participants

- Program participants are highly satisfied with the program overall.
- Participants indicate they want to be notified about future program options via e-mail.
- Most participants are familiar with LEDs and are currently using them in their homes.

Participating program auditors (Residential In-Home Audit subprogram only)

- Auditors welcome the opportunity for business through the program and are enthusiastic program promoters.
- Auditors report receiving inquiries about the program because of marketing efforts by FirstEnergy. Auditors mention noticing customer interest in the audit program that they attribute to FirstEnergy marketing efforts; specifically, bill inserts and Home Energy Reports generated by the Behavior subprogram. Two auditors mentioned the Behavior subprogram as being effective, and one reported that 60 percent of their referrals are attributed to this

program. Auditors shared that "solving a problem" for the customer is more effective than focusing on deficiencies of the house itself or pointing out how much money they will save.

- Satisfaction with field-use of the Surveyor tool is mixed. Some auditors reported both confusion as to how the savings values are generated and frustration with the perceived limitations of the reports generated from Surveyor, such as the inability to upload pictures of problem areas in the house, needing to select inputs from dropdowns instead of entering more specific values, and the need to be connected to the internet while in the field. Auditors indicate they often augment its reports and/or calculate energy savings on their own.
- Auditors feel that the follow-through with audit recommendations can be low because of the rebate structure for recommended upgrades. Auditors reported that although much of the cost of the audit is rebated for the customer, the incentives for implementing recommended upgrades are often not sufficient to prompt implementation of recommended improvements. Additionally, auditors explained that it is especially difficult to identify the requisite 350 kWh in savings if a home has non-electric heating and/or water heating.
- Auditors are pleased with the support provided by the ICSP. Auditors expressed satisfaction with their interaction with ICSP staff, commenting that they are "doing a great job" and that they are responsive to their needs and inquiries.

4.5 STATUS OF RECOMMENDATIONS FOR PROGRAM

Table 4-8: Home Performance Program Status Report on Process and Impact Recommendations

Recommendations	EDC Status of Recommendation (Implemented, Being Considered, Rejected AND Explanation of Action Taken by EDC)
For the New Homes component, flag homes with greater than 20,000 kWh for a REMRate baseline heating loads vs. heating energy usage review.	In Progress.
For the conservation kits, consider including fewer 9W globes. Customers are slower to install those than any other lamps included in the kits.	Being Considered
Collect customer e-mail addresses during customer contact opportunities such as program feedback, rebate forms, and calls to the Customer Contact Center (CCC), etc., to use in future marketing campaigns. Be sure the language included permits future solicitation. Provide a "subscribe to EE program updates" on the FirstEnergy and ICSP websites.	Being Considered
Consider revising the rebate structure for the audit-recommended improvements to adjust the focus of the program more towards encouraging implementation of efficiency upgrades.	Being Considered
Consider other energy savings modeling tools that may have advantages over Surveyor. Holding an informational seminar on how the savings values are determined may also be beneficial for auditors.	Being Considered
Continue to market the program through bill inserts and steer customers to the program via the Behavior subprogram Home Energy Reports. Communicating how the program can solve energy-related problems for the customer may drive more participation, according to auditors.	Being Considered

4.6 FINANCIAL REPORTING

A breakdown of the program finances (by program) is presented in Table 4-9. West Penn Power's Home Performance Program has a lower TRC benefit-cost ratio than like programs for other FirstEnergy EDCs in Pennsylvania. The program components tend to have a bimodal TRC distribution, with energy conservation kits having marginal TRC ratios near 3.0, while program components such as New Homes, in-home audits, have TRC ratios near 0.7. The Home Energy Reports component may buoy program TRCs next program year, as participants' savings tend to increase over time. Increased distribution of conservation kits, may also help to boost program benefits. A reduction in in the New Home component may also reduce overall incremental costs.

Table 4-9: Summary of Program Finances

Row #	Cost Category	Actual PYTD Costs ($1,000)	Actual Phase II Costs ($1,000)
1	Incremental Measure Costs (Sum of rows 2 to 4)	$1,602	$2,993
2	EDC Incentives to Participants	$521	$1,777
3	EDC Incentives to Trade Allies	$0	$0
4	Participant Costs (net of incentives/rebates paid by utilities)	$1,081	$1,216
5	Program Overhead Costs (Sum of rows 6, 7, 8, 9, 10)	$3,224	$8,397
6	Design & Development	$17	$46
7	Administration, Management, and Technical Assistance[1]	$2,894	$7,597
8	Marketing[2]	$155	$374
9	EDC Evaluation Costs	$55	$75
10	SWE Audit Costs	$104	$306
11	Increases in costs of natural gas (or other fuels) for fuel switching programs	$0	$0
12	Total TRC Costs[3] (Sum of rows 1, 5 and 11)	$4,826	$11,391
13	Total NPV Lifetime Energy Benefits	$4,104	$7,195
14	Total NPV Lifetime Capacity Benefits	$557	$847
15	Total NPV TRC Benefits[4]	$4,661	$8,042
16	TRC Benefit-Cost Ratio[5]	0.97	0.71

NOTES

Per PUC direction, TRC inputs and calculations are required in the Annual Report only and should comply with the 2013 Total Resource Cost Test Order. Please see the "Report Definitions" section of this report for more details.

[1] Includes rebate processing, tracking system, general administration, EDC and CSP program management, general management and legal, and technical assistance.
[2] Includes the marketing CSP and marketing costs by program CSPs.
[3] Total TRC Costs includes Total EDC Costs and Participant Costs.
[4] 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. NOTE: Savings carried over from Phase I are not to be included as a part of Total TRC Benefits for Phase II.
[5] TRC Ratio equals Total NPV TRC Benefits divided by Total NPV TRC Costs.

5 RESIDENTIAL LOW INCOME PROGRAM

The Low Income Program provides basic to comprehensive whole building measures at no cost to low-income households. This program also educates customers about their home's energy use and ways to save energy. The program is broadly organized into three different delivery types: direct install, giveaway and direct delivery kit programs.

The Direct Install component is comprised of the WARM Plus, WARM Extra Measures and WARM Multifamily programs. These programs included an onsite home energy audit for income qualified customers and the direct install of energy efficient measures at no cost to participants by the Company's implementation contractor. The WARM Multifamily program was introduced this year to provide energy efficient measures to customers who live in multifamily housing units. Appliance replacements were also expanded in Phase II. Measures installed under these programs include[25]:

- CFLs
- Smart Power Strips
- Furnace whistles
- Faucet aerators
- Energy-saving showerheads
- LED nightlights
- Heat pump water heaters
- ENERGY STAR refrigerators
- Energy-efficient freezers
- Energy-efficient resistance water heaters
- Programmable thermostats
- Pipe insulation for hot water pipes

The efficiency of refrigerators and freezers were also tested during the in-home audit process. If these appliances were found to be inefficient, customers had the option to have their old units removed and replaced with energy-saving appliances through the program.

The Giveaway component, which is a subset of the Low Income Low Use Program, was targeted to low income customers at community events. CFLs, and limited numbers of faucet aerators, furnace whistles and energy-saving showerheads, were either distributed directly by the Company or sent to non-profit organizations contracted by the Company that then distributed the items to Company customers.

Low Income~~,~~ Low Use Program (LILU) kits were directly mailed to income-qualified customers. There were two types of kits: the first type was for homes with electric water heaters, the second type for homes with non-electric water heaters. These kits were identical to the ones sent out by the Home Energy Audit (HEA) program. Items in these kits (depending on the recipients' water heater type) may have included:

[25] Many other energy saving measures are provided to customers through the program; however, the expected savings from these other measures are nominal. No ex-ante savings were claimed for measures outside of this list.

- CFLs
- LED nightlights
- Faucet aerators
- Energy-saving showerhead
- Adapters for faucet aerators.

5.1 PROGRAM UPDATES

The WARM Program's electronic application process went live March 2015. Customers now have the opportunity and ability to sign up for the WARM program and submit an application on-line simply by accessing the energysavePA.com website.

5.1.1 Definition of Participant

For the WARM Plus, Multifamily, and WARM Extra Measure programs, a participant is defined as a unique rebate ID in the tracking and reporting database. This has essentially a direct correspondence with unique homes that received direct install measures, but there is a small amount of overlap (two separate rebates for some customers) as "WARM Extra Measures" can overlap with WARM Plus. For the Giveaway component the participant is defined as a family unit who received the energy efficiency measures, such as faucet aerator or a CFL. In the LILU kit program, a participant is defined as a home to which a kit was delivered.

5.2 IMPACT EVALUATION GROSS SAVINGS

This section provides details of evaluation findings, including reported savings, sample design, and verified savings for the components of the Residential Low Income Program.

5.2.1 Evaluation Methodology

Gross Impact Evaluation for Direct Install Components

During Phase I, verified savings from the WARM Program were determined using a billing analysis of prior-year participants' billing data. This is not possible for Phase II because the Phase II program has been redesigned, and is not represented by the Phase I program or the general WARM LIURP program.

ADM's verification activities for these direct install programs included a review of tracking data and a review of on-site verification forms completed by third party quality assurance contractors. These verification forms noted any discrepancy between what was listed as installed by the implementation contractor and what was still installed in the home. ADM used these forms to verify installation rates for energy efficiency measures and to calculate verified impacts. The on-site QA/QC inspection process is described in greater detail at the end of this section. In general, the inspectors found high in-service rates for the direct install program. The primary source of discrepancy between reported and verified savings is due to a possible synchronization issue regarding the definition of one unit, or the per-unit energy savings for hot water pipe wrap. The PY6 TRM transitioned from a 10-foot measure unit to a 1-foot measure unit for this measure. As such, participating contractors report the number of units by the foot, rather than in 10-foot increments. For the first month of PY6 (June 2014), the associated savings in the tracking reporting system corresponded to 10-foot increments. ADM has confirmed that the tracking and reporting system uses the correct value. The realization rate for the direct install component reflects ADM's correction. A small number of homes received envelope improvement measures with impacts that are not readily calculable through TRM algorithms. The Company did not report any impacts for these measures.

Gross Impact Evaluation for Giveaway Events

The Company provided to ADM their list of invoices and measures given out through the Low Income Giveaway program component. ADM checked the invoice list against the quantities of give-away items listed in the Company's official tracking database. ADM did not find any discrepancies between the invoice list and the tracking database. However, the in-service rates for certain measures are not directly knowable, and the historically verified in-service rates for measures such as energy saving showerheads and aerators are below the TRM defaults. ADM applied to night lights, aerators, and showerheads, the in-service rates derived from the LILU direct delivery program. ADM also calculated energy savings values for all distributed CFLs. The Company reported energy savings according to the correct EDC-specific "waste heat factors" from the TRM. The in-service rate used in the calculation of reported savings was 96%, while the 2014 PA TRM uses a 97% in-service rate. This adjustment resulted in an approximate 101% realization rate for the giveaway events.

Gross Impact Evaluation for LILU Energy Conservation kits

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, and an energy-saving showerhead. The kit provided to customers with non-electric water heating consists of CFLs, LED night lights, and a furnace whistle.

In evaluating the gross impact analysis for the energy conservation kits in PY6, 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 PY6,
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 2014 TRM. The second item, the total number and type of kits mailed to customers in PY6, 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 PY6 are eligible based on shipment dates.

The third item, installation rates, are determined through customer surveys, except for CFLs which are given "deemed" installation rates of 0.97 (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[26]. 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.

The final item, the delivery rate is determined through the customer surveys. Survey respondents are asked to indicate whether they received the conservation kit that was mailed to them. 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.

[26] LED night lights are the only exception to this rule. If a nightlight is reported to be installed, the night light ISR may take on a value of 1 if the night light replaces a preexisting incandescent model, a 0 if the night light is a new installation, and a 0.5 if the customer reports to have installed the nightlight, but does not specify whether it supplanted an incandescent night light.

The 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.

As with the Home Energy Audit kits and the Schools kits, the average kit receipt rates and measure-level in service rates are closely correlated across all four FirstEnergy PA EDCs. EDC-specific variations are explicable primarily due to statistical fluctuations, which may account for a ±10% uncertainty in final verified impacts at the EDC-level. Due to this, the average statewide in service rate is used for all four FirstEnergy EDCs. The combination of survey results reduces the likelihood that one particular EDC will receive an unusually high or low realization rate due to such statistical fluctuations, and is generally consistent with the PA TRM's treatment of in-service rates, which are uniform across the state. The statistical precision for this program component is based on the number of West Penn Power customers that completed survey responses.

5.2.2 Program Sampling

The three program components are treated as separate sub-programs, each with distinct populations, samples, and realization rates.

LILU Conservation Kits

The sampling approach for LILUs energy conservation kits program component is random sampling, but with specific targets for data acquisition modes and kit types. While the Home Energy Audit kit surveys were administered online, ADM used both telephone and online surveys for this program evaluation. The primary reason for using telephone surveys is that only about 30% of LILU customers provided emails addressed to the Company. As such, a 2:1 telephone to online survey ratio was targeted.

Stratification by kit type was done to ensure that appropriate realization rates are determined for the two individual kit types. The sample size for verification surveys was sufficiently large to determine gross impact with ±10% relative precision at the 90% confidence level. This large sample size is motivated by the fact that installation rates for some items in the kit are relatively low that only a large sample can accurately capture a true estimate of the installation rate. This is the main advantage of a survey instrument as compared to on-site data collection for this program.

Giveaway Events

Sampling was not conducted for the giveaway event evaluation. ADM reviewed invoices and calculations for all reported measures.

Direct Install Programs

The Company's QA/QC contractor performs random on-site verification inspections. ADM received from the Company a list of on-site inspections, and then requested the data collection forms and on-site notes for projects that are in the PY6 program population.

Table 5-1: Phase II Residential Low Income Program
Reported Results by Customer Sector

Sector	Participants	Reported Gross Energy Savings (MWh/yr)	Reported Gross Demand Reduction (MW)	Incentives ($1,000)
Residential	0	0	0.00	0
Low-Income	10,876	3,641	0.30	0
Small Commercial and Industrial	0	0.0	0.00	0
Large Commercial and Industrial	0	0.0	0.00	0
Government, Non-Profit, and Institutional	0	0.0	0.00	0
Phase II Total	10,876	3,641	0.30	0

Table 5-2: Residential Low Income Program
Sampling Strategy for Program Year 6

Stratum	Population Size	Target Levels of Confidence & Precision	Target Sample Size	Achieved Sample Size	Evaluation Activity
Direct Install	1,297	11.5%	38	37	DR, OS
CFL Give-away	3,042	0.0%	3,042	3,042	DR
LILU Standard Kits	677	8.1%	70	54	DR,S
LILU All Electric Kits	245	15.4%	20	23	DR,S
Program Total	5,261	0.0%	3,170	3,156	
DR=Desk Review, S=Survey, OS=On-Site Verification					

Table 5-3: Program Year 6 Residential Low Income Program
Summary of Evaluation Results for Energy

Stratum	Reported Gross Energy Savings (MWh/yr)	Energy Realization Rate (%)	Verified Gross Energy Savings (MWh/yr)	Observed Coefficient of Variation (C_v) or Proportion in Sample Design	Relative Precision at 85% C.L.
Direct Install	1,037	89.6%	929	0.5	11.7%
CFL Give-away	511	100.9%	516	0.5	0.0%
LILU Standard Kits	215	98.9%	213	0.5	9.4%
LILU All Electric Kits	86	98.8%	85	0.5	14.3%
Program Total	1,849	94.2%	1,743		6.4%

Table 5-4: Program Year 6 Residential Low Income Program Summary of Evaluation Results for Demand

Stratum	Reported Gross Demand Savings (MW)	Demand Realization Rate (%)	Verified Gross Demand Savings (MW)	Observed Coefficient of Variation (C_v) or Proportion in Sample Design	Relative Precision at 85% C.L.
Direct Install	0.10	98.4%	0.10	0.5	11.7%
CFL Give-away	0.06	100.6%	0.06	0.5	0.0%
LILU Standard Kits	0.02	98.0%	0.02	0.5	9.4%
LILU All Electric Kits	0.01	97.9%	0.01	0.5	14.3%
Program Total	0.19	99.0%	0.19		6.1%

5.2.3 On-Site Inspections

The Company has contracted with Pure Energy Coach, LLC to conduct quality assurance / quality control (QA/QC) inspections for direct install measures. The QA/QC contractor conducted 245 inspections for the Act 129 Multifamily, WARM Plus, and Warm Extra Measures program components. ADM sampled 35 of these inspections for impact evaluation purposes. The table below summarizes the on-site inspection findings.

Table 5-5: Summary of on-site inspection findings for Low Income Direct Install Programs

Measure	Quantity in Database	Verified Quantity by Inspection	In-Service Rates (ISRs)	Resolution of Discrepancies
Low Flow Faucet Aerators	4	2	50%	These may have been removed by customer, or even missed by inspector. ADM will review subsequent inspections to assess the significance of this finding.
CFLs	348	346	99%	n/a
LED Night Lights	27	21	78%	n/a
Water Heater Pipe Insulation	476	476	100%	n/a
Refrigerator and Freezer Replacement	4	4	100%	n/a
Low Flow Showerheads	5	5	100%	n/a
Smarts Strips	14	13	93%	n/a
Water Heating	6	6	100%	n/a
Total	604	593	98%	

5.3 IMPACT EVALUATION NET SAVINGS

NTG research is not required and was not conducted for the Low Income program.

5.4 PROCESS EVALUATION

The following activities were completed for the evaluation of the WARM Extra Measures, WARM Plus, and Multifamily low income subprograms:

FirstEnergy Program Staff In-depth Interviews

Tetra Tech and ADM conducted in-depth interviews with program staff at FirstEnergy to discuss Phase II design and implementation updates, program goals, and key researchable issues of interest for the Phase II evaluation. The interviews assessed the effectiveness of the program's current operations, detailed program implementation practices, and identified key researchable topics.

Customer (Household) Phone Surveys for WARM Extra Measures, WARM Plus, and Multifamily Subprograms

Tetra Tech conducted phone surveys with participating households to assess awareness of program, program components effectiveness in meeting customer needs, and satisfaction. The sample frame included PY5 through PY6 Quarter 1.

LILU Kits Subprogram Participating Customer (Household) Phone Surveys

For the LILU Kits subprogram, Tetra Tech coordinated with ADM to add a limited set of process-related questions to their web and phone verification survey to assess customer satisfaction, usefulness of the educational material included within the kit, and other items households would like to see in the kit.

Table 5-6: Residential Low Income Program Sampling Strategy for Program Year 6

Target Group or Stratum (if appropriate)	Stratum Boundaries (if appropriate)	Population Size[27]	Assumed Proportion or CV in Sample Design	Assumed Levels of Confidence & Precision	Target Sample Size	Achieved Sample Size	Percent of Population Frame Contacted to Achieve Sample	Used For Evaluation Activities (Impact, Process, NTG)
WARM Extra Measures	Extra Measures	757	P=0.5	85/15	35	32	11% (N=87)	Extra Measures
WARM Plus	WARM Plus	664	P=0.5	85/15	35	39	13% (N=87)	WARM Plus
Multifamily	Multifamily	0	P=0.5	85/15	0	0	0% (N=0)	Multifamily
LILU Kit	Kits	956	P=0.5	85/15	90	77	92% (N=881)	Kits
Program Total		2,377	P=0.5	85/15	70	148	44% (N1,055)	

In-depth Interviews with Participating Contractors and Auditors

Tetra Tech conducted in-depth interviews with contractors and auditors participated in the WARM Extra Measures, WARM Plus and Multifamily subprograms. The contractors and auditors were selected from the PY6 program participant data files. The focus of the contractor interviews was to assess the operation of the program at the contractor and auditor level.

[27] The values in this column represent the population as of the time that the process and NTG samples were drawn, and are generally smaller than the end-of-year values shown in the gross impact evaluation tables above.

Secondary Research to Benchmark LILU Kit Subprogram Contents

Tetra Tech conducted a secondary benchmarking review on kit programs to determine how the FirstEnergy's LILU program's measures compare to other similar low income programs administered across the country to inform future program design.

Key Findings

1) Satisfaction is high with households and contractors participating in the low income programs. LILU kit participants are highly satisfied with kit contents and the instructions for installation.
2) The WARM Plus, Multifamily and WARM Extra Measures programs are leading to additional energy saving activities in the household, in order of most mentioned to least: turning off the lights when leaving the room, washing laundry in cold water, turning down the thermostat in the winter, unplugging electronics and appliances when not in use, sealing up leaky windows or doors, installing more CFLs, changing the furnace filter, and lowering the water heater temperature.

More than 40 percent of households report that direct install measures received through the WARM Extra Measures, WARM Plus, and Multifamily subprograms were not installed or only partially installed by the energy specialist, or auditor.

5.5 STATUS OF RECOMMENDATIONS FOR PROGRAM

The following recommendations resulted from the process and impact evaluation effort.

Table 5-7: Residential Low Income Program Status Report on Process and Impact Recommendations

Recommendations	EDC Status of Recommendation (Implemented, Being Considered, Rejected AND Explanation of Action Taken by EDC)
Enhance quality assurance reviews and follow-up with those contractors for whom households report measures are more frequently "left behind" for future installation.	Implemented
For the conservation kits, consider including fewer 9W globes. Customers are slower to install those than any other lamps included in the kits.	Being Considered

5.6 FINANCIAL REPORTING

A breakdown of the program finances (by program) is presented in Table 5-8. West Penn Power's Low-Income program tends to have lower TRC benefit-cost ratios than corresponding programs for other FirstEnergy Pennsylvania EDCs. Relative to these other programs, West Penn Power's program has a much smaller fraction of impacts attributable to LILU conservation kits, which tend to have high benefit-cost ratios.

Table 5-8: Summary of Program Finances

Row #	Cost Category	Actual PYTD Costs ($1,000)	Actual Phase II Costs ($1,000)
1	Incremental Measure Costs (Sum of rows 2 to 4)	$0	$1
2	EDC Incentives to Participants	$0	$1
3	EDC Incentives to Trade Allies	$0	$0
4	Participant Costs (net of incentives/rebates paid by utilities)	$0	$0
5	Program Overhead Costs (Sum of rows 6, 7, 8, 9, 10)	$2,124	$3,951
6	Design & Development	$8	$30
7	Administration, Management, and Technical Assistance[1]	$1,925	$3,468
8	Marketing[2]	$41	$81
9	EDC Evaluation Costs	$103	$173
10	SWE Audit Costs	$47	$199
11	Increases in costs of natural gas (or other fuels) for fuel switching programs	$0	$0
12	Total TRC Costs[3] (Sum of rows 1, 5 and 11)	$2,124	$3,952
13	Total NPV Lifetime Energy Benefits	$605	$981
14	Total NPV Lifetime Capacity Benefits	$60	$84
15	Total NPV TRC Benefits[4]	$664	$1,065
16	TRC Benefit-Cost Ratio[5]	0.31	0.27

NOTES

Per PUC direction, TRC inputs and calculations are required in the Annual Report only and should comply with the 2013 Total Resource Cost Test Order. Please see the "Report Definitions" section of this report for more details.

[1] Includes rebate processing, tracking system, general administration, EDC and CSP program management, general management and legal, and technical assistance.
[2] Includes the marketing CSP and marketing costs by program CSPs.
[3] Total TRC Costs includes Total EDC Costs and Participant Costs.
[4] 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. NOTE: Savings carried over from Phase I are not to be included as a part of Total TRC Benefits for Phase II.
[5] TRC Ratio equals Total NPV TRC Benefits divided by Total NPV TRC Costs.

6 C/I SMALL ENERGY EFFICIENT EQUIPMENT PROGRAM

This program provides for the implementation of cost effective, high efficiency measures through lighting, HVAC, Motors and Drives, Specialty Equipment, and Custom incentive programs. The program also offers appliance recycling, and the program component is operated in a similar manner to the residential appliance recycling program.

6.1 PROGRAM UPDATES

There were no updates to this program in PY6.

6.1.1 Definition of Participant

Each separate rebated project is counted as a participant.

6.2 IMPACT EVALUATION GROSS SAVINGS

6.2.1 Evaluation Methodology

The program has two categorical components: Equipment incentives and appliance recycling. The majority of the gross reported energy savings for this program were attributable to lighting measures, followed by custom projects and then prescriptive HVAC and appliance projects. The M&V methodology for this program is described below.

Gross Impact Evaluation for Efficient Equipment Incentives
For each sampled project, the gross impact evaluation process starts with a desk review, and often continues to an on-site verification visits, metering or logging, and data analysis. The steps are described below for lighting projects, custom projects, and prescriptive (HVAC and food service) projects.

Lighting Projects
Each sampled lighting project first undergoes a desk review. The desk review includes reconciliation of invoices, fixture specification sheets (cut sheets), and re-calculating reported savings using TRM algorithms and/or ex-ante assumptions, and identifying key parameters to be researched in the M&V plan.

Evaluation of all but the simplest of projects requires an M&V plan. The first step in the M&V planning process is to check that the project is sufficiently documented. For example, contractors working on large projects often have detailed, space-by-space inventories of the baseline and new lighting fixtures. If such detailed information is found to be lacking, ADM analysts will contact the applicant or the contractor directly, or through a request to the ICSP, and ask if such documentation is available. For large lighting projects, the M&V plan may call for sampling within the project. In such cases, the targeted precision level is ±20% at the 90% confidence level (90/20), with the sampling unit as the line item in the lighting calculator.

The desk review and M&V plan inform the data acquisition activities needed to evaluate the project. For most lighting projects, the default activities are on-site verification and logging hours of use. Most lighting

projects are metered unless there is a good reason *not* to meter[28,29]. In rare cases, the desk review process may indicate that an on-site visit would not add sufficient value to the evaluation effort. In such cases, a verification interview may suffice to reduce uncertainty regarding the project. Data analysis is finalized upon the retrieval of loggers. Billing analysis is a viable option for certain projects, and in some cases the verified results are determined wholly or partially by billing analysis.

As a final step in lighting project analysis, ADM analysts determine the incremental material and labor costs, and "dual-baseline" energy savings in cases that involve T12 lamps. In estimating the material and labor costs, preference is given first to invoices, then to the SWE incremental cost database, and then to the cost values from the CA DEER database, then to other sources as needed and described in Appendix A.

Custom Commercial and Industrial Projects

As with lighting projects, each sampled custom project undergoes a desk review prior to M&V plan construction. The desk review includes a full documentation review and if needed, additional topical research. Evaluation of most projects requires an M&V plan[30]. The first step in the M&V planning process is to check that the project is sufficiently documented, and that the evaluation engineer can articulate the mechanism or process that will yield the expected energy savings. ADM engineers are encouraged to contact the applicant early on in the M&V planning process to ask for additional documentation, clarification, or even to seek feedback on the feasibility of the proposed data acquisition and analysis methodology. The desk review and M&V plan will depend on the opportunities and constraints posed by each project. However, some defaults or "modes" are discussed for certain categories of projects below:

Air Compressor Projects: In many cases, vendors perform a baseline metering study prior to air compressor upgrades. The data collected from such studies are very useful, provided that they appear to be consistent with the overall project documentation. In many cases it is possible to use metered flow data or power data along with compressor curves to establish the facility's compressed air load profile. The energy usage of the proposed air compressor may then be derived from application of compressor curves to the compressed air load profile. Additional activities such as post-installation metering or a billing analysis may be recommended, depending on project specifics. In some cases baseline meter data are not available. In these cases ADM will meter the new air compressor and use compressor curves to establish the underlying compressed air load profile, and then determine the baseline usage through application of the baseline compressor curves and (if needed) compressor staging practices.

Water Pumping Projects: Pumping projects are typically evaluated through billing analysis, using water throughput as the normalizing variable.

[28] The most frequent reasons are that the affected lights are installed outdoors and controlled by photocells or time clocks. Increasingly, high quality trending data are available from energy management systems, and the data may be used in-lieu of logging. Other rate cases may be customer-driven, such as the requirement for explosion proof loggers in a chemical plant.

[29] Primary and secondary schools are the general exception. TRM hours of use are applied to whole-school lighting upgrades, but logging is still recommended for projects that are confined to just one location such as a gym or library.

[30] Some projects already have transparent M&V documentation including baseline and post-implementation meter data and production records. In such cases the M&V focus shifts to analysis, rather than new research and data collection.

General Process Improvements: For general process improvements, the evaluation determines the change in the energy usage intensity associated with the creation or maintenance of one production unit[31].

General Space and Process Cooling Improvements: Data acquisition for such projects involves the determination of independent variables that predict the cooling load (units produced, degree-days, etc.) along with utility bills, EMS trending data, or sub-metering. The data analysis may involve regressions or energy simulation models.

Prescriptive Non-Lighting Projects

These projects are evaluated at the basic level or rigor because they tend to represent an insignificant amount of reported impacts in the program-level sampling scheme. The process verification involves a desk review and an on-site verification or verification by interview and review of invoices and other documentation.

As with lighting projects, incremental costs are evaluated as the gross impact evaluation nears completion. In estimating the material and labor costs, preference is given first to invoices, then to the SWE incremental cost database, and then to the cost values from the CA DEER database, then to other sources as needed and described in Appendix A.

Gross Impact Evaluation for Appliance Recycling

Appliance recycling represents an insignificant amount of the program's reported impacts. The default evaluation is a database review to verify that the per-unit impacts are consistent with verified impacts from the Residential Appliance Turn-In program.

6.2.2 Program Sampling

ADM evaluated the commercial and industrial programs using stratified ratio estimation. Lighting projects with expected savings above 800 MWh, and other projects with expected savings above 400 MWh, were automatically selected for evaluation prior to rebate approval, and were thus placed in a 'certainty' or non-sampling stratum.

At the end of the second 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 qualitative measure categories, and then by quantitative subcategories defined by expected energy savings. ADM used a coefficient of variation (CV) of 0.5 for all projects.

[31] The production unit depends on the project and is determined through documentation review and interviews with the applicant. Examples include a ton of steel produced by a mill, a desired level of dissolved oxygen in a wastewater treatment plan, a ton of refrigeration, and a day of snowmaking at a ski park.

Table 6-1: Phase II C/I Small Energy Efficient Equipment Program
Reported Results by Customer Sector

Sector	Participants	Reported Gross Energy Savings (MWh/yr)	Reported Gross Demand Reduction (MW)	Incentives ($1,000)
Residential	0	0	0.00	0
Low-Income	0	0	0.00	0
Small Commercial and Industrial	775	25,788	3.52	1,729
Large Commercial and Industrial	0	0	0.00	0
Government, Non-Profit, and Institutional	169	5,304	0.92	116
Phase II Total	944	31,092	4.44	1,845

Table 6-2: C/I Small Energy Efficient Equipment Program
Sampling Strategy for Program Year 6

Stratum	Population Size	Target Levels of Confidence & Precision	Target Sample Size	Achieved Sample Size	Evaluation Activity
CFL Kits-1	0	n/a	0	0	n/a
Lighting-Certainty	1	0.0%	1	1	DR,OS,L,B
Lighting-2	22	22.5%	7	7	DR,OS,L,B
Lighting-3	62	25.6%	7	7	DR,OS,L,B
Lighting-4	258	23.6%	9	9	DR,OS,L,B
Custom-Certainty	6	0.0%	6	6	DR,OS,M,B,ES
Custom-2	0	n/a	0	0	DR,OS,M,B,ES
Custom-3	39	34.1%	4	2	DR,OS,M,B,ES
HVAC and DHW-1	0	n/a	0	0	DR,OS,M,B,ES
HVAC and DHW-2	39	71.1%	1	1	DR,OS,S
Appliance Turn-in-1	105	71.7%	1	1	DR
Kitchen/Appliances-1	11	68.6%	1	1	DR
Program Total	543	11.6%	37	35	

DR=Desk Review, S=Survey, OS=On-Site Verification, L=Logging, M=Metering,
B=Billing Analysis, ES=Energy Simulation. At least one, but not all activities are performed for each sampled project.

Table 6-3: Program Year 6 C/I Small Energy Efficient Equipment Program Summary of Evaluation Results for Energy

Stratum	Reported Gross Energy Savings (MWh/yr)	Energy Realization Rate (%)	Verified Gross Energy Savings (MWh/yr)	Observed Coefficient of Variation (C_v) or Proportion in Sample Design	Relative Precision at 85% C.L.
CFL Kits-1	0	98.0%	0	0.5	100.0%
Lighting-Certainty	668	100.0%	668	0.5	0.0%
Lighting-2	4,374	87.9%	3,844	0.5	22.5%
Lighting-3	4,567	103.2%	4,712	0.5	25.6%
Lighting-4	4,566	118.9%	5,427	0.5	23.6%
Custom-Certainty	759	86.8%	659	0.5	0.0%
Custom-2	0	n/a	0	0.5	0.0%
Custom-3	1,653	99.5%	1,644	0.5	49.6%
HVAC and DHW-1	0	n/a	0	0.5	0.0%
HVAC and DHW-2	160	37.3%	60	0.5	71.1%
Appliance Turn-in-1	86	100.0%	86	0.5	71.7%
Kitchen/Appliances-1	73	100.0%	73	0.5	68.6%
Program Total	16,906	101.6%	17,172		12.4%

Table 6-4: Program Year 6 C/I Small Energy Efficient Equipment Program Summary of Evaluation Results for Demand

Stratum	Reported Gross Demand Savings (MW)	Demand Realization Rate (%)	Verified Gross Demand Savings (MW)	Observed Coefficient of Variation (C_v) or Proportion in Sample Design	Relative Precision at 85% C.L.
CFL Kits-1	0.00	111.8%	0.00	0.5	100.0%
Lighting-Certainty	0.21	100.0%	0.21	0.5	0.0%
Lighting-2	0.63	119.8%	0.76	0.5	22.5%
Lighting-3	0.59	115.0%	0.68	0.5	25.6%
Lighting-4	0.70	144.7%	1.01	0.5	23.6%
Custom-Certainty	0.14	81.1%	0.11	0.5	0.0%
Custom-2	0.00	n/a	0.00	0.5	0.0%
Custom-3	0.22	95.0%	0.21	0.5	49.6%
HVAC and DHW-1	0.00	n/a	0.00	0.5	0.0%
HVAC and DHW-2	0.12	33.5%	0.04	0.5	71.1%
Appliance Turn-in-1	0.02	100.0%	0.02	0.5	71.7%
Kitchen/Appliances-1	0.01	n/a	0.00	0.5	0.0%
Program Total	2.63	115.4%	3.03		11.8%

6.2.3 On-Site Inspections

The Company's ICSP, CLEAResult, conducts QA/QC on-site inspections for 5% of pending rebate applications. The QA/QC visits are conducted prior to rebate approval, and can occur prior to or after

measure installation[32]. Nonresidential energy efficiency projects typically involve complex or numerous energy efficiency measures. It is therefore inadequate to classify inspections in a binary (e.g. Pass/Fail) manner. Site inspections may result in three general outcomes:

Case 1: The reported energy efficiency measures are found to be installed as described in rebate application materials

Case2: The energy efficiency project is completed, but there may be minor discrepancies between the installed measures and the associated documentation. These can include:

- A discrepancy in the quantities for some or all of the energy efficiency measures
- A discrepancy in the description of the energy efficiency measure (e.g. fixture wattage, HVAC system capacity or efficiency, motor horsepower or efficiency)
- A discrepancy in the baseline equipment
- A mischaracterization of equipment operation (e.g. lighting hours of use or control type, VFD control feedback mechanism, space heating and cooling set points)

Case 3: The energy efficiency project is not completed, or there are major discrepancies in the attributes discussed above in Case 2.

The on-site inspections occur prior to rebate approval. Approximately (34%)[33] of QA/QC inspections correspond to Case 1 above. Approximately 66% of on-site inspections result in a "Case 2" finding. In such cases, the application materials are updated to reflect the as-found equipment, and the rebate application is processed accordingly. Note that most "Case 2" findings do not result in material changes to the ex-ante savings[34] – the high proportion of site-visits that fall into this case is mostly a function of Case 1 being reserved for perfection.

This may involve an adjustment to the rebate amount and to the reported impacts in CLEAResult's tracking and reporting system[35]. In the event of a Case 3 finding, the rebate application is cancelled. Based on CLEAResult's historical records, this scenario occurs approximately 0% of the time.

These QA/QC activities are exclusive of ADM's on-site verification activities. ADM's independent evaluation activities are described in the preceding section, and the program realization rates are informed, in part, by on-site findings. The primary source of variance between reported and verified impacts are not due to failures in verification, but rather to differences between planning assumptions and ex-post measurements in key parameters that describe operational characteristics. These include hours of use for lighting, both hours of use and part-load conditions for HVAC, refrigeration, and motors.

[32] In cases where baseline conditions are critical to the overall project energy savings calculation CLEAResult staff may conduct baseline on-site inspections. These inspections may also involve metering to help determine baseline lighting hours of use or other attributes that may correlate with the project's energy savings.

[33] Percentages here apply to all CLEAResult administered programs for all four FirstEnergy Pennsylvania EDCs.

[34] ADM reviewed summary of 110 on-site inspections conducted by CLEAResult in PY6, and developed a 'QC realization rate' to help inform the annual report. The QC realization rate was 98%, with a CV of 0.39. The adjustments made by CLEAResult accounted for variations in hours of use as well as variations in equipment specification.

[35] Adjustments to the Company's tracking and reporting are not necessary because QA/QC inspections occur prior to rebate approval.

6.3 IMPACT EVALUATION NET SAVINGS

Tetra Tech conducted the NTG research according to the Common Approach, Statewide Evaluator Guidance Memos GM-024 (Consistent Freeridership methodology) and GM-025 (Consistent Spillover methodology) using the participant self-report method. Participant data for Phase II, PY6 (Q1-Q4) was first aggregated to the level of individual participants based on account number and multiple record accounts were identified. After the multiple accounts were sampled, the final random sample was selected. The NTG research was conducted in conjunction with the process evaluation effort.

Table 6-5: C/I Small Energy Efficient Equipment Program
Sampling Strategy for Program Year 6 NTG Research

Stratum	Population Size	Assumed CV or Proportion in Sample Design	Assumed Levels of Confidence & Precision	Target Sample size	Achieved Sample Size	Percent of Sample Frame Contacted[36] to Achieve Sample
Lighting	343	P=0.5	85/15	22	39	n/a
Custom	45	P=0.5	85/15	3	8	n/a
HVAC and DHW	39	P=0.5	85/15	3	7	n/a
Kitchen/Appliances	116	P=0.5	85/15	7	9	n/a
Program Total	543		85/15	35	63	24%(N=128)

Table 6-6: Program Year 6 C/I Small Energy Efficient Equipment Program
Summary of Evaluation Results for NTG Research

Target Group or Stratum (if appropriate)	Estimated Free Ridership	Estimated Participant Spillover	NTG Ratio	Observed Coefficient of Variation or Proportion	Relative Precision
Lighting	34.6%	10.0%	75.4%	0.37	8.1%
Custom	64.1%	12.6%	48.6%	0.49	22.7%
HVAC and DHW	57.1%	12.0%	54.9%	0.41	20.2%
Kitchen/Appliances	45.8%	9.8%	63.9%	0.41	19.0%
Program Total[37]	39.1%	10.4%	71.2%		7.5%

6.4 PROCESS EVALUATION

Tetra Tech conducted the process evaluation in conjunction with the NTG research. These activities included:

FirstEnergy and Program Implementer Staff In-depth Interviews

Tetra Tech and ADM conducted in-depth interviews with FirstEnergy program staff and the ICSP to discuss Phase II design and implementation updates, program goals, and key researchable issues of interest for

[36] Sample frame is a list of contacts that have a chance to be selected into the sample. Percent contacted means of all the sample frame how many were called to get the completes.

[37] NTG ratio at program level should be developed using stratum weight and stratum NTG ratios.

the Phase II evaluation. The interviews assessed the effectiveness of the program's current operations, detailed program implementation practices, and identified key researchable topics. In addition, both FirstEnergy and ICSP staff provided input on the types of information that would be most beneficial to design and implementation efforts.

Participant Surveys

The participant surveys gathered data and information related to assess free-ridership and spillover and process related topics. The topic areas included:

- Program awareness and marketing
- The company's decision-making process in regards to new equipment
- Energy efficiency at the company
- Program satisfaction

Participant data for Phase II, PY6 (Q1-Q4) was first aggregated to the level of individual participants based on account number and multiple record accounts were identified. After the multiple accounts were sampled, the final random sample was selected. The process evaluation survey research was conducted in conjunction with the NTG research.

Table 6-7: C/I Small Energy Efficient Equipment Program Sampling Strategy for Program Year 6

Target Group or Stratum (if appropriate)	Population Size	Assumed Proportion or CV in Sample Design	Assumed Levels of Confidence & Precision	Target Sample Size	Achieved Sample Size	Percent of Population Frame Contacted to Achieve Sample	Used For Evaluation Activities (Impact, Process, NTG)
Lighting	343	P=0.5	85/15	22	39	n/a	Process, NTG
Custom	45	P=0.5	85/15	3	8	n/a	Process, NTG
HVAC and DHW	39	P=0.5	85/15	3	7	n/a	Process, NTG
Kitchen/Appliances	116	P=0.5	85/15	7	9	n/a	Process, NTG
Program Total	543		85/15	35	63	24%(N=128)	

Key Findings[38]

1) Participants report high levels of satisfaction with all aspects of the program. Program participants are highly satisfied with the overall program and more than 90 percent of customers said they would likely participate in the program again in the future. Each individual aspect of the program received an average rating of "highly satisfied," with the exception of the incentive amount, which received a mean satisfaction just shy of "highly satisfied". Most participants said they did not experience any obstacles or barriers while implementing their project (89 percent) – and those that had difficulties, the issues were typically internal to the customer (e.g. convincing management to fund initial costs). Lastly, two-thirds of customers have recommended the program to colleagues in their industry.

[38] Key findings are reported in aggregate for the four FirstEnergy PA EDCs. Results were very similar for each EDC and for each program.

2) Almost all aspects of program satisfaction rated higher in Phase II than Phase I. When compared with results from the Phase I C&I evaluation, all aspects of program satisfaction increased in average score between Phase I and Phase II, with the exception of the incentive offered, which decreased marginally.
3) The participant information files are improved from Phase I. Interview staff reported high levels of survey completion on their first attempt to contact respondents, which is atypical for C&I studies. The high quality sample information resulted in above-average numbers of participants calling the survey lab to complete the survey, a fact that is directly correlated with the advance letter reaching the correct individual within the firm.
4) Although customers' stated preference of receiving information about energy efficiency via email or direct mail, contractors are successfully marketing the programs to customers. Two-thirds (67 percent) of respondents indicated their preferred method of communication is email newsletters, while 30 percent said they preferred direct mail from their EDC. However, more than half (54 percent) of respondents learned about the program through their contractor.
5) Budget and financial plans fall into two planning periods. Almost 45 percent of customers indicated their firm creates budgets/financial plans of one year or less, while 35 percent of customers said their business' budgets/financial plans span five years or longer. Responses differed between strata – large C&I customers are more likely to create plans spanning more than 5 years (47 percent), while small C&I and GNI customers typically plan in one-year increments (50 percent and 53 percent, respectively).
6) The budget cycle was a primary factor for when projects can be implemented. Of the 45 percent of respondents who indicated that they had business or production cycles that affect planning and implementation of efficiency projects, more than half of respondents (53 percent) have budget and financial planning cycles that affect when projects can be planned and implemented. Customers' budget and financial planning periods overwhelmingly fall into two categories, under one year or five years and longer. Customers often cited financial plans and budgets as a driving force behind whether energy improvements could be pursued, highlighting the crucial role of working alongside customers during their planning and budgeting periods.

6.5 STATUS OF RECOMMENDATIONS FOR PROGRAM

The following recommendations resulted from the process and impact evaluation effort.

Table 6-8: C/I Small Energy Efficient Equipment Program
Status Report on Process and Impact Recommendations

Recommendations	EDC Status of Recommendation (Implemented, Being Considered, Rejected AND Explanation of Action Taken by EDC)
Ensure continued engagement with past participants as they are likely to participate in the future.	Implemented
If participation is lacking in the future, consider a referral/recruitment award program from past participants.	Being Considered

6.6 FINANCIAL REPORTING

A breakdown of the program finances (by program) is presented in Table. It is expected that the program's TRC will continue to climb as the volume of projects continues to dilute fixed costs associated with program administration and evaluation. In PY6 WPP had several large projects for institutional customers that were especially costly, but were likely to produce energy savings for longer than 15 years. These projects had a negative impact on the TRC for PY6, although the benefit-cost ratio was close to 1.0.

Table 6-9: Summary of Program Finances

Row #	Cost Category	Actual PYTD Costs ($1,000)	Actual Phase II Costs ($1,000)
1	Incremental Measure Costs (Sum of rows 2 to 4)	$7,324	$8,758
2	EDC Incentives to Participants	$1,087	$1,845
3	EDC Incentives to Trade Allies	$0	$0
4	Participant Costs (net of incentives/rebates paid by utilities)	$6,236	$6,913
5	Program Overhead Costs (Sum of rows 6, 7, 8, 9, 10)	$1,541	$3,397
6	Design & Development	$9	$26
7	Administration, Management, and Technical Assistance[1]	$1,162	$2,653
8	Marketing[2]	$210	$408
9	EDC Evaluation Costs	$108	$135
10	SWE Audit Costs	$52	$175
11	Increases in costs of natural gas (or other fuels) for fuel switching programs	$0	$0
12	Total TRC Costs[3] (Sum of rows 1, 5 and 11)	$8,865	$12,155
13	Total NPV Lifetime Energy Benefits	$8,132	$9,824
14	Total NPV Lifetime Capacity Benefits	$1,224	$1,502
15	Total NPV TRC Benefits[4]	$9,356	$11,325
16	TRC Benefit-Cost Ratio[5]	1.06	0.93

NOTES

Per PUC direction, TRC inputs and calculations are required in the Annual Report only and should comply with the 2013 Total Resource Cost Test Order. Please see the "Report Definitions" section of this report for more details.

[1] Includes rebate processing, tracking system, general administration, EDC and CSP program management, general management and legal, and technical assistance.
[2] Includes the marketing CSP and marketing costs by program CSPs.
[3] Total TRC Costs includes Total EDC Costs and Participant Costs.
[4] 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. NOTE: Savings carried over from Phase I are not to be included as a part of Total TRC Benefits for Phase II.
[5] TRC Ratio equals Total NPV TRC Benefits divided by Total NPV TRC Costs.

7 C/I SMALL ENERGY EFFICIENT BUILDINGS PROGRAM

This program has two broad components. The first component is energy conservation kits delivered by mail to nonresidential customers. The second component includes custom "whole building" projects such as new construction, retro-commissioning, and building envelope improvements.

7.1 PROGRAM UPDATES

The program had no major updates in PY6.

7.1.1 Definition of Participant

Each separate rebated project is counted as a participant.

7.2 IMPACT EVALUATION GROSS SAVINGS

7.2.1 Evaluation Methodology

The projects rebated under this program include energy conservation kits as well as custom projects that involve new construction, retro-commissioning, building envelope improvements. The M&V methodology for this program is described below.

Gross Impact Evaluation for Conservation Kits

The program distributed conservation kits consisting of 13W and 23W or 26W CFLS to commercial and industrial customers, and kits consisting of 13W and 20W CFLs, and a pair of LED night lights, to apartment complexes.

ADM's evaluation strategy is to first place the CFLs into one of the following categories

1) Whereabouts unknown: The customer did not receive the CFL conservation kit
2) The CFL was found to be broken upon arrival
3) The CFL has arrived, and is installed in a non-residential setting
4) The CFL has been taken to business owner's residence for residential use, or has been distributed to an employee, parishioner, etc. for residential use.
5) The CFL is in storage, and will likely replace other CFLs that arrived in the kit
6) The CFL is in storage, and will likely replace other, non-kit lamps as they burn out.

CFLs that are determined to be in categories 1, 2, and 5 above are credited zero kWh and kW impacts. CFLs that are in category 4 are evaluated according to the 2013 TRM protocols for CFLs in the residential sector. CFLs in category 3 are evaluated with nonresidential TRM protocols, and with hours of use and coincidence factors as determined from the 2014 Metering Study conducted by the SWE[39]. CFLs in category 6 are evaluated as CFLs in category 3. The fractions of distributed CFLs in each of the above six categories are determined primarily through surveys. ADM conducted 96 surveys among all four FirstEnergy PA EDCs and used the results to formulate in-service rates by facility type. The stratification followed facility types because the number of eligible sockets for screw-based lamps varies considerably with facility types, and the in-service rates tend to vary according to the number of available sockets.

[39] Pennsylvania Statewide ACT 129 2014 Commercial & Residential Light Metering Study, Table 4-13 for Interior Screw-Base CFLs and LEDs.

The nonresidential TRM protocols also include HVAC interactive effects. ADM applied the 12% and 34% values for energy and demand respectively, but also included HVAC applicability factors at the sector level to account for CFLs that are not installed in air conditioned space.

As a last step, ADM identified the fraction of CFLs that were originally sent to a business, but were later distributed for residential use by the business owner. This "cross sector" migration percentage accounts for the participants and impacts reported in the residential sector below. For this program component, cross-sector migration tends to reduce energy savings and demand reductions because the residential sector has lower lighting hours of use and coincidence factors. Portfolio level cross-sector sales determination and the associated adjustments to verified impacts and incentives are discussed in detail in Appendix D.

Gross Impact Evaluation for Efficient Equipment Incentives

Sampling and project-level gross impact evaluation methodologies for efficient equipment and building upgrade measures are identical to the methodology described in Section 6 for the C/I Small Efficient Equipment Program. The projects in this program tend to involve new construction, retro-commissioning, and other controls or envelope upgrades that tend to affect the systemic energy usage performance of the involved facilities. Data acquisition for such projects involves the determination of independent variables that predict the heating and cooling loads along with utility bills, EMS trending data, or sub-metering. The data analysis may involve regressions or energy simulation models.

Table 7-1: Phase II C/I Small Energy Efficient Buildings Program Reported Results by Customer Sector

Sector	Participants	Reported Gross Energy Savings (MWh/yr)	Reported Gross Demand Reduction (MW)	Incentives ($1,000)
Residential	882	727	0.13	64
Low-Income	0	0	0.00	0
Small Commercial and Industrial	4,625	4,136	0.83	129
Large Commercial and Industrial	0	0	0.00	0
Government, Non-Profit, and Institutional	696	991	0.29	9
Phase II Total	6,203	5,854	1.24	202

Table 7-2: C/I Small Energy Efficient Buildings Program Sampling Strategy for Program Year 6

Stratum	Population Size	Target Levels of Confidence & Precision	Target Sample Size	Achieved Sample Size	Evaluation Activity
CFL Kits-1	3575	17.4%	17	27	S
Lighting-Certainty	0	n/a	0	0	DR,OS,L,B
Lighting-2	0	n/a	0	0	DR,OS,L,B
Lighting-3	0	n/a	0	0	DR,OS,L,B
Lighting-4	0	n/a	0	0	DR,OS,L,B
Custom-Certainty	0	n/a	0	0	DR,OS,M,B,ES
Custom-2	0	n/a	0	0	DR,OS,M,B,ES
Custom-3	7	31.4%	3	3	DR,OS,M,B,ES
HVAC and DHW-1	0	n/a	0	0	DR,OS,M,B,ES
HVAC and DHW-2	0	n/a	0	0	DR,OS,S
Appliance Turn-in-1	0	n/a	0	0	DR
Kitchen/Appliances-1	0	n/a	0	0	DR
Program Total	3582	15.5%	20	30	

DR=Desk Review, S=Survey, OS=On-Site Verification, L=Logging, M=Metering, B=Billing Analysis, ES=Energy Simulation. At least one, but not all activities are performed for each sampled project.

Table 7-3: Program Year 6 C/I Small Energy Efficient Buildings Program Summary of Evaluation Results for Energy

Stratum	Reported Gross Energy Savings (MWh/yr)	Energy Realization Rate (%)	Verified Gross Energy Savings (MWh/yr)	Observed Coefficient of Variation (C_v) or Proportion in Sample Design	Relative Precision at 85% C.L.
CFL Kits-1	2,821	84.0%	2,369	0.5	13.8%
Lighting-Certainty	0	n/a	0	0.5	0.0%
Lighting-2	0	n/a	0	0.5	0.0%
Lighting-3	0	n/a	0	0.5	0.0%
Lighting-4	0	n/a	0	0.5	0.0%
Custom-Certainty	0	n/a	0	0.5	0.0%
Custom-2	0	n/a	0	0.5	0.0%
Custom-3	521	65.4%	341	0.5	31.4%
HVAC and DHW-1	0	n/a	0	0.5	0.0%
HVAC and DHW-2	0	n/a	0	0.5	0.0%
Appliance Turn-in-1	0	n/a	0	0.5	0.0%
Kitchen/Appliances-1	0	n/a	0	0.5	0.0%
Program Total	3,342	81.1%	2,710		12.7%

Table 7-4: Program Year 6 C/I Small Energy Efficient Buildings Program Summary of Evaluation Results for Demand

Stratum	Reported Gross Demand Savings (MW)	Demand Realization Rate (%)	Verified Gross Demand Savings (MW)	Observed Coefficient of Variation (C_v) or Proportion in Sample Design	Relative Precision at 85% C.L.
CFL Kits-1	0.51	84.4%	0.43	0.5	13.8%
Lighting-Certainty	0.00	n/a	0.00	0.5	0.0%
Lighting-2	0.00	n/a	0.00	0.5	0.0%
Lighting-3	0.00	n/a	0.00	0.5	0.0%
Lighting-4	0.00	n/a	0.00	0.5	0.0%
Custom-Certainty	0.00	n/a	0.00	0.5	0.0%
Custom-2	0.00	n/a	0.00	0.5	0.0%
Custom-3	0.18	n/a	0.00	0.5	0.0%
HVAC and DHW-1	0.00	n/a	0.00	0.5	0.0%
HVAC and DHW-2	0.00	n/a	0.00	0.5	0.0%
Appliance Turn-in-1	0.00	n/a	0.00	0.5	0.0%
Kitchen/Appliances-1	0.00	n/a	0.00	0.5	0.0%
Program Total	0.69	62.6%	0.43		13.8%

7.2.1 On-Site Inspections

This program has two components: Conservation Kits and downstream rebates for commercial and industrial energy efficiency projects. There are no on-site visits conducted for the conservation kits. All other projects are eligible for on-site QA/QC inspections. These QA/QC inspections are identical in process as the effort described for the C/I Small Energy Efficient Equipment Program.

As with other nonresidential programs, CLEAResult's QA/QC activities are exclusive of ADM's on-site verification activities. ADM's independent evaluation activities are described in the preceding section. The program realization rates are informed, in part, by on-site findings. The primary source of variance between reported and verified impacts are not due to failures in verification, but rather to differences between planning assumptions and ex-post measurements in key parameters that describe operational characteristics. This program may involve projects that involve relatively complex calculations, including building energy simulations and engineering calculations. In many cases, discrepancies between reported and verified impacts result from differences in calculation methodologies and data sources. The impact evaluation effort has the benefit of having access to post-installation utility meter data, trending data, or logger data, and often the newly available information helps to improve project savings estimates.

7.3 IMPACT EVALUATION NET SAVINGS

A NTG evaluation was not conducted for this program in PY6.

7.4 PROCESS EVALUATION

A process evaluation was not conducted for this program in PY6.

7.5 STATUS OF RECOMMENDATIONS FOR PROGRAM

Table 7-5: Program Year 6 C/I Small Energy Efficient Buildings
Status Report on Process and Impact Recommendations

Recommendations	EDC Status of Recommendation (Implemented, Being Considered, Rejected AND Explanation of Action Taken by EDC)
In Phase III, consider subsuming this program into the C/I Small Energy Efficient Equipment Program to reduce administrative costs and to ensure adequate budget is available in case participation levels increase significantly.	Under consideration

7.6 FINANCIAL REPORTING

A breakdown of the program finances (by program) is presented in Table 7-6. This program's TRC benefit-cost ratio is relatively low primarily because the program has not yet achieved the scale necessary to dilute fixed costs associated with implementation.

Table 7-6: Summary of Program Finances

Row #	Cost Category	Actual PYTD Costs ($1,000)	Actual Phase II Costs ($1,000)
1	Incremental Measure Costs (Sum of rows 2 to 4)	$653	$942
2	EDC Incentives to Participants	$202	$344
3	EDC Incentives to Trade Allies	$0	$0
4	Participant Costs (net of incentives/rebates paid by utilities)	$451	$597
5	Program Overhead Costs (Sum of rows 6, 7, 8, 9, 10)	$571	$1,088
6	Design & Development	$3	$9
7	Administration, Management, and Technical Assistance[1]	$433	$825
8	Marketing[2]	$101	$173
9	EDC Evaluation Costs	$15	$19
10	SWE Audit Costs	$19	$63
11	Increases in costs of natural gas (or other fuels) for fuel switching programs	$0	$0
12	Total TRC Costs[3] (Sum of rows 1, 5 and 11)	$1,224	$2,030
13	Total NPV Lifetime Energy Benefits	$724	$814
14	Total NPV Lifetime Capacity Benefits	$115	$133
15	Total NPV TRC Benefits[4]	$840	$947
16	TRC Benefit-Cost Ratio[5]	0.69	0.47

NOTES

Per PUC direction, TRC inputs and calculations are required in the Annual Report only and should comply with the 2013 Total Resource Cost Test Order. Please see the "Report Definitions" section of this report for more details.

[1] Includes rebate processing, tracking system, general administration, EDC and CSP program management, general management and legal, and technical assistance.
[2] Includes the marketing CSP and marketing costs by program CSPs.
[3] Total TRC Costs includes Total EDC Costs and Participant Costs.
[4] 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. NOTE: Savings carried over from Phase I are not to be included as a part of Total TRC Benefits for Phase II.
[5] TRC Ratio equals Total NPV TRC Benefits divided by Total NPV TRC Costs.

8 C/I LARGE ENERGY EFFICIENT EQUIPMENT PROGRAM

This program provides for the implementation of cost effective, high efficiency measures through lighting, HVAC, Motors and Drives, Specialty Equipment, and Custom incentive programs. In addition to rebates, the program distributed conservation kits consisting of CFLs and smart power strips to several master metered multi-family communities. The program also offers appliance recycling, and the program component is operated in a similar manner to the residential appliance recycling program.

8.1 PROGRAM UPDATES

There were no updates to this program in PY6.

8.1.1 Definition of Participant

Each separate rebated project is counted as a participant.

8.2 IMPACT EVALUATION GROSS SAVINGS

8.2.1 Evaluation Methodology

The projects rebated under this program include equipment upgrades and custom projects that often involve hardware and process improvements at industrial facilities. The M&V methodology for this program is described below.

Gross Impact Evaluation for Efficient Equipment Incentives
For each sampled project, the gross impact evaluation process starts with a desk review, and often continues to an on-site verification visits, metering or logging, and data analysis. The steps are described below for lighting projects, custom projects, and prescriptive (HVAC and food service) projects.

Lighting Projects
Each sampled lighting project first undergoes a desk review. The desk review includes reconciliation of invoices, fixture specification sheets (cut sheets), and re-calculating reported savings using TRM algorithms and/or ex-ante assumptions, and identifying key parameters to be researched in the M&V plan.

Evaluation of all but the simplest of projects requires an M&V plan. The first step in the M&V planning process is to check that the project is sufficiently documented. For example, contractors working on large projects often have detailed, space-by-space inventories of the baseline and new lighting fixtures. If such detailed information is found to be lacking, ADM analysts will contact the applicant or the contractor directly, or through a request to the ICSP, and ask if such documentation is available. For large lighting projects, the M&V plan may call for sampling within the project. In such cases, the targeted precision level is ±20% at the 90% confidence level (90/20), with the sampling unit as the line item in the lighting calculator.

The desk review and M&V plan inform the data acquisition activities needed to evaluate the project. For most lighting projects, the default activities are on-site verification and logging hours of use. Most lighting

projects are metered unless there is a good reason to *not* to meter[40,41]. In rare cases, the desk review process may indicate that an on-site visit would not add sufficient value to the evaluation effort. In such cases, a verification interview may suffice to reduce uncertainty regarding the project. Data analysis is finalized upon the retrieval of loggers. Billing analysis is a viable option for certain projects, and in some cases the verified results are determined wholly or partially by billing analysis.

As a final step in lighting project analysis, ADM analysts determine the incremental material and labor costs, and "dual-baseline" energy savings in cases that involve T12 lamps. In estimating the material and labor costs, preference is given first to invoices, then to the SWE incremental cost database, and then to the cost values from the CA DEER database, then to other sources as needed and described in Appendix A.

Custom Commercial and Industrial Projects

As with lighting projects, each sampled custom project undergoes a desk review prior to M&V plan construction. The desk review includes a full documentation review and if needed, additional topical research. Evaluation of most projects requires an M&V plan[42]. The first step in the M&V planning process is to check that the project is sufficiently documented, and that the evaluation engineer can articulate the mechanism or process that will yield the expected energy savings. ADM engineers are encouraged to contact the applicant early on in the M&V planning process to ask for additional documentation, clarification, or even to seek feedback on the feasibility of the proposed data acquisition and analysis methodology. The desk review and M&V plan will depend on the opportunities and constraints posed by each project. However, some defaults or "modes" are discussed for certain categories of projects below:

Air Compressor Projects: In many cases, vendors perform a baseline metering study prior to air compressor upgrades. The data collected from such studies are very useful, provided that they appear to be consistent with the overall project documentation. In many cases it is possible to use metered flow data or power data along with compressor curves to establish the facility's compressed air load profile. The energy usage of the proposed air compressor may then be derived from application of compressor curves to the compressed air load profile. Additional activities such as post-installation metering or a billing analysis may be recommended, depending on project specifics. In some cases baseline meter data are not available. In these cases ADM will meter the new air compressor and use compressor curves to establish the underlying compressed air load profile, and then determine the baseline usage through application of the baseline compressor curves and (if needed) compressor staging practices.

Water Pumping Projects: Pumping projects are typically evaluated through billing analysis, using water throughput as the normalizing variable.

[40] The most frequent reasons are that the affected lights are installed outdoors and controlled by photocells or time clocks. Increasingly, high quality trending data are available from energy management systems, and the data may be used in-lieu of logging. Other rate cases may be customer-driven, such as the requirement for explosion proof loggers in a chemical plant.

[41] Primary and secondary schools are the general exception. TRM hours of use are applied to whole-school lighting upgrades, but logging is still recommended for projects that are confined to just one location such as a gym or library.

[42] Some projects already have transparent M&V documentation including baseline and post-implementation meter data and production records. In such cases the M&V focus shifts to analysis, rather than new research and data collection.

General Process Improvements: For general process improvements, the evaluation determines the change in the energy usage intensity associated with the creation or maintenance of one production unit[43].

General Space and Process Cooling Improvements: Data acquisition for such projects involves the determination of independent variables that predict the cooling load (units produced, degree-days, etc.) along with utility bills, EMS trending data, or sub-metering. The data analysis may involve regressions or energy simulation models.

Prescriptive Non-Lighting Projects

These projects are evaluated at the basic level or rigor because they tend to represent an insignificant amount of reported impacts in the program-level sampling scheme. The process verification involves a desk review and an on-site verification or verification by interview and review of invoices and other documentation. As with lighting projects, incremental costs are evaluated as the gross impact evaluation nears completion. In estimating the material and labor costs, preference is given first to invoices, then to the SWE incremental cost database, and then to the cost values from the CA DEER database, then to other sources as needed and described in Appendix A.

8.2.1 Program Sampling

ADM evaluated the commercial and industrial programs using stratified ratio estimation. Lighting projects with expected savings above 800 MWh, and other projects with expected savings above 400 MWh, were automatically selected for evaluation prior to rebate approval, and were thus placed in a 'certainty' or non-sampling stratum.

At the end of the second 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 qualitative measure categories, and then by quantitative subcategories defined by expected energy savings. ADM used a coefficient of variation (CV) of 0.5 for all projects

Table 8-1: Phase II C/I Large Efficient Equipment Program Reported Results by Customer Sector

Sector	Participants	Reported Gross Energy Savings (MWh/yr)	Reported Gross Demand Reduction (MW)	Incentives ($1,000)
Residential	0	0	0.00	0
Low-Income	0	0	0.00	0
Small Commercial and Industrial	0	0	0.00	0
Large Commercial and Industrial	133	55,279	5.86	1,997
Government, Non-Profit, and Institutional	56	10,689	1.31	177
Phase II Total	189	65,968	7.17	2,174

[43] The production unit depends on the project and is determined through documentation review and interviews with the applicant. Examples include a ton of steel produced by a mill, a desired level of dissolved oxygen in a wastewater treatment plan, a ton of refrigeration, and a day of snowmaking at a ski park.

Table 8-2: C/I Large Efficient Equipment Program
Sampling Strategy for Program Year 6

Stratum	Population Size	Target Levels of Confidence & Precision	Target Sample Size	Achieved Sample Size	Evaluation Activity
CFL Kits-1	0	n/a	0	0	n/a
Lighting-Certainty	4	0.0%	4	4	DR,OS,L,B
Lighting-2	5	39.4%	2	2	DR,OS,L,B
Lighting-3	8	32.9%	3	3	DR,OS,L,B
Lighting-4	60	40.5%	3	3	DR,OS,L,B
Custom-Certainty	16	0.0%	16	16	DR,OS,M,B,ES
Custom-2	10	45.5%	2	2	DR,OS,M,B,ES
Custom-3	0	n/a	0	0	DR,OS,M,B,ES
HVAC and DHW-1	0	n/a	0	0	DR,OS,M,B,ES
HVAC and DHW-2	3	58.8%	1	1	DR,OS,S
Appliance Turn-in-1	0	n/a	0	0	DR
Kitchen/Appliances-1	0	n/a	0	0	DR
Program Total	106	4.0%	31	31	

Table 8-3: Program Year 6 C/I Large Efficient Equipment Program Summary of Evaluation Results for Energy

Stratum	Reported Gross Energy Savings (MWh/yr)	Energy Realization Rate (%)	Verified Gross Energy Savings (MWh/yr)	Observed Coefficient of Variation (C_v) or Proportion in Sample Design	Relative Precision at 85% C.L.
CFL Kits-1	0	100.0%	0	0.5	100.0%
Lighting-Certainty	9,288	100.0%	9,288	0.5	0.0%
Lighting-2	2,267	93.5%	2,118	0.5	39.4%
Lighting-3	2,131	102.7%	2,188	0.5	32.9%
Lighting-4	2,442	90.3%	2,205	0.5	40.5%
Custom-Certainty	29,155	99.3%	28,949	0.5	0.0%
Custom-2	2,546	134.8%	3,433	0.5	45.5%
Custom-3	0	n/a	0	0.5	0.0%
HVAC and DHW-1	0	n/a	0	0.5	0.0%
HVAC and DHW-2	14	111.9%	15	0.5	58.8%
Appliance Turn-in-1	0	n/a	0	0.5	0.0%
Kitchen/Appliances-1	0	n/a	0	0.5	0.0%
Program Total	47,843	100.7%	48,196		4.4%

Table 8-4: Program Year 6 C/I Large Efficient Equipment Program Summary of Evaluation Results for Demand

Stratum	Reported Gross Demand Savings (MW)	Demand Realization Rate (%)	Verified Gross Demand Savings (MW)	Observed Coefficient of Variation (C_v) or Proportion in Sample Design	Relative Precision at 85% C.L.
CFL Kits-1	0.00	100.0%	0.00	0.5	100.0%
Lighting-Certainty	1.12	100.0%	1.12	0.5	0.0%
Lighting-2	0.27	112.5%	0.30	0.5	39.4%
Lighting-3	0.10	122.7%	0.12	0.5	32.9%
Lighting-4	0.37	91.4%	0.34	0.5	40.5%
Custom-Certainty	2.96	99.1%	2.94	0.5	0.0%
Custom-2	0.28	89.2%	0.25	0.5	45.5%
Custom-3	0.00	n/a	0.00	0.5	0.0%
HVAC and DHW-1	0.00	n/a	0.00	0.5	0.0%
HVAC and DHW-2	0.00	100.0%	0.00	0.5	58.8%
Appliance Turn-in-1	0.00	n/a	0.00	0.5	0.0%
Kitchen/Appliances-1	0.00	n/a	0.00	0.5	0.0%
Program Total	5.11	99.4%	5.07		4.3%

8.2.1 On-Site Inspections

The Company's ICSP, CLEAResult, conducts QA/QC on-site inspections for 5% of pending rebate applications. The QA/QC visits are conducted prior to rebate approval, and can occur prior to or after measure installation[44]. Nonresidential energy efficiency projects typically involve complex or numerous energy efficiency measures. It is therefore inadequate to classify inspections in a binary (e.g. Pass/Fail) manner. Site inspections may result in three general outcomes:

Case 1: The reported energy efficiency measures are found to be installed as described in rebate application materials

Case2: The energy efficiency project is completed, but there may be minor discrepancies between the installed measures and the associated documentation. These can include:

- A discrepancy in the quantities for some or all of the energy efficiency measures
- A discrepancy in the description of the energy efficiency measure (e.g. fixture wattage, HVAC system capacity or efficiency, motor horsepower or efficiency)
- A discrepancy in the baseline equipment
- A mischaracterization of equipment operation (e.g. lighting hours of use or control type, VFD control feedback mechanism, space heating and cooling set points)

Case 3: The energy efficiency project is not completed, or there are major discrepancies in the attributes discussed above in Case 2.

The on-site inspections occur prior to rebate approval. Approximately (34%)[45] of QA/QC inspections correspond to Case 1 above. Approximately 66% of on-site inspections result in a "Case 2" finding. In such cases, the application materials are updated to reflect the as-found equipment, and the rebate application is processed accordingly. Note that most "Case 2" findings do not result in material changes to the ex-ante savings[46] – the high proportion of site-visits that fall into this case is mostly a function of Case 1 being reserved for perfection.

This may involve an adjustment to the rebate amount and to the reported impacts in CLEAResult's tracking and reporting system[47]. In the event of a Case 3 finding, the rebate application is cancelled. Based on CLEAResult's historical records, this scenario occurs approximately 0% of the time.

These QA/QC activities are exclusive of ADM's on-site verification activities. ADM's independent evaluation activities are described in the preceding section, and the program realization rates are informed, in part, by on-site findings. The primary source of variance between reported and verified impacts are not due to failures in verification, but rather to differences between planning assumptions

[44] In cases where baseline conditions are critical to the overall project energy savings calculation CLEAResult staff may conduct baseline on-site inspections. These inspections may also involve metering to help determine baseline lighting hours of use or other attributes that may correlate with the project's energy savings.

[45] Percentages here apply to all CLEAResult administered programs for all four FirstEnergy Pennsylvania EDCs.

[46] ADM reviewed summary of 110 on-site inspections conducted by CLEAResult in PY6, and developed a 'QC realization rate' to help inform the annual report. The QC realization rate was 98%, with a CV of 0.39. The adjustments made by CLEAResult accounted for variations in hours of use as well as variations in equipment specification.

[47] Adjustments to the Company's tracking and reporting are not necessary because QA/QC inspections occur prior to rebate approval.

and ex-post measurements in key parameters that describe operational characteristics. These include hours of use for lighting, both hours of use and part-load conditions for HVAC, refrigeration, and motors.

8.3 IMPACT EVALUATION NET SAVINGS

Tetra Tech conducted the NTG research according to the Common Approach, Statewide Evaluator Guidance Memos GM-024 (Consistent Freeridership methodology) and GM-025 (Consistent Spillover methodology) using the participant self-report method. The complete participant dataset for Phase II, PY6 (Q1-Q4) was used for this evaluation effort.

Table 8-5: C/I Large Energy Efficient Equipment Program Sampling Strategy for Program Year 6 NTG Research

Stratum	Population Size	Assumed CV or Proportion in Sample Design	Assumed Levels of Confidence & Precision	Target Sample size	Achieved Sample Size	Percent of Sample Frame Contacted[48] to Achieve Sample
Lighting	77	P=0.5	85/15	15	27	n/a
Custom	26	P=0.5	85/15	5	15	n/a
HVAC and DHW	3	P=0.5	85/15	1	1	n/a
Kitchen/Appliances	0	P=0.5	85/15	0	0	n/a
Program Total	106		85/15	21	43	67%(N=71)

Table 8-6: Program Year 6 C/I Large Energy Efficient Equipment Program Summary of Evaluation Results for NTG Research

Target Group or Stratum (if appropriate)	Estimated Free Ridership	Estimated Participant Spillover	NTG Ratio	Observed Coefficient of Variation or Proportion	Relative Precision
Lighting	46.3%	9.3%	63.0%	0.37	8.3%
Custom	28.3%	6.7%	78.4%	0.49	11.9%
HVAC and DHW	25.0%	16.0%	91.0%	0.41	48.1%
Kitchen/Appliances	n/a	n/a	n/a	0.41	100.0%
Program Total[49]	34.4%	7.6%	73.2%		8.4%

8.4 PROCESS EVALUATION

Tetra Tech conducted the process evaluation in conjunction with the NTG research. These activities included:

FirstEnergy and Program Implementer Staff In-depth Interviews

Tetra Tech and ADM conducted in-depth interviews with FirstEnergy program staff and the ICSP to discuss Phase II design and implementation updates, program goals, and key researchable issues of interest for the Phase II evaluation. The interviews assessed the effectiveness of the program's current operations,

[48] Sample frame is a list of contacts that have a chance to be selected into the sample. Percent contacted means of all the sample frame how many were called to get the completes.

[49] NTG ratio at program level should be developed using stratum weight and stratum NTG ratios.

detailed program implementation practices, and identified key researchable topics. In addition, both FirstEnergy and ICSP staff provided input on the types of information that would be most beneficial to design and implementation efforts.

Participant Surveys

The participant surveys gathered data and information related to assess free-ridership and spillover and process related topics. The topic areas included:

- Program awareness and marketing
- The company's decision-making process in regards to new equipment
- Energy efficiency at the company
- Program satisfaction

The complete participant dataset for Phase II, PY6 (Q1-Q4) was used for this evaluation effort.

Table 8-7: C/I Large Energy Efficient Equipment Program Sampling Strategy for Program Year 6

Target Group or Stratum (if appropriate)	Population Size	Assumed Proportion or CV in Sample Design	Assumed Levels of Confidence & Precision	Target Sample Size	Achieved Sample Size	Percent of Population Frame Contacted to Achieve Sample	Used For Evaluation Activities (Impact, Process, NTG)
Lighting	77	P=0.5	85/15	15	27	n/a	Process, NTG
Custom	26	P=0.5	85/15	5	15	n/a	Process, NTG
HVAC and DHW	3	P=0.5	85/15	1	1	n/a	Process, NTG
Kitchen/Appliances	0	P=0.5	85/15	0	0	n/a	Process, NTG
Program Total	106		85/15	21	43	67%(N=71)	

Key Findings[50]

1) Participants report high levels of satisfaction with all aspects of the program. Program participants are highly satisfied with the overall program and more than 90 percent of customers said they would likely participate in the program again in the future. Each individual aspect of the program received an average rating of "highly satisfied," with the exception of the incentive amount, which received a mean satisfaction just shy of "highly satisfied". Most participants said they did not experience any obstacles or barriers while implementing their project (89 percent) – and those that had difficulties, the issues were typically internal to the customer (e.g. convincing management to fund initial costs). Lastly, two-thirds of customers have recommended the program to colleagues in their industry.
2) Almost all aspects of program satisfaction rated higher in Phase II than Phase I. When compared with results from the Phase I C&I evaluation, all aspects of program satisfaction increased in average score between Phase I and Phase II, with the exception of the incentive offered, which decreased marginally.

[50] Key findings are reported in aggregate for the four FirstEnergy PA EDCs. Results were very similar for each EDC and for each program.

3) The participant information files are improved from Phase I. Interview staff reported high levels of survey completion on their first attempt to contact respondents, which is atypical for C&I studies. The high quality sample information resulted in above-average numbers of participants calling the survey lab to complete the survey, a fact that is directly correlated with the advance letter reaching the correct individual within the firm.
4) Although customers' stated preference of receiving information about energy efficiency via email or direct mail, contractors are successfully marketing the programs to customers. Two-thirds (67 percent) of respondents indicated their preferred method of communication is email newsletters, while 30 percent said they preferred direct mail from their EDC. However, more than half (54 percent) of respondents learned about the program through their contractor.
5) Budget and financial plans fall into two planning periods. Almost 45 percent of customers indicated their firm creates budgets/financial plans of one year or less, while 35 percent of customers said their business' budgets/financial plans span five years or longer. Responses differed between strata – large C&I customers are more likely to create plans spanning more than 5 years (47 percent), while small C&I and GNI customers typically plan in one-year increments (50 percent and 53 percent, respectively).

The budget cycle was a primary factor for when projects can be implemented. Of the 45 percent of respondents who indicated that they had business or production cycles that affect planning and implementation of efficiency projects, more than half of respondents (53 percent) have budget and financial planning cycles that affect when projects can be planned and implemented. Customers' budget and financial planning periods overwhelmingly fall into two categories, under one year or five years and longer. Customers often cited financial plans and budgets as a driving force behind whether energy improvements could be pursued, highlighting the crucial role of working alongside customers during their planning and budgeting periods.

8.5 STATUS OF RECOMMENDATIONS FOR PROGRAM

The following recommendations resulted from the process and impact evaluation effort.

Table 8-8: C/I Large Energy Efficient Equipment Program Status Report on Process and Impact Recommendations

Recommendations	EDC Status of Recommendation (Implemented, Being Considered, Rejected AND Explanation of Action Taken by EDC)
Continue conducting outreach with trade allies and contractors to promote the program when working with commercial customers, and continue incorporating case studies and testimonials into marketing materials provided to customers and trade allies.	Implemented
Seek opportunities to provide contractors and targeted customers with additional literature and marketing materials they can use to convey benefits of the program to management staff.	Being Considered
Continue working closely with contractors and business owners to establish time periods during which project installations occur.	Implemented

8.6 FINANCIAL REPORTING

A breakdown of the program finances (by program) is presented in Table 8-9.

Table 8-9: Summary of Program Finances

Row #	Cost Category	Actual PYTD Costs ($1,000)	Actual Phase II Costs ($1,000)
1	Incremental Measure Costs (Sum of rows 2 to 4)	$5,892	$8,186
2	EDC Incentives to Participants	$2,174	$3,064
3	EDC Incentives to Trade Allies	$0	$0
4	Participant Costs (net of incentives/rebates paid by utilities)	$3,718	$5,121
5	Program Overhead Costs (Sum of rows 6, 7, 8, 9, 10)	$757	$1,325
6	Design & Development	$2	$7
7	Administration, Management, and Technical Assistance[1]	$504	$951
8	Marketing[2]	$61	$114
9	EDC Evaluation Costs	$176	$210
10	SWE Audit Costs	$13	$44
11	Increases in costs of natural gas (or other fuels) for fuel switching programs	$0	$0
12	Total TRC Costs[3] (Sum of rows 1, 5 and 11)	$6,649	$9,511
13	Total NPV Lifetime Energy Benefits	$26,181	$27,878
14	Total NPV Lifetime Capacity Benefits	$2,349	$2,588
15	Total NPV TRC Benefits[4]	$28,531	$30,466
16	TRC Benefit-Cost Ratio[5]	4.29	3.20

NOTES

Per PUC direction, TRC inputs and calculations are required in the Annual Report only and should comply with the 2013 Total Resource Cost Test Order. Please see the "Report Definitions" section of this report for more details.

[1] Includes rebate processing, tracking system, general administration, EDC and CSP program management, general management and legal, and technical assistance.
[2] Includes the marketing CSP and marketing costs by program CSPs.
[3] Total TRC Costs includes Total EDC Costs and Participant Costs.
[4] 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. NOTE: Savings carried over from Phase I are not to be included as a part of Total TRC Benefits for Phase II.
[5] TRC Ratio equals Total NPV TRC Benefits divided by Total NPV TRC Costs.

9 C/I LARGE ENERGY EFFICIENT BUILDINGS PROGRAM

This program includes energy conservation kits consisting of CFLs, and custom "whole building" projects such as new construction, retro-commissioning, and building envelope improvements.

9.1 PROGRAM UPDATES

In PY6 the program included several custom projects in addition to conservation kits.

9.1.1 Definition of Participant

Each separate rebated project is counted as a participant.

9.2 IMPACT EVALUATION GROSS SAVINGS

9.2.1 Evaluation Methodology

The projects rebated under this program include energy conservation kits as well as custom projects that involve new construction, retro-commissioning, building envelope improvements. The M&V methodology for this program is described below.

Gross Impact Evaluation for Conservation Kits
The program distributed conservation kits consisting of 13W and 23W or 26W CFLS to commercial and industrial customers, and kits consisting of 13W and 20W CFLs, and a pair of LED night lights, to apartment complexes.

ADM's evaluation strategy is to first place the CFLs into one of the following categories

1) Whereabouts unknown: The customer did not receive the CFL conservation kit
2) The CFL was found to be broken upon arrival
3) The CFL has arrived, and is installed in a non-residential setting
4) The CFL has been taken to business owner's residence for residential use, or has been distributed to an employee, parishioner, etc. for residential use.
5) The CFL is in storage, and will likely replace other CFLs that arrived in the kit
6) The CFL is in storage, and will likely replace other, non-kit lamps as they burn out.

CFLs that are determined to be in categories 1, 2, and 5 above are credited zero kWh and kW impacts. CFLs that are in category 4 are evaluated according to the 2013 TRM protocols for CFLs in the residential sector. CFLs in category 3 are evaluated with nonresidential TRM protocols, and with hours of use and coincidence factors as determined from the 2014 Metering Study conducted by the SWE[51]. CFLs in category 6 are evaluated as CFLs in category 3. The fractions of distributed CFLs in each of the above six categories are determined primarily through surveys. ADM conducted 96 surveys among all four FirstEnergy PA EDCs and used the results to formulate in-service rates by facility type. The stratification followed facility types because the number of eligible sockets for screw-based lamps varies considerably with facility types, and the in-service rates tend to vary according to the number of available sockets.

[51] Pennsylvania Statewide ACT 129 2014 Commercial & Residential Light Metering Study, Table 4-13 for Interior Screw-Base CFLs and LEDs.

The nonresidential TRM protocols also include HVAC interactive effects. ADM applied the 12% and 34% values for energy and demand respectively, but also included HVAC applicability factors at the sector level to account for CFLs that are not installed in air conditioned space.

As a last step, ADM identified the fraction of CFLs that were originally sent to a business, but were later distributed for residential use by the business owner. This "cross sector" migration percentage accounts for the participants and impacts reported in the residential sector below. For this program component, cross-sector migration tends to reduce energy savings and demand reductions because the residential sector has lower lighting hours of use and coincidence factors. Portfolio level cross-sector sales determination and the associated adjustments to verified impacts and incentives are discussed in detail in Appendix D.

Gross Impact Evaluation for Efficient Equipment Incentives

Sampling and project-level gross impact evaluation methodologies for efficient equipment and building upgrade measures are identical to the methodology described in Section 6 for the C/I Small Efficient Equipment Program. The projects in this program tend to involve new construction, retro-commissioning, and other controls or envelope upgrades that tend to affect the systemic energy usage performance of the involved facilities. Data acquisition for such projects involves the determination of independent variables that predict the heating and cooling loads along with utility bills, EMS trending data, or sub-metering. The data analysis may involve regressions or energy simulation models.

Table 9-1: Phase II C/I Large Energy Efficient Buildings Program
Reported Results by Customer Sector

Sector	Participants	Reported Gross Energy Savings (MWh/yr)	Reported Gross Demand Reduction (MW)	Incentives ($1,000)
Residential	5	139	0.02	1
Low-Income	0	0	0.00	0
Small Commercial and Industrial	0	0	0.00	128
Large Commercial and Industrial	32	865	0.13	0
Government, Non-Profit, and Institutional	95	907	0.12	0
Phase II Total	132	1,911	0.27	129

Table 9-2: C/I Large Energy Efficient Buildings Program
Sampling Strategy for Program Year 6

Stratum	Population Size	Target Levels of Confidence & Precision	Target Sample Size	Achieved Sample Size	Evaluation Activity
CFL Kits-1	128	23.1%	9	3	S
Lighting-Certainty	0	n/a	0	0	DR,OS,L,B
Lighting-2	0	n/a	0	0	DR,OS,L,B
Lighting-3	0	n/a	0	0	DR,OS,L,B
Lighting-4	0	n/a	0	0	DR,OS,L,B
Custom-Certainty	2	0.0%	2	2	DR,OS,M,B,ES
Custom-2	0	n/a	0	0	DR,OS,M,B,ES
Custom-3	2	50.9%	1	1	DR,OS,M,B,ES
HVAC and DHW-1	0	n/a	0	0	DR,OS,M,B,ES
HVAC and DHW-2	0	n/a	0	0	DR,OS,S
Appliance Turn-in-1	0	n/a	0	0	DR
Kitchen/Appliances-1	0	n/a	0	0	DR
Program Total	132	8.4%	12	6	

Table 9-3: Program Year 6 C/I Large Energy Efficient Buildings Program
Summary of Evaluation Results for Energy

Stratum	Reported Gross Energy Savings (MWh/yr)	Energy Realization Rate (%)	Verified Gross Energy Savings (MWh/yr)	Observed Coefficient of Variation (C_v) or Proportion in Sample Design	Relative Precision at 85% C.L.
CFL Kits-1	119	111.5%	133	0.5	41.1%
Lighting-Certainty	0	n/a	0	0.5	0.0%
Lighting-2	0	n/a	0	0.5	0.0%
Lighting-3	0	n/a	0	0.5	0.0%
Lighting-4	0	n/a	0	0.5	0.0%
Custom-Certainty	1,477	100.5%	1,484	0.5	0.0%
Custom-2	0	n/a	0	0.5	0.0%
Custom-3	315	28.2%	89	0.5	50.9%
HVAC and DHW-1	0	n/a	0	0.5	0.0%
HVAC and DHW-2	0	n/a	0	0.5	0.0%
Appliance Turn-in-1	0	n/a	0	0.5	0.0%
Kitchen/Appliances-1	0	n/a	0	0.5	0.0%
Program Total	1,911	89.2%	1,706		4.2%

Table 9-4: Program Year 6 C/I Large Energy Efficient Buildings Program Summary of Evaluation Results for Demand

Stratum	Reported Gross Demand Savings (MW)	Demand Realization Rate (%)	Verified Gross Demand Savings (MW)	Observed Coefficient of Variation (C_v) or Proportion in Sample Design	Relative Precision at 85% C.L.
CFL Kits-1	0.02	102.6%	0.02	0.5	41.1%
Lighting-Certainty	0.00	n/a	0.00	0.5	0.0%
Lighting-2	0.00	n/a	0.00	0.5	0.0%
Lighting-3	0.00	n/a	0.00	0.5	0.0%
Lighting-4	0.00	n/a	0.00	0.5	0.0%
Custom-Certainty	0.24	103.5%	0.25	0.5	0.0%
Custom-2	0.00	n/a	0.00	0.5	0.0%
Custom-3	0.01	n/a	0.00	0.5	0.0%
HVAC and DHW-1	0.00	n/a	0.00	0.5	0.0%
HVAC and DHW-2	0.00	n/a	0.00	0.5	0.0%
Appliance Turn-in-1	0.00	n/a	0.00	0.5	0.0%
Kitchen/Appliances-1	0.00	n/a	0.00	0.5	0.0%
Program Total	0.27	99.2%	0.27		3.4%

9.2.1 On-Site Inspections

This program has two components: Conservation Kits and downstream rebates for commercial and industrial energy efficiency projects. There are no on-site visits conducted for the conservation kits. All other projects are eligible for on-site QA/QC inspections. These QA/QC inspections are identical in process as the effort described for the C/I Large Energy Efficient Equipment Program.

As with other nonresidential programs, CLEAResult's QA/QC activities are exclusive of ADM's on-site verification activities. ADM's independent evaluation activities are described in the preceding section. The program realization rates are informed, in part, by on-site findings. The primary source of variance between reported and verified impacts are not due to failures in verification, but rather to differences between planning assumptions and ex-post measurements in key parameters that describe operational characteristics. This program may involve projects that involve relatively complex calculations, including building energy simulations and engineering calculations. In many cases, discrepancies between reported and verified impacts result from differences in calculation methodologies and data sources. The impact evaluation effort has the benefit of having access to post-installation utility meter data, trending data, or logger data, and often the newly available information helps to improve project savings estimates.

9.3 IMPACT EVALUATION NET SAVINGS

A NTG evaluation was not conducted for this program in PY6.

9.4 PROCESS EVALUATION

A process evaluation was not conducted for this program in PY6.

9.5 STATUS OF RECOMMENDATIONS FOR PROGRAM

The following recommendations resulted from the process and impact evaluation effort.

Table 9-5: C/I Large Energy Efficient Buildings Program
Status Report on Process and Impact Recommendations

Recommendations	EDC Status of Recommendation (Implemented, Being Considered, Rejected AND Explanation of Action Taken by EDC)
In Phase III, consider subsuming this program into the C/I Small Energy Efficient Equipment Program to reduce administrative costs and to ensure adequate budget is available in case participation levels increase significantly.	Under consideration

9.6 FINANCIAL REPORTING

A breakdown of the program finances (by program) is presented in Table 9-6. This program's TRC benefit-cost ratio is relatively low primarily because the program has not yet achieved the scale necessary to dilute fixed costs associated with implementation.

Table 9-6: Summary of Program Finances

Row #	Cost Category	Actual PYTD Costs	Actual Phase II Costs
		($1,000)	($1,000)
1	Incremental Measure Costs (Sum of rows 2 to 4)	$1,039	$1,039
2	EDC Incentives to Participants	$129	$129
3	EDC Incentives to Trade Allies	$0	$0
4	Participant Costs (net of incentives/rebates paid by utilities)	$910	$910
5	Program Overhead Costs (Sum of rows 6, 7, 8, 9, 10)	$223	$412
6	Design & Development	$1	$4
7	Administration, Management, and Technical Assistance[1]	$157	$305
8	Marketing[2]	$33	$52
9	EDC Evaluation Costs	$25	$26
10	SWE Audit Costs	$7	$25
11	Increases in costs of natural gas (or other fuels) for fuel switching programs	$0	$0
12	Total TRC Costs[3] (Sum of rows 1, 5 and 11)	$1,263	$1,451
13	Total NPV Lifetime Energy Benefits	$1,016	$1,016
14	Total NPV Lifetime Capacity Benefits	$138	$138
15	Total NPV TRC Benefits[4]	$1,154	$1,154
16	TRC Benefit-Cost Ratio[5]	0.91	0.80

NOTES

Per PUC direction, TRC inputs and calculations are required in the Annual Report only and should comply with the 2013 Total Resource Cost Test Order. Please see the "Report Definitions" section of this report for more details.

[1] Includes rebate processing, tracking system, general administration, EDC and CSP program management, general management and legal, and technical assistance.
[2] Includes the marketing CSP and marketing costs by program CSPs.
[3] Total TRC Costs includes Total EDC Costs and Participant Costs.
[4] 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. NOTE: Savings carried over from Phase I are not to be included as a part of Total TRC Benefits for Phase II.
[5] TRC Ratio equals Total NPV TRC Benefits divided by Total NPV TRC Costs.

10 GOVERNMENT AND INSTITUTIONAL PROGRAM

This program provides for the implementation of cost effective, high efficiency measures through lighting, HVAC, appliances, multifamily and audit programs. Participation in most measures are restricted to certain rate classes that are designated for nonprofit organizations. GNI customers in other rate classes participate through other C/I programs.

10.1 PROGRAM UPDATES

There were no updates to this program in PY6.

10.1.1 Definition of Participant

Each separate rebated project is counted as a participant.

10.2 IMPACT EVALUATION GROSS SAVINGS

10.2.1 Evaluation Methodology

This program offers all measures included in the other nonresidential programs, but eligibility is restricted to certain rate classes that are designated for nonprofit organizations. The program has limited participation due to the rate class eligibility restriction. Historically, most of the projects rebated under this program involve lighting upgrades, and a small percentage of impacts are attributable to HVAC replacements or other non-lighting projects. The participants are often volunteer fire departments, municipalities, and religious organizations.

Gross Impact Evaluation for Efficient Equipment Incentives

For each sampled project, the gross impact evaluation process starts with a desk review, and often continues to an on-site verification visits, metering or logging, and data analysis. The steps are described below for lighting projects and prescriptive (HVAC and food service) projects. There were no custom projects in this program in PY6.

Lighting Projects

Each sampled lighting project first undergoes a desk review. The desk review includes reconciliation of invoices, fixture specification sheets (cut sheets), and re-calculating reported savings using TRM algorithms and/or ex-ante assumptions, and identifying key parameters to be researched in the M&V plan.

Evaluation of all but the simplest of projects requires an M&V plan. The first step in the M&V planning process is to check that the project is sufficiently documented. For example, contractors working on large projects often have detailed, space-by-space inventories of the baseline and new lighting fixtures. If such detailed information is found to be lacking, ADM analysts will contact the applicant or the contractor directly, or through a request to the ICSP, and ask if such documentation is available. For large lighting projects, the M&V plan may call for sampling within the project. In such cases, the targeted precision level is ±20% at the 90% confidence level (90/20), with the sampling unit as the line item in the lighting calculator.

The desk review and M&V plan inform the data acquisition activities needed to evaluate the project. For most lighting projects, the default activities are on-site verification and logging hours of use. Most lighting

projects are metered unless there is a good reason to *not* to meter[52,53]. In rare cases, the desk review process may indicate that an on-site visit would not add sufficient value to the evaluation effort. In such cases, a verification interview may suffice to reduce uncertainty regarding the project. Data analysis is finalized upon the retrieval of loggers. For projects that involve formal samples, only the sampled line items are included in the realization rate calculation. This reduces uncertainty and subjectivity from the process of assigning hours of use from loggers to line items in the calculator.

As a final step in lighting project analysis, ADM analysts determine the incremental material and labor costs, and "dual-baseline" energy savings in cases that involve T12 or incandescent lamps. In estimating the material and labor costs, preference is given first to invoices, then to the SWE incremental cost database, and then to the cost values from the CA DEER database.

Prescriptive Projects

These projects are evaluated at the basic level or rigor because they tend to represent an insignificant amount of reported impacts in the program-level sampling scheme. The process verification involves a desk review and an on-site verification or verification by interview and review of invoices and other documentation.

As with lighting projects, incremental costs are evaluated as the gross impact evaluation nears completion. In estimating the material and labor costs, preference is given first to invoices, then to the SWE incremental cost database, and then to the cost values from the CA DEER database, then to other sources as needed and described in Appendix A.

Program-Specific Evaluation Considerations

The Government and Institutional Program tends to have volatile realization rates, in part due to low participation rates, and in part due to inaccuracies in the rebate applications related to lighting hours of use and baseline fixture types. The lighting hours of use in this sector, in particular for volunteer fire departments, are quite low – perhaps 1,000 hours per year or less. A second issue is that some of the customers or their contractors may not be familiar with "standard" lighting fixture types and codes, and may enter incorrect baseline fixture types. For these customers, ADM tends to supplement on-site data collection activities with a review of utility meter data. In many cases, the facilities' consumption history helps to provide reasonable upper limits on the project energy savings, and can help to guide baseline fixture specification in cases where physical evidence of baseline fixture types may not exist.

[52] The most frequent reasons are that the affected lights are installed outdoors and controlled by photocells or time clocks. Increasingly, high quality trending data are available from energy management systems, and the data may be used in-lieu of logging. Other rate cases may be customer-driven, such as the requirement for explosion proof loggers in a chemical plant.

[53] Primary and secondary schools are the general exception. TRM hours of use are applied to whole-school lighting upgrades, but logging is still recommended for projects that are confined to just one location such as a gym or library.

10.2.2 Program Sampling

ADM sampled eight of 13 projects completed in PY6.

Table 10-1: Phase II Government and Institutional Program Reported Results by Customer Sector

Sector	Participants	Reported Gross Energy Savings (MWh/yr)	Reported Gross Demand Reduction (MW)	Incentives ($1,000)
Residential	0	0	0.00	0
Low-Income	0	0	0.00	0
Small Commercial and Industrial	0	0	0.00	0
Large Commercial and Industrial	0	0	0.00	0
Government, Non-Profit, and Institutional	30	846	13.12	49
Phase II Total	30	846	13.12	49

Table 10-2: Government and Institutional Program Sampling Strategy for Program Year 6

Stratum	Population Size	Target Levels of Confidence & Precision	Target Sample Size	Achieved Sample Size	Evaluation Activity
CFL Kits-1	0	n/a	0	0	n/a
Lighting-Certainty	0	n/a	0	0	DR,OS,L,B
Lighting-2	2	0.0%	2	2	DR,OS,L,B
Lighting-3	2	0.0%	2	2	DR,OS,L,B
Lighting-4	8	32.9%	3	3	DR,OS,L,B
Custom-Certainty	0	n/a	0	0	DR,OS,M,B,ES
Custom-2	0	n/a	0	0	DR,OS,M,B,ES
Custom-3	0	n/a	0	0	DR,OS,M,B,ES
HVAC and DHW-1	0	n/a	0	0	DR,OS,M,B,ES
HVAC and DHW-2	1	0.0%	1	1	DR,OS,S
Appliance Turn-in-1	0	n/a	0	0	DR
Kitchen/Appliances-1	0	n/a	0	0	DR
Program Total	13	7.2%	8	8	

Table 10-3: Program Year 6 Government and Institutional Program Summary of Evaluation Results for Energy

Stratum	Reported Gross Energy Savings (MWh/yr)	Energy Realization Rate (%)	Verified Gross Energy Savings (MWh/yr)	Observed Coefficient of Variation (C_v) or Proportion in Sample Design	Relative Precision at 85% C.L.
CFL Kits-1	0	n/a	0	0.5	0.0%
Lighting-Certainty	0	n/a	0	0.5	0.0%
Lighting-2	240	14.4%	35	0.5	0.0%
Lighting-3	141	100.0%	141	0.5	0.0%
Lighting-4	107	73.8%	79	0.5	32.9%
Custom-Certainty	0	n/a	0	0.5	0.0%
Custom-2	0	n/a	0	0.5	0.0%
Custom-3	0	n/a	0	0.5	0.0%
HVAC and DHW-1	0	n/a	0	0.5	0.0%
HVAC and DHW-2	1	113.6%	1	0.5	0.0%
Appliance Turn-in-1	0	n/a	0	0.5	0.0%
Kitchen/Appliances-1	0	n/a	0	0.5	0.0%
Program Total	489	52.3%	255		10.2%

Table 10-4: Program Year 6 Government and Institutional Program Summary of Evaluation Results for Demand

Stratum	Reported Gross Demand Savings (MW)	Demand Realization Rate (%)	Verified Gross Demand Savings (MW)	Observed Coefficient of Variation (C_v) or Proportion in Sample Design	Relative Precision at 85% C.L.
CFL Kits-1	0.00	n/a	0.00	0.5	0.0%
Lighting-Certainty	0.00	n/a	0.00	0.5	0.0%
Lighting-2	0.03	9.9%	0.00	0.5	0.0%
Lighting-3	0.00	n/a	0.00	0.5	0.0%
Lighting-4	0.02	16.6%	0.00	0.5	32.9%
Custom-Certainty	0.00	n/a	0.00	0.5	0.0%
Custom-2	0.00	n/a	0.00	0.5	0.0%
Custom-3	0.00	n/a	0.00	0.5	0.0%
HVAC and DHW-1	0.00	n/a	0.00	0.5	0.0%
HVAC and DHW-2	0.00	n/a	0.00	0.5	0.0%
Appliance Turn-in-1	0.00	n/a	0.00	0.5	0.0%
Kitchen/Appliances-1	0.00	n/a	0.00	0.5	0.0%
Program Total	0.05	12.5%	0.01		17.1%

10.2.3 On-Site Inspections

The Company's ICSP, CLEAResult, conducts QA/QC on-site inspections for 5% of pending rebate applications. The QA/QC visits are conducted prior to rebate approval, and can occur prior to or after measure installation[54]. Nonresidential energy efficiency projects typically involve complex or numerous energy efficiency measures. It is therefore inadequate to classify inspections in a binary (e.g. Pass/Fail) manner. Site inspections may result in three general outcomes:

Case 1: The reported energy efficiency measures are found to be installed as described in rebate application materials

Case2: The energy efficiency project is completed, but there may be minor discrepancies between the installed measures and the associated documentation. These can include:

- A discrepancy in the quantities for some or all of the energy efficiency measures
- A discrepancy in the description of the energy efficiency measure (e.g. fixture wattage, HVAC system capacity or efficiency, motor horsepower or efficiency)
- A discrepancy in the baseline equipment
- A mischaracterization of equipment operation (e.g. lighting hours of use or control type, VFD control feedback mechanism, space heating and cooling set points)

Case 3: The energy efficiency project is not completed, or there are major discrepancies in the attributes discussed above in Case 2.

The on-site inspections occur prior to rebate approval. Approximately (34%)[55] of QA/QC inspections correspond to Case 1 above. Approximately 66% of on-site inspections result in a "Case 2" finding. In such cases, the application materials are updated to reflect the as-found equipment, and the rebate application is processed accordingly. Note that most "Case 2" findings do not result in material changes to the ex-ante savings[56] – the high proportion of site-visits that fall into this case is mostly a function of Case 1 being reserved for perfection.

This may involve an adjustment to the rebate amount and to the reported impacts in CLEAResult's tracking and reporting system[57]. In the event of a Case 3 finding, the rebate application is cancelled. Based on CLEAResult's historical records, this scenario occurs approximately 0% of the time.

These QA/QC activities are exclusive of ADM's on-site verification activities. ADM's independent evaluation activities are described in the preceding section, and the program realization rates are informed, in part, by on-site findings. The primary source of variance between reported and verified impacts are not due to failures in verification, but rather to differences between planning assumptions

[54] In cases where baseline conditions are critical to the overall project energy savings calculation CLEAResult staff may conduct baseline on-site inspections. These inspections may also involve metering to help determine baseline lighting hours of use or other attributes that may correlate with the project's energy savings.

[55] Percentages here apply to all CLEAResult administered programs for all four FirstEnergy Pennsylvania EDCs.

[56] ADM reviewed summary of 110 on-site inspections conducted by CLEAResult in PY6, and developed a 'QC realization rate' to help inform the annual report. The QC realization rate was 98%, with a CV of 0.39. The adjustments made by CLEAResult accounted for variations in hours of use as well as variations in equipment specification.

[57] Adjustments to the Company's tracking and reporting are not necessary because QA/QC inspections occur prior to rebate approval.

and ex-post measurements in key parameters that describe operational characteristics. These include hours of use for lighting, both hours of use and part-load conditions for HVAC, refrigeration, and motors.

10.3 IMPACT EVALUATION NET SAVINGS

Tetra Tech conducted the NTG research according to the Common Approach, Statewide Evaluator Guidance Memos GM-024 (Consistent Freeridership methodology) and GM-025 (Consistent Spillover methodology) using the participant self-report method. The complete participant dataset for Phase II, PY6 (Q1-Q4) was used for this evaluation effort.

Table 10-5: Government and Institutional Program Sampling Strategy for Program Year 6 NTG Research

Stratum	Population Size[58]	Assumed CV or Proportion in Sample Design	Assumed Levels of Confidence & Precision	Target Sample size	Achieved Sample Size	Percent of Sample Frame Contacted[59] to Achieve Sample
Lighting	25	P=0.5	85/15	6	18	n/a
Custom	0	P=0.5	85/15	0	0	n/a
HVAC and DHW	2	P=0.5	85/15	1	0	n/a
Kitchen/Appliances	0	P=0.5	85/15	0	0	n/a
Program Total	27		85/15	7	18	89%(N=24)

Table 10-6: Program Year 6 Government and Institutional Program Summary of Evaluation Results for NTG Research

Target Group or Stratum (if appropriate)	Estimated Free Ridership	Estimated Participant Spillover	NTG Ratio	Observed Coefficient of Variation or Proportion	Relative Precision
Lighting	54.2%	11.7%	57.5%	0.37	6.7%
Custom	n/a	n/a	n/a	0.49	100.0%
HVAC and DHW	n/a	n/a	n/a	0.41	100.0%
Kitchen/Appliances	n/a	n/a	n/a	0.41	100.0%
Program Total[60]	53.8%	11.6%	57.1%		6.7%

10.4 PROCESS EVALUATION

Tetra Tech conducted the process evaluation in conjunction with the NTG research. These activities included:

FirstEnergy and Program Implementer Staff In-depth Interviews

[58] Due to the low number of participants in this program, NTG and process evaluation results are reported by combining statistics across the four FirstEnergy EDCs in PA.

[59] Sample frame is a list of contacts that have a chance to be selected into the sample. Percent contacted means of all the sample frame how many were called to get the completes.

[60] NTG ratio at program level should be developed using stratum weight and stratum NTG ratios.

Tetra Tech and ADM conducted in-depth interviews with FirstEnergy program staff and the ICSP to discuss Phase II design and implementation updates, program goals, and key researchable issues of interest for the Phase II evaluation. The interviews assessed the effectiveness of the program's current operations, detailed program implementation practices, and identified key researchable topics. In addition, both FirstEnergy and ICSP staff provided input on the types of information that would be most beneficial to design and implementation efforts.

Participant Surveys

The participant surveys gathered data and information related to assess free-ridership and spillover and process related topics. The topic areas included:

- Program awareness and marketing
- The company's decision-making process in regards to new equipment
- Energy efficiency at the company
- Program satisfaction

The complete participant dataset for Phase II, PY6 (Q1-Q4) was used for this evaluation effort.

Table 10-7: Government and Institutional Program Sampling Strategy for Program Year 6

Target Group or Stratum (if appropriate)	Population Size	Assumed Proportion or CV in Sample Design	Assumed Levels of Confidence & Precision	Target Sample Size	Achieved Sample Size	Percent of Population Frame Contacted to Achieve Sample	Used For Evaluation Activities (Impact, Process, NTG)
Lighting	25	P=0.5	85/15	6	18	n/a	Process, NTG
Custom	0	P=0.5	85/15	0	0	n/a	Process, NTG
HVAC and DHW	2	P=0.5	85/15	1	0	n/a	Process, NTG
Kitchen/Appliances	0	P=0.5	85/15	0	0	n/a	Process, NTG
Program Total	27		85/15	7	18	89%(N=24)	

Key Findings[61]

1) Participants report high levels of satisfaction with all aspects of the program. Program participants are highly satisfied with the overall program and more than 90 percent of customers said they would likely participate in the program again in the future. Each individual aspect of the program received an average rating of "highly satisfied," with the exception of the incentive amount, which received a mean satisfaction just shy of "highly satisfied". Most participants said they did not experience any obstacles or barriers while implementing their project (89 percent) – and those that had difficulties, the issues were typically internal to the customer (e.g. convincing management to fund initial costs). Lastly, two-thirds of customers have recommended the program to colleagues in their industry.
2) Almost all aspects of program satisfaction rated higher in Phase II than Phase I. When compared with results from the Phase I C&I evaluation, all aspects of program satisfaction increased in

[61] Key findings are reported in aggregate for the four FirstEnergy PA EDCs. Results were very similar for each EDC and for each program.

average score between Phase I and Phase II, with the exception of the incentive offered, which decreased marginally.

3) The participant information files are improved from Phase I. Interview staff reported high levels of survey completion on their first attempt to contact respondents, which is atypical for C&I studies. The high quality sample information resulted in above-average numbers of participants calling the survey lab to complete the survey, a fact that is directly correlated with the advance letter reaching the correct individual within the firm.
4) Although customers' stated preference of receiving information about energy efficiency via email or direct mail, contractors are successfully marketing the programs to customers. Two-thirds (67 percent) of respondents indicated their preferred method of communication is email newsletters, while 30 percent said they preferred direct mail from their EDC. However, more than half (54 percent) of respondents learned about the program through their contractor.
5) Budget and financial plans fall into two planning periods. Almost 45 percent of customers indicated their firm creates budgets/financial plans of one year or less, while 35 percent of customers said their business' budgets/financial plans span five years or longer. Responses differed between strata – large C&I customers are more likely to create plans spanning more than 5 years (47 percent), while small C&I and GNI customers typically plan in one-year increments (50 percent and 53 percent, respectively).
6) The budget cycle was a primary factor for when projects can be implemented. Of the 45 percent of respondents who indicated that they had business or production cycles that affect planning and implementation of efficiency projects, more than half of respondents (53 percent) have budget and financial planning cycles that affect when projects can be planned and implemented. Customers' budget and financial planning periods overwhelmingly fall into two categories, under one year or five years and longer. Customers often cited financial plans and budgets as a driving force behind whether energy improvements could be pursued, highlighting the crucial role of working alongside customers during their planning and budgeting periods

10.5 STATUS OF RECOMMENDATIONS FOR PROGRAM

The following recommendations resulted from the process and impact evaluation effort.

Table 10-8: Government and Institutional Program Status Report on Process and Impact Recommendations

Recommendations	EDC Status of Recommendation (Implemented, Being Considered, Rejected AND Explanation of Action Taken by EDC)
Continue conducting outreach with trade allies and contractors to promote the program when working with commercial customers, and continue incorporating case studies and testimonials into marketing materials provided to customers and trade allies.	Implemented
Seek opportunities to provide contractors and targeted customers with additional literature and marketing materials they can use to convey benefits of the program to management staff.	Being Considered
Continue working closely with contractors and business owners to establish time periods during which project installations occur.	Implemented
Consider stipulating an annual indoor lighting hours of use of 1,000 hours for all program participants	Being Considered

10.6 FINANCIAL REPORTING

A breakdown of the program finances (by program) is presented in Table 10-9. This program's TRC benefit-cost ratio is relatively low primarily because the program has not yet achieved the scale necessary to dilute fixed costs associated with implementation.

Table 10-9: Summary of Program Finances

Row #	Cost Category	Actual PYTD Costs ($1,000)	Actual Phase II Costs ($1,000)
1	Incremental Measure Costs (Sum of rows 2 to 4)	$179	$186
2	EDC Incentives to Participants	$24	$60
3	EDC Incentives to Trade Allies	$0	$0
4	Participant Costs (net of incentives/rebates paid by utilities)	$154	$125
5	Program Overhead Costs (Sum of rows 6, 7, 8, 9, 10)	$343	$872
6	Design & Development	$2	$6
7	Administration, Management, and Technical Assistance[1]	$276	$710
8	Marketing[2]	$45	$106
9	EDC Evaluation Costs	$8	$10
10	SWE Audit Costs	$12	$40
11	Increases in costs of natural gas (or other fuels) for fuel switching programs	$0	$0
12	Total TRC Costs[3] (Sum of rows 1, 5 and 11)	$522	$1,058
13	Total NPV Lifetime Energy Benefits	$121	$132
14	Total NPV Lifetime Capacity Benefits	$4	$4
15	Total NPV TRC Benefits[4]	$125	$137
16	TRC Benefit-Cost Ratio[5]	0.24	0.13

NOTES

Per PUC direction, TRC inputs and calculations are required in the Annual Report only and should comply with the 2013 Total Resource Cost Test Order. Please see the "Report Definitions" section of this report for more details.

[1] Includes rebate processing, tracking system, general administration, EDC and CSP program management, general management and legal, and technical assistance.
[2] Includes the marketing CSP and marketing costs by program CSPs.
[3] Total TRC Costs includes Total EDC Costs and Participant Costs.
[4] 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. NOTE: Savings carried over from Phase I are not to be included as a part of Total TRC Benefits for Phase II.
[5] TRC Ratio equals Total NPV TRC Benefits divided by Total NPV TRC Costs.

APPENDIX A | EM&V INFORMATION

Participant Definitions

Table A-0-1: Program Year 6 Participant Definition by Program[62]

Program	Participant Definition	Can there be more than one measure per participant?	Sample Defined By:
EE Products: Upstream Lighting	One package of lamps	Yes	Achieved Census
EE Products: Upstream Televisions	One Television	Yes	Achieved Census
EE Products: Refrigerators / Freezers	Unique Rebate ID	Yes	Each Appliance
EE Products: Heat Pump Water Heaters	Unique Rebate ID	Yes	Each Appliance
EE Products: ASHP	Unique Rebate ID	Yes	Each Appliance
EE Products: Clothes Washers	Unique Rebate ID	Yes	Each Appliance
EE Products: GSHP	Unique Rebate ID	Yes	Each Appliance
EE Products: HVAC Tune-Ups	Unique Rebate ID	Yes	Each Appliance
EE Products: Dehumidifiers	Unique Rebate ID	Yes	Each Appliance
EE Products: CAC	Unique Rebate ID	Yes	Each Appliance
EE Products: Mini-split HP	Unique Rebate ID	Yes	Each Appliance
EE Products: RAC	Unique Rebate ID	Yes	Each Appliance
EE Products: Smart Strips	Unique Rebate ID	Yes	Each Appliance
EE Products: Upstream Smart Strips	Unique Rebate ID	Yes	Achieved Census
EE Products: Electric Resistance Water Heaters	Unique Rebate ID	Yes	Each Appliance
EE Products: Upstream Computers/Monitors	Unique Rebate ID	Yes	Achieved Census
EE Products: Solar Water Heaters	Unique Rebate ID	Yes	Each Appliance
EE Products: ECM Fans	Unique Rebate ID	Yes	Each Appliance
EE Products: Dishwashers	Unique Rebate ID	Yes	Each Appliance
EE Products: Mini-split AC	Unique Rebate ID	Yes	Each Appliance
EE Products: Tune-Up with ECM	Unique Rebate ID	Yes	Each Appliance
Appliance Turn-In: Refrigerators	Unique Rebate ID	No	Each Appliance
Appliance Turn-In: Freezers	Unique Rebate ID	Yes	Each Appliance
Appliance Turn-In: RACs	Unique Rebate ID	Yes	Each Appliance
HEA: HEA Kits	Unique Rebate ID	No (although the kit itself does have several measures)	Each Kit
HEA: School Kits	Unique Rebate ID	No (the kit is the measure)	Each Kit
HEA: New Home	Unique Rebate ID	No (the home is the measure)	Each Home
HEA: Direct Install, Prescriptive Measures	Unique Rebate ID	Yes	Each itemized measure
HEA: Weatherization, > 2MWh	Unique Rebate ID	Yes	Each home
HEA: Weatherization, < 2MWh	Unique Rebate ID	Yes	Each home
HEA: Home Energy Reports	Unique Rebate ID	No	Each home
Low-Income - Lighting Giveaway	One lamp	No	Achieved Census

[62] EDCs can modify table as necessary to provide additional granularity.

Low-Income - Furnace Whistle Giveaway	One Furnace Whistle	No	Achieved Census
Low-Income - Showerhead Giveaway	One Showerhead	No	Achieved Census
Low-Income - LED Night Light Giveaway	One LED Night Light	No	Achieved Census
Low-Income - Aerator Giveaway	One Aerator	No	Achieved Census
Low-Income - Direct Install	One Home	Yes	Each Home
Low-Income - LILU Conservation kits	One Kit	No	Each Kit
Nonresidential Programs – Conservation Kit	One Kit	Yes	Each Kit
Nonresidential Programs – Appliance Recycling	Unique Rebate ID	Yes	Each rebate
Nonresidential Programs – All other projects	Unique Rebate ID	Yes	Each rebate

Program Year 6 Evaluation Activities

Table A-0-2: Program Year 6 Actual Evaluation Activities

Programs (Sub Programs if necessary)	Sectors	Records Review	Participant Surveys[63]	Site Visits	Metering or EMS Data	Billing Analysis or Energy Simulation
Refrigerators	Res Appliance Turn-In	Census	31	0	0	0
Freezers	Res Appliance Turn-In	Census	16	0	0	0
RACs	Res Appliance Turn-In	Census	15	0	0	0
Upstream Lighting	Residential EE Products	Census	1000	0	0	0
Upstream Televisions	Residential EE Products	Census	0	0	0	0
Refrigerators / Freezers	Residential EE Products	20	25	0	0	0
Upstream Computers/Monitors	Residential EE Products	Census	0	0	0	0
Heat Pump Water Heaters	Residential EE Products	7	6	0	0	0
ASHP	Residential EE Products	15	15	0	0	0
Clothes Washers	Residential EE Products	9	23	0	0	0
GSHP	Residential EE Products	6	7	0	0	0
HVAC Tune-Ups	Residential EE Products	46	17	0	0	0
Dehumidifiers	Residential EE Products	10	10	0	0	0
CAC	Residential EE Products	4	3	0	0	0
MiniSplit HP	Residential EE Products	15	26	0	0	0
Room AC	Residential EE Products	0	0	0	0	0

[63] Nonparticipant surveys were not conducted for impact evaluation.

Programs (Sub Programs if necessary)	Sectors	Records Review	Participant Surveys[63]	Site Visits	Metering or EMS Data	Billing Analysis or Energy Simulation
Smart Strips	Residential EE Products	Census	0	0	0	0
Whole House Fan	Residential EE Products	0	0	0	0	0
Electric Resistance Water Heaters	Residential EE Products	2	1	0	0	0
Solar Water Heaters	Residential EE Products	0	0	0	0	0
ECM Fans	Residential EE Products	1	0	0	0	0
MiniSplit AC	Residential EE Products	0	0	0	0	0
Pool Pump Motors	Residential EE Products	0	0	0	0	0
HEA Kits	Res Home Energy Audits	Census	79	0	0	0
School Kits	Res Home Energy Audits	Census	287	0	0	0
New Construction	Res Home Energy Audits	7	0	0	0	0
Direct Install, Prescriptive	Res Home Energy Audits	Census	0	0	0	0
Weatherization, > 2MWh	Res Home Energy Audits	0	0	0	0	8 (billing)
Weatherization, < 2MWh	Res Home Energy Audits	Census (Tracking Data Review)	0	0	0	0
Home Energy Reports	Res Home Energy Audits	0	0	0	0	2 (billing)
Giveaway Measures	Low-Income Res	Census	0	0	0	0
Direct Install	Low-Income Res	37	0	0	37	0
Conservation Kits	Low-Income Res	Census	77	0	0	0
C/I Lighting	C/I	43	0	33	34	4
C/I Custom	C/I	32	0	22	34	11
C/I HVAC and DHW	C/I	3	0	2	2	0
C/ I Kitchen/Appliances	C/I	1	0	1	1	0
C/I Appliance Recycling	C/I	1	0	0	0	0
C/I CFL Kits	C/I	Census	30	0	0	0

Table A-0-3: Program Year 6 Net Impact and Process Evaluation Activities

Programs (Sub Programs if necessary)	Program Staff Interviews	ICSP Interviews	Participant Surveys	Nonpartitipcant Surveys	Trade Ally Surveys
Appliance Turn-In	No	No	51	0	0
Efficient Products	Yes	Yes	131	0	55
Home Performance	Yes	No	159	0	9
Low Income	Yes	n/a	148	0	5
Small C/I Equipment	Yes	Yes	63	0	0
Small C/I Buildings	Yes	Yes	0	0	0
Large C/I Equipment	Yes	Yes	43	0	0
Large C/I Buildings	Yes	Yes	0	0	0
Gov./Institutional	Yes	Yes	7	0	0

APPENDIX B | TRC INCREMENTAL COSTS

Incremental costs for most measures offered in the residential sector are taken from the Incremental Cost Database provided by the SWE (SWE IC DB). To facilitate TRC calculations for certain programs, the verified impacts and incremental costs are calculated individually for all evaluated measures, and then are cast into per-unit average impacts and incremental costs, with the incremental costs weighted by gross verified energy savings. For example, the first line in the table below shows a cost of $7.70 for the average package of lamps sold through the upstream lighting program. Exact costs are known for certain measures such as energy conservation kits in the residential sector.

For early replacement measures, exact costs from invoices are preferred to other cost estimates. In the residential sector, exact costs are known for the energy conservation kits distributed by the Home Performance Program and the Low-Income Low-Use program component and are as provided by the Company. Though the costs of the low-income audits are known, they are incorporated into TRC costs as program administration costs rather than participant costs. For appliance recycling, the incentive cost is taken to approximate the incremental cost of participation, as it is assumed that the incentive is equal to the residual value of the appliance.

For nonresidential measures, ADM develops a project-specific incremental cost for each evaluated project. The program-level incremental cost is developed through the application of the same sample weights as those used to determine verified gross impacts. For nonresidential projects, the order of preference for material and labor costs is as follows: Invoices, SWE IC DB, DEER 2008 Incremental Cost Database (escalated 15% to account for inflation) and industry research. The incremental material cost for most projects is derived from invoices. The SWE IC DB provides costs for the most frequently encountered fixture types, but there are many relatively rare fixture types that are not listed. To expand the applicability of the SWE IC DB to all fixture types listed in the TRM Appendix C, ADM modeled the linear fluorescent fixture costs in the SWE IC DB as a function of wattage, the number of lamps, and lamp types, then applied the modeled costs to all linear fluorescents listed in Appendix C. A similar process, starting with the DEER 2008 incremental cost database, yielded costs for all HID lamp types.

Incremental costs for New Home lighting projects were derived in a two-step process. First, the actual cost of installed fixtures was determined (almost exclusively from invoices). The cost of meeting the baseline lighting power density allowance with typical fixtures (T5, T8, HID, as appropriate for the space type) was then calculated from the aforementioned per-fixture cost models. The incremental cost is taken as the actual cost of the installed fixtures minus the cost of the baseline fixtures. Projects that achieved savings through more efficient application of lamps, rather than relying on premium efficiency lamps, have negative incremental costs (e.g. a customer could have installed 100 fixtures, but installed 77 instead).

Incremental costs for Non lighting measures were taken from SWE IC DB costs in 'replace on burnout' scenarios, and from invoices for early replacement measures. If labor costs were not available in invoices, ADM used labor to material cost fractions as published in or extrapolated from the DOE Report, *Process Equipment Cost Estimation, and Final Report*[64].

[64] *Process Equipment Cost Estimation, Final Report,* H.P. Loh, Jennifer Lyons, and Charles White, III. DOE/NETL-2002.1169, 2002. The labor factors in Table 6 are extrapolated to other equipment such as air compressors.

Table A-0-1: Summary of Incremental Costs

Program	Measure	Incremental Cost	Incremental Cost Source
Residential Appliance Turn-In	Refrigerators	$50.00	Assume Incentive ≈Incremental Cost
Residential Appliance Turn-In	Freezers	$50.00	Assume Incentive ≈Incremental Cost
Residential Appliance Turn-In	RACs	$25.00	Assume Incentive ≈Incremental Cost
Residential EE Products	Upstream Lighting	$8.53	SWE DB (Weighted Average per Package)
Residential EE Products	Upstream Televisions	$1.00	EE&C Plan
Residential EE Products	Refrigerators / Freezers	$27.03	SWE DB (Weighted for Freezer/Frig Mix)
Residential EE Products	Upstream Computers/Monitors	$1.00	EE&C Plan
Residential EE Products	Heat Pump Water Heaters	$1,045.00	SWE DB
Residential EE Products	ASHP	$2,193.95	SWE DB (Weighted for tonnage, HSPF)
Residential EE Products	Clothes Washers	$150.00	SWE DB
Residential EE Products	GSHP	$10,897.00	SWE DB
Residential EE Products	HVAC Tune-Ups	$88.00	SWE DB
Residential EE Products	Dehumidifiers	$20.00	SWE DB
Residential EE Products	CAC	$2,607.91	SWE DB (Weighted for tonnage, SEER)
Residential EE Products	MiniSplit HP	$447.75	SWE DB
Residential EE Products	Room AC	$50.00	SWE DB
Residential EE Products	Smart Strips	$21.00	SWE DB
Residential EE Products	Whole House Fan	$490.00	SWE DB
Residential EE Products	Electric Resistance Water Heaters	$89.40	SWE DB
Residential EE Products	Solar Water Heaters	$7,414.00	SWE DB
Residential EE Products	ECM Fans	$360.00	SWE DB
Residential EE Products	MiniSplit AC	$447.75	SWE DB
Residential EE Products	Pool Pump Motors	$750.00	SWE DB
Residential Home Performance	HEA Kits	$46.20	Invoices
Residential Home Performance	School Kits	$26.35	Invoices

Program	Measure	Incremental Cost	Incremental Cost Source
Residential Home Performance	New Construction	$2,561.00	SWE DB
Residential Home Performance	Weatherization, > 2MWh - Per kWh saved	$1.06	invoice review
Residential Home Performance	Weatherization, > 2MWh - Per kWh saved	$1.06	invoice review
Residential Home Performance	Air Sealing (per home)	$1,050.00	SWE DB
Residential Home Performance	20W CFL	$2.50	SWE DB
Residential Home Performance	13W CFL	$2.50	SWE DB
Residential Home Performance	Attic Insulation	$1.85	SWE DB
Residential Home Performance	23W CFL	$3.00	SWE DB
Residential Home Performance	Dimmable CFL (27W)	$3.00	SWE DB
Residential Home Performance	3 Way CFL	$3.00	SWE DB
Residential Home Performance	Energy-Savings Surge Protector	$21.00	SWE DB
Residential Home Performance	DHW Pipe Insulation 1ft	$3.00	SWE DB
Residential Home Performance	Showerhead	$6.00	SWE DB
Residential Home Performance	LED Night Light	$2.00	SWE DB
Residential Home Performance	Bath Aerator	$2.00	SWE DB
Residential Home Performance	Furnace Whistle	$2.00	SWE DB
Residential Home Performance	Kitchen Aerator	$2.00	SWE DB
Residential Home Performance	Windows (per 100 sqft)	$325.00	SWE DB
Residential Home Performance	Test Out	$250.00	Estimate - based on incentive
Residential Home Performance	Test In	$250.00	Estimate - based on incentive
Residential Home Performance	DHW Pipe Insulation - WPP	$3.00	SWE DB
Residential Home Performance	Showerhead - WPP	$6.00	SWE DB
Residential Home Performance	13W CFL - WPP	$2.50	SWE DB
Residential Home Performance	Bath aerator - WPP	$2.00	SWE DB
Residential Home Performance	Energy-Savings Surge Protector - WPP	$21.00	SWE DB
Residential Home Performance	20W CFL - WPP	$2.50	SWE DB

Program	Measure	Incremental Cost	Incremental Cost Source
Residential Home Performance	23W CFL - WPP	$3.00	SWE DB
Residential Home Performance	Kitchen aerator - WPP	$2.00	SWE DB
Residential Home Performance	3 Way CFL - WPP	$3.00	SWE DB
Residential Home Performance	LED Night Light - WPP	$2.00	SWE DB
Residential Home Performance	Home Energy Rerports	$0.00	All costs reported as admin costs
Low-Income Program	All Measures	$0.00	All measures paid for by program
Large C/I Equipment	CR_PRJ-176871 Custom-Certainty	$446,194.00	Material: Invoice, Labor: Invoice
Small C/I Buildings	CR_PRJ-192248 Custom-3	$16,215.00	Material: Invoice, Labor: Invoice
Large C/I Buildings	CR_PRJ-192256 Custom-3	$27,485.00	Material: Invoice, Labor: Invoice
Small C/I Buildings	CR_PRJ-192278 Custom-3	$14,605.00	Material: Invoice, Labor: Invoice
Small C/I Equipment	CR_PRJ-192987 Lighting-4	$1,701.00	Material: ADM analysis for new constriction, Labor: ADM analysis for new constriction
Small C/I Equipment	CR_PRJ-194588 Lighting-2	$23,267.00	Material: Invoice, Labor: SWE DB
Small C/I Equipment	CR_PRJ-197143 Lighting-2	$66,306.00	Material: Invoice, Labor: Invoice
Small C/I Equipment	CR_PRJ-206284 Lighting-2	$49,937.00	Material: Invoice, Labor: SWE DB
Government	CR_PRJ-208747 Lighting-3	$58,949.00	Material: SWE DB, Labor: SWE DB
Large C/I Equipment	CR_PRJ-210528 Custom-Certainty	-$3,130,510.08	Material: ADM Analysis, Labor: ADM Analysis
Small C/I Equipment	CR_PRJ-212550 Lighting-4	$310.00	Material: Invoice, Labor: SWE DB
Government	CR_PRJ-212893 Lighting-4	$1,323.00	Material: Invoice, Labor: SWE DB
Large C/I Equipment	CR_PRJ-216570 Custom-Certainty	$39,380.14	Material: Invoice, Labor: Invoice
Large C/I Equipment	CR_PRJ-216575 Custom-Certainty	$157,487.29	Material: Invoice, Labor: Invoice
Large C/I Equipment	CR_PRJ-216579 Custom-Certainty	$223,396.73	Material: Invoice, Labor: Invoice
Large C/I Equipment	CR_PRJ-218380 Lighting-4	$13,300.00	Material: Invoice, Labor: SWE DB
Small C/I Equipment	CR_PRJ-218586 Lighting-Certainty	$157,779.00	Material: Invoice, Labor: SWE DB
Large C/I Equipment	CR_PRJ-219914 Lighting-3	$92,733.00	Material: Invoice, Labor: Invoice
Large C/I Equipment	CR_PRJ-219918 Lighting-3	$148,710.00	Material: Invoice, Labor: SWE DB
Large C/I Equipment	CR_PRJ-220570 Custom-Certainty	$42,782.22	Material: Invoice, Labor: Invoice
Government	CR_PRJ-224652 Lighting-2	$9,615.00	Material: SWE DB, Labor: SWE DB
Small C/I Buildings	CR_PRJ-228258 Custom-3	$101,387.46	Material: EE&C Plan, Labor: EE&C Plan
Small C/I Equipment	CR_PRJ-228436 Lighting-2	$12,664.00	Material: Invoice, Labor: SWE DB
Large C/I Equipment	CR_PRJ-229101 Custom-Certainty	$100,322.87	Material: Invoice, Labor: Invoice
Large C/I Equipment	CR_PRJ-233101 Lighting-Certainty	$106,710.00	Material: Invoice, Labor: Invoice

Program	Measure	Incremental Cost	Incremental Cost Source
Large C/I Equipment	CR_PRJ-235816 Lighting-Certainty	$318,182.70	Material: Invoice, Labor: DEER 2008 Inflated 15%
Small C/I Equipment	CR_PRJ-235826 Lighting-3	$13,325.00	Material: Invoice, Labor: Invoice
Small C/I Equipment	CR_PRJ-235884 Lighting-4	$37,083.00	Material: Invoice, Labor: SWE DB
Large C/I Buildings	CR_PRJ-235903 Custom-Certainty	$682,052.60	Material: Invoice, Labor: Invoice
Small C/I Equipment	CR_PRJ-237579 Lighting-2	$7,219.00	Material: ADM analysis for new constriction, Labor: ADM analysis for new constriction
Large C/I Equipment	CR_PRJ-239210 Custom-Certainty	$323,263.00	Material: Invoice, Labor: Invoice
Large C/I Equipment	CR_PRJ-239240 Lighting-Certainty	$1,010,319.45	Material: Invoice, Labor: ADM analysis for new constriction
Government	CR_PRJ-239595 Lighting-4	$23,456.60	Material: SWE DB, Labor: SWE DB
Large C/I Equipment	CR_PRJ-241870 Lighting-3	$85,225.00	Material: Invoice, Labor: SWE DB
Small C/I Equipment	CR_PRJ-241886 Lighting-2	$6,002.00	Material: Invoice, Labor: invoice
Large C/I Equipment	CR_PRJ-243150 Lighting-4	$33,065.28	Material: Invoice, Labor: SWE DB
Small C/I Equipment	CR_PRJ-243378 Lighting-3	$12,004.00	Material: ADM analysis for new constriction, Labor: ADM analysis for new constriction
Large C/I Equipment	CR_PRJ-244366 Lighting-Certainty	$148,525.00	Material: Invoice, Labor: SWE DB
Large C/I Equipment	CR_PRJ-247694 Custom-2	$1,441.85	Material: Invoice, Labor: DOE Report
Large C/I Equipment	CR_PRJ-247887 Custom-Certainty	$48,818.00	Material: Invoice, Labor: invoice
Small C/I Equipment	CR_PRJ-247895 Lighting-2	$93,693.00	Material: Invoice, Labor: SWE DB
Small C/I Equipment	CR_PRJ-247947 Lighting-3	$70,458.00	Material: Invoice, Labor: SWE DB
Small C/I Equipment	CR_PRJ-249323 Lighting-3	$22,807.00	Material: Invoice, Labor: invoice
Large C/I Equipment	CR_PRJ-251665 Lighting-4	$37,185.00	Material: Invoice, Labor: SWE DB
Government	CR_PRJ-255804 Lighting-2	$14,414.00	Material: SWE DB, Labor: SWE DB
Large C/I Equipment	CR_PRJ-256153 Custom-2	$10,440.63	Material: Invoice, Labor: DOE Report
Large C/I Equipment	CR_PRJ-256403 Custom-Certainty	$26,521.19	Material: Customer Estimate, Labor: Customer Estimate
Small C/I Equipment	CR_PRJ-256737 Custom-Certainty	$812,312.00	Material: Invoice, Labor: invoice
Government	CR_PRJ-259780 HVAC and DHW-2	$1,343.25	Material: SWE DB, Labor: SWE DB
Large C/I Equipment	CR_PRJ-261352 Custom-Certainty	$195,679.80	Material: Invoice, Labor: Invoice
Large C/I Buildings	CR_PRJ-261604 Custom-Certainty	$229,055.94	Material: Invoice, Labor: invoice
Small C/I Equipment	CR_PRJ-267144 Lighting-4	$20,139.00	Material: Invoice, Labor: invoice
Large C/I Equipment	CR_PRJ-267228 Custom-Certainty	$206,286.25	Material: Invoice, Labor: DOE Report
Large C/I Equipment	CR_PRJ-268053 HVAC and DHW-2	$13,000.00	Material: SWE DB, Labor: SWE DB
Small C/I Equipment	CR_PRJ-281063 Lighting-3	$46,791.00	Material: Invoice, Labor: invoice
Large C/I Equipment	CR_PRJ-283951 Custom-Certainty	$60,727.00	Material: Invoice, Labor: Invoice

Program	Measure	Incremental Cost	Incremental Cost Source
Large C/I Equipment	CR_PRJ-284162 Custom-Certainty	$2,559,608.00	Material: Invoice, Labor: Invoice
Government	CR_PRJ-315136 Lighting-4	$10,377.00	Material: Invoice, Labor: SWE DB
Small C/I Equipment	CR_PRJ-329877 Kitchen/Appliances-1	$576.00	Material: SWE DB, Labor: SWE DB
Government	CR_PRJ-331108 Lighting-3	$36,041.00	Material: Customer Estimate, Labor: SWE DB
Small C/I Equipment	CR_PRJ-333715 Lighting-4	$10,744.00	Material: Invoice, Labor: SWE DB
Small C/I Equipment	CR_PRJ-337720 Custom-3	$36,203.00	Material: Invoice, Labor: invoice
Small C/I Equipment	CR_PRJ-346067 Lighting-4	$2,295.00	Material: Invoice, Labor: SWE DB
Small C/I Equipment	CR_PRJ-348878 Lighting-4	$1,408.00	Material: SWE DB, Labor: SWE DB
Large C/I Equipment	CR_PRJ-349150 Custom-Certainty	$254,445.00	Material: Invoice, Labor: invoice
Large C/I Equipment	CR_PRJ-349751 Lighting-2	$26,681.00	Material: Invoice, Labor: Invoice
Small C/I Equipment	CR_PRJ-352854 Lighting-4	$15,860.00	Material: Invoice, Labor: invoice
Large C/I Equipment	CR_PRJ-354138 Lighting-2	$47,144.00	Material: Invoice, Labor: SWE DB
Large C/I Equipment	CR_PRJ-362320 Custom-Certainty	$724,438.10	Material: Invoice, Labor: invoice
Small C/I Equipment	CR_PRJ-365609 Lighting-3	$149,788.00	Material: Invoice, Labor: SWE DB
Small C/I Equipment	CR_PRJ-371068 Custom-3	$2,093.00	Material: ADM analysis for new constriction, Labor: ADM analysis for new constriction
Small C/I Equipment	CR_PRJ-372253 HVAC and DHW-2	$1,791.67	Material: SWE DB, Labor: SWE DB
Small C/I Equipment	CR_PRJ-377094 Lighting-4	$3,195.80	Material: Invoice, Labor: invoice
Small C/I Equipment	CR_PRJ-377121 Lighting-3	$3,871.00	Material: Invoice, Labor: invoice
Small C/I Equipment	CR_PRJ-256599 Custom-Certainty	$53,724.00	Material: Invoice, Labor: Invoice
Small C/I Equipment	CR_PRJ-256727 Custom-Certainty	$329,253.00	Material: Invoice, Labor: Invoice
Small C/I Equipment	CR_PRJ-256635 Custom-Certainty	$365,726.00	Material: Invoice, Labor: Invoice
Small C/I Equipment	CR_PRJ-256787 Custom-Certainty	$134,472.00	Material: Invoice, Labor: Invoice
Small C/I Equipment	CR_PRJ-256751 Custom-Certainty	$139,560.00	Material: Invoice, Labor: Invoice
Small C/I Equipment	JACO-3344024 Appliance Turn-in-1	$50.00	Material: SWE DB, Labor: SWE DB

APPENDIX C | LOW-INCOME PARTICIPATION IN NON-LOW-INCOME PROGRAMS

For PY6 surveys, the evaluation team added income questions in each residential survey effort to assess low income participation in non-low income specific programs.
Table 1 provides the 2014 income ranges by household sizes, based on 2015 Federal Poverty Level (FPL). The income ranges will be updated annually. The survey will be programmed so that the interviewer reads the annual income ranges associated with their household sizes as listed in Table 1, supporting determination of whether the household is above or below 150% of FPL.65 For example, if the respondent answers that three people lived in the household in 2014/2015, the interviewer will then ask Responses 1 through 5 for Household Size equals 3 as stated in Table 1.

Q1 Including yourself, how many people live in your household? _____People
Q2 Including all money earned from wages, salaries, tips, commissions, workers' compensation, unemployment insurance, child support, or other sources, about how much was your total annual household income before taxes? Was it less than $XX [FILL RESPONSES FOR MAX 150% FROM TABLE 1]?

If no, was it over $YY [FILL RESPONSES FOR MIN 200% FROM TABLE 1]? (PROBE: IF R DOESN'T KNOW ANNUAL RANGE, PROMPT WITH MONTHLY RANGE
1 Less than or equal to 150% poverty
2 151%-200% poverty
3 Over 200% poverty
D Don't know
R Refused

Table 1. Income Range Table (2015)[66]

Household Size	Response 1 (<=50% FPL)	Response 2 (51%-100% FPL)	Response 3 (101%-150 FPL)	Response 4 (151%-200% FPL)	Response 5 (>200% FPL)
1	≤$5,885	$5,885 - $11,770	$11,770 - $17,655	$17,655 - $23,540	≥$23,540
2	≤$7,965	$7,965 - $15,930	$15,930 - $23,895	$23,895 - $31,860	≥$31,860
3	≤$10,045	$10,045 - $20,090	$20,090 - $30,135	$30,135 - $40,180	≥$40,180
4	≤$12,125	$12,125 - $24,250	$24,250 - $36,375	$36,375 - $48,500	≥$48,500
5	≤$14,205	$14,205 - $28,410	$28,410 - $42,615	$42,615 - $56,820	≥$56,820
6	≤$16,285	$16,285 - $32,570	$32,570 - $48,855	$48,855 - $65,140	≥$65,140
7	≤$18,365	$18,365 - $36,730	$36,730 - $55,095	$55,095 - $73,460	≥$73,460
8	≤$20,445	$20,445 - $40,890	$40,890 - $61,335	$61,335 - $81,780	≥$81,780

The low-income participation in upstream CFLs was determined from a survey in September 2015. The survey included the same questions as above with the annual income ranges rounded to the nearest $1,000 to facilitate the telephone survey effort. Respondents were categorized as low-income qualified if the stated incomes were below 150% of FPL.

[65] Monthly income (annual/12) will be programmed for cases where the respondent answers "Don't know" to the annual value.

[66] Source: http://aspe.hhs.gov/poverty/15poverty.cfm

APPENDIX D | RESIDENTIAL LIGHTING UPSTREAM PROGRAM CROSS-SECTOR SALES

It is well known and reasonable that some lamps in the upstream programs are purchased and installed in nonresidential settings. As a result, these lamps experience higher annual hours of use and higher peak demand impacts. In September 2015, ADM conducted a "random digit dial" (RDD) telephone survey for residential customers to assess the impact of cross sector sales. The surveys focused on customers that have purchased either CFLs and LEDs in the last 12 months, from stores that participate in the upstream lighting programs offered by the four FirstEnergy EDCs in Pennsylvania.

The extrapolation from the residential surveys is straightforward. Out of 980 completed survey responses (11,118 efficient lamps purchased in the last 12 months), 36 reported installing a total of (646) CFLs or LEDs in non-residential settings. The fraction of efficient lamps that are installed in non-residential settings is 646/11118=5.81%.

There are incremental demand reductions and incremental energy savings associated with the crossover of CFLs from the residential sector to the nonresidential sector. The hours of use and demand coincidence factors applied to the cross-sector CFLs are taken from the 2014 Metering Study conducted by the SWE[67].

PY6 Upstream Cross Sector Sales Impact Calculation Parameters

Building Type	Hours	Hours	CF	Space Cooling Likelihood
Auto Related	15%	2,001	31%	50%
Education - Primary School	3%	2,944	36%	50%
Education - Secondary School	1%	2,944	36%	50%
Education - University	0%	2,944	36%	80%
Medical - Clinic	2%	2,476	42%	90%
Lodging - Common Spaces	2%	2,925	37%	90%
Nursing Home	4%	2,476	42%	90%
Police and Fire Station - Unmanned	4%	1,456	22%	80%
Religious Worship	8%	1,456	22%	80%
Restaurant - Sit-Down	9%	3,054	57%	90%
Retail - Large	8%	2,383	50%	90%
Retail - Small	10%	2,383	50%	90%
Storage /Warehouse	4%	2,815	44%	20%

The nonresidential TRM protocols also include HVAC interactive effects. ADM applied the 12% and 34% values for energy and demand respectively, but also included applicability factors to account for our the fact that not all of the CFLs are installed in air conditioned space. The HVAC applicability factors are presented in the last column of the above table, and are estimates based on ADM's on-site evaluation experience in Pennsylvania.

Cross sector sales imply that a some amount of incentives that were intended for the residential sector also migrated to the nonresidential sector. The table below shows the overall amount of incentives

[67] Pennsylvania Statewide ACT 129 2014 Commercial & Residential Light Metering Study, Table 4-13 for Interior Screw-Base CFLs and LEDs.

associated with upstream lighting, the amount that remained in the residential sector, and the amount that migrated to the commercial (presumably the small commercial) sector.

Incentive shifts to account for Residential to Small C/I crossover CFLs.

EDC	Total Incentives for Upstream Lighting	Total Incentives for Residential Sector (95.07%)	Total Incentives for Small Commercial Sector (4.93%)
Met-Ed	$453,104	$426,777	$26,327
Penelec	$452,462	$426,172	$26,290
Penn Power	$114,721	$108,055	$6,666
West Penn	$489,260	$460,832	$28,428

Note that the Companies also included CFLs in their nonresidential sector programs. Based on customer surveys, a portion of CFLs distributed to small commercial customers in the C/I Small Energy Efficient Buildings Program were subsequently redistributed to employees, members, or parishioners for use in their homes. The TRM residential lighting protocols are used to evaluate the energy and demand impacts associated with these "crossover" CFLs. The table below also shows the budget shifts needed to account for the crossover.

Incentive shifts to account for Small C/I to Residential crossover CFLs.

EDC	Total Incentives for CFL Kits in the "Small Buildings" Programs	Total Incentives Small Commercial Sector	Total Incentives for Residential Sector
Met-Ed	$100,634	$75,675	$24,959
Penelec	$154,754	$116,764	$37,990
Penn Power	$60,452	$45,643	$14,809
West Penn	$151,260	$107,449	$43,810

Similarly, some participants of the CFL kits program component in the C/I Large Energy Efficient Buildings Program also reported CFL migration to the residential sector. The table below shows the necessary budget shifts to account for this migration.

Incentive shifts to account for Large C/I to Residential crossover CFLs.

EDC	Total Incentives for CFL Kits in the "Large Buildings" Programs	Total Incentives Large Commercial Sector	Total Incentives for Residential Sector
Met-Ed	$14,051	$10,805	$3,246
Penelec	$5,724	$5,079	$645
Penn Power	$1,440	$1,215	$225
West Penn	$6,300	$5,427	$873

The net funding shift for each EDC is summarized in the table below. The net flow of funding is in the opposite direction of CFL flow.

Net funding shifts between sectors to account for crossover CFLs.

EDC	Monies to be shifted from Small C/I to Residential Energy Efficient Products	Monies to be shifted from Residential EE Products to Small C/I Buildings	Monies to be shifted from Residential to Large C/I Buildings
Met-Ed	$1,368	$0	$3,246
Penelec	$0	$11,700	$645
Penn Power	$0	$8,143	$225
West Penn	$0	$15,382	$873

APPENDIX GLOSSARY OF TERMS

This Glossary of Terms was provided by the SWE.

-A-

Administration Management and Technical Assistance Costs: Includes rebate processing, tracking system, general administration, EDC and CSP program management, general management and legal, and technical assistance.

Avoided Cost: In the context of energy efficiency, the costs that are avoided by the implementation of an energy efficiency measure, program, or practice. Such costs are used in benefit/cost analyses of energy efficiency measures and programs as defined by the Pennsylvania PUC in the 2013 TRC Test Order.

-B-

Baseline: Conditions that would have occurred without implementation of the subject measure or project. Baseline conditions are sometimes referred to as "business-as-usual" conditions and are used to calculate program-related efficiency or emissions savings. Baselines can be defined as either project-specific baselines or performance-standard baselines (e.g., building codes). For the purposes of Act 129, baselines are defined in the Pennsylvania TRM, in approved custom protocols, and in TRM interim approved protocols.

Baseline Data: The information representing the systems being upgraded before the energy efficiency activity takes place.

Benefit/Cost Ratio: The mathematical relationship between the benefits and costs associated with the implementation of energy efficiency measures, programs, or practices. The benefits and costs are typically expressed in dollars. This is the ratio of the discounted total benefits of the program to the discounted total costs over the expected useful life of the energy efficiency measure. The explicit formula for use in Pennsylvania is set forth in the TRC Order. Also see *Benefit-Cost Test*.

Benefit-Cost Test: Also called *Cost-Effectiveness Test,* defined as the methodology used to compare the benefits of an investment to the costs. For programs evaluated under Act 129, the TRC Test is the required benefit-cost test as established in the TRC Order.

Bias: The extent to which a measurement, sampling, or analytic method systematically underestimates or overestimates a value. Some examples of types of bias include engineering model bias; meter bias; sensor bias; an inadequate or inappropriate estimate of what would have happened absent a program or measure installation; a sample that is unrepresentative of a population; and selection of other variables in an analysis that are too correlated with the savings variable (or each other) in explaining the dependent variable (such as consumption).

-C-

Coefficient of Variation: The mean (average) of a sample divided by its standard error.

Coincident Demand: The demand of a device, circuit, or building that occurs at the same time as the system peak demand. For purposes of Act 129 reporting, the coincident demand is during the peak period as defined in the TRM (June through August, excluding weekends and holidays between 2 and 6 PM.

Coincidence Factor: The ratio, expressed as a numerical value or as a percentage of connected load, of the coincident demand of an electrical appliance or facility type to the system peak.

Completed Project: A project in which the energy conservation measure has been installed and is commercially operable, and for which an incentive has been provided.

Confidence: An indication of the probability that an estimate is within a specified range of the true value of the quantity in question. Confidence is the likelihood that the evaluation has captured the true value of a variable within a certain estimated range. Also see *Precision*.

Correlation: For a set of observations, such as for participants in an energy efficiency program, the extent to which values for one variable are associated with values of another variable for the same participant. For example, facility size and energy consumption usually have a high positive correlation.

Cost-Benefit and Cost-Effectiveness Analysis: See *Benefit-Cost Test*.

Cost-Effectiveness: An indicator of the relative performance or economic attractiveness of an investment or practice. In the energy efficiency field, the present value of the estimated benefits produced by an energy efficiency program is compared to the estimated total costs to determine if the proposed investment or measure is desirable from a variety of perspectives (e.g., whether the estimated benefits exceed the estimated costs consistent with definitions in the TRC Order. See *Benefit-Cost Test*.

Cost-Effectiveness Test: See *Benefit-Cost Test*.

Cumulative Energy Savings: The summation of energy savings associated with multiple projects or programs over a specified period of time.

Custom Program: An energy efficiency program intended to provide efficiency solutions to unique situations not amenable to common or prescriptive solutions addressed by the Pennsylvania TRM. Each custom project is examined for its individual characteristics, savings opportunities, efficiency solutions, and often, customer incentives. Under Act 129, these programs fall outside of the jurisdiction of the Pennsylvania TRM, and thus the M&V protocols for each should be approved by the SWE.

-D-

Deemed Savings: An estimate of energy or demand savings for a single unit of an installed energy efficiency measure that: (1) has been developed from data sources and analytical methods that are widely considered acceptable for the measure and purpose, and (2) is applicable to the situation being evaluated. Individual parameters or calculation methods can also be deemed. Deemed savings for measures implemented under Act 129 are stipulated in the Pennsylvania TRM, which undergoes an annual review and update process, as well as in the Interim TRM Measures, which are subject to interim approval by the SWE.

Defensibility: The ability of evaluation results to stand up to scientific scrutiny. Defensibility is based on assessments by experts of the evaluation's validity, reliability, and accuracy. Under Act 129, it is the role of the SWE to determine the defensibility of the verified savings estimates reported by each of the EDCs.

Delta Watts: The difference in the connected load (wattage) between existing or baseline equipment and the energy-efficient replacement equipment, expressed in Watts or kilowatts.

Demand: The rate of energy flow. Demand usually refers to the amount of electric energy used by a customer or piece of equipment over a defined time interval (e.g., 15 minutes), expressed in kW (equals kWh/h). Demand can also refer to natural gas usage over a defined time interval, usually as Btu/hr, kBtu/hr, therms/day, or ccf/day.

Demand Reduction: See *Demand Savings*.

Demand Response: The reduction of customer energy usage at times of peak usage in order to help system reliability, to reflect market conditions and pricing, or to support infrastructure optimization or deferral of additional infrastructure. Demand response programs may include contractually obligated or voluntary curtailment, direct load control, and pricing strategies.

Demand Savings: The reduction in electric demand from the demand associated with a baseline system to the demand associated with the higher-efficiency equipment or installation. Demand savings associated with energy efficiency measures implemented under Act 129 are calculated according to the approved calculation methods stipulated in the TRM or subsequently approved through alternative methods (e.g., interim measures, custom protocols).

Demand-side Management: Strategies used to manage energy demand including energy efficiency, load management, fuel substitution, and load shedding.

-E-

Energy Efficiency and Conservation (EE&C) Plan: Plan as filed by the EDC and approved by the PUC.

EE&C Plan Estimate for Program Year: An estimate of the energy savings or demand reduction for the current program year as filed in the EDC EE&C plans.

Effective Useful Life: An estimate of the median number of years that efficiency measures installed under a program are still in place and operable. For measures implemented under Act 129, it is required that the effective useful life or 15 years, whichever is less, be used to determine measure assessments.

Electric Distribution Company (EDC): In reference to Act 129, there are seven EDCs with at least 100,000 customers that are required to adopt a plan to reduce energy and demand consumption within their service territory in accordance with 66 Pa. C.S. § 2608. The seven EDCs are: Duquesne Light, Metropolitan Edison Company, Pennsylvania Electric Company, Pennsylvania Power Company, PECO Energy Company, PPL Electric Utilities and West Penn Power.

End Use: An appliance, activity, system, or equipment that uses energy.

Energy Conservation: Using less of a service in order to save energy. The term often is used unintentionally instead of *energy efficiency*.

Energy Efficiency: The use of less energy to provide the same or an improved level of service to the energy consumer; or the use of less energy to perform the same function.

Energy Efficiency Measure: An installed piece of equipment or a system, modification of equipment systems, or modified operations in customer facilities that reduce the total amount of electrical or gas energy and the capacity that otherwise would have been needed to deliver an equivalent or improved level of comfort or energy service.

Energy Savings: A reduction in electricity use (kWh) or in fossil fuel use in thermal unit(s).

Evaluation: The conduct of any of a wide range of assessment studies and other activities aimed at documenting an enhanced understanding of a program or portfolio, including determining the effects of a program, understanding or documenting program performance, program-related markets and market operations, program-induced changes in energy efficiency markets, levels of potential demand or energy savings, and/or program cost-effectiveness. Market assessments, monitoring and evaluation, and M&V are aspects of evaluation.

Ex-anteEx-anteEx-Ante Savings Estimate: Forecasted savings used for program and portfolio planning purposes.

Ex-postEx-post Savings Estimate: Savings estimate reported by an evaluator after the energy impact evaluation has been completed.

-F-

Free Driver: A program nonparticipant who adopted a particular efficiency measure or practice as a result of the evaluated program. Also see *Spillover*.

Free-Rider: A program participant who would have implemented the program measure or practice in the absence of the program. Free-riders can be: (1) total, in which the participant's activity would have completely replicated the program measure; (2) partial, in which the participant's activity would have partially replicated the program measure; or (3) deferred, in which the participant's activity would have completely replicated the program measure, but after the program's timeframe.

Free-Ridership Rate: The percent of savings attributable to free-riders.

-G-

Gross Impact: See *Gross Savings*.

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

Gross kW: Expected demand reduction based on a comparison of standard or replaced equipment with equipment installed through an energy efficiency program.

Gross kWh: Expected kWh reduction based on a comparison of standard or replaced equipment with equipment installed through an energy efficiency program.

-H, I-

Impact Evaluation: An evaluation of the program-specific, directly induced quantitative changes (kWh, kW, and therms) attributable to an energy efficiency program.

Incremental Cost: The difference between the cost of an existing or baseline equipment or service and the cost of an alternative energy efficient equipment or service.

Incremental Energy Savings: The difference between the amount of energy savings associated with a project or a program in one period and the amount of energy savings associated with that project or program in a prior period.

-J, K-

Kilowatt (kW): A measure of the rate of power used during a pre-set time period (e.g., minutes, hours, days, months) equal to 1,000 Watts.

Kilowatt-Hour (kWh): A common unit of electric energy; one kilowatt-hour is numerically equal to 1,000 Watts used for one hour.

-L-

Lifetime kW: The expected demand savings over the lifetime of an installed measure, equal to the annual peak kW reduction associated with a measure multiplied by the expected lifetime of that measure. It is expressed in units of kW-years.

Lifetime MWh: The expected electrical energy savings over the lifetime of an installed measure, calculated by multiplying the annual MWh reduction associated with a measure by the expected lifetime of that measure.

Lifetime Supply Costs: The net present value of avoided supply costs associated with savings, net of changes in energy use that would have happened in the absence of the program over the life of the energy efficiency measure, factoring in persistence of savings. See *Avoided Cost*.

Load Factor: A percentage indicating the ratio of electricity or natural gas used during a given timeframe to the amount that would have been used if the usage had stayed at the highest demand the whole time. The term is also used to indicate the percentage of capacity of an energy facility, such as a power plant or gas pipeline, that is utilized for a given period of time.

Load Management: Steps taken to reduce power demand at peak load times or to shift some of it to off-peak times. Load management may coincide with peak hours, peak days, or peak seasons. Load management may be pursued by persuading consumers to modify behavior or by using equipment that regulates some electric consumption. This may lead to complete elimination of electric use during the period of interest (load shedding) and/or to an increase in electric demand in the off-peak hours as a result of shifting electric usage to that period (load shifting).

-M-

Market Assessment: An analysis that provides an assessment of how and how well a specific market or market segment is functioning with respect to the definition of well-functioning markets or with respect to other specific policy objectives. Generally includes a characterization or description of the specific market or market segments, including a description of the types and number of buyers and sellers in the market, the key factors that influence the market, the type and number of transactions that occur on an annual basis, and the extent to which market participants consider energy efficiency as an important part of these transactions. This analysis may also include an assessment of whether a market has been sufficiently transformed to justify a reduction or elimination of specific program interventions. Market assessments can be blended with strategic planning analysis to produce recommended program designs or budgets. One particular kind of market assessment effort is a baseline study, or the characterization of a market before the commencement of a specific intervention in the market, for the purpose of guiding the intervention and/or assessing its effectiveness later.

Measurement and Verification (M&V): A subset of program impact evaluations that are associated with the documentation of energy savings at individual sites or projects using one or more methods that can involve measurements, engineering calculations, statistical analyses, and/or computer simulation modeling.

Measurement Error: In the evaluation context, a reflection of the extent to which the observations conducted in the study deviate from the true value of the variable being observed. The error can be random (equal around the mean) or systematic (indicating bias).

Megawatt (MW): A unit for measuring electricity equal to 1,000 kilowatts or one million Watts.

Megawatt-Hour (MWh): A unit of electric energy numerically equal to 1,000,000 Watts used for one hour.

Metered Data: Data collected over time through a meter for a specific end use, energy-using system (e.g., lighting, HVAC), or location (e.g., floors of a building, a whole premise). Metered data may be collected over a variety of time intervals. Usually refers to electricity or gas data.

Metering: The collection of energy consumption data over time through the use of meters. These meters may collect information about an end use, a circuit, a piece of equipment, or a whole building (or facility). *Short-term metering* generally refers to data collection for no more than a few weeks. *End-use metering* refers specifically to separate data collection for one or more end uses in a facility, such as lighting, air conditioning, or refrigeration. *Spot metering* is an instantaneous measurement (rather than over time) to determine equipment size or power draw.

Monitoring: The collection of relevant measurement data over time at a facility, including but not limited to energy consumption or emissions data (e.g., energy and water consumption, temperature, humidity, volume of emissions, and hours of operation) for the purpose of conducting a savings analysis or to evaluate equipment or system performance.

-N-

Net Impact: See *Net Savings*.

Net Present Value: The discounted value of the net benefits or costs over a specified period of time (e.g., the expected useful life of the energy efficiency measure).

Net Savings: The total change in load that is attributable to an energy efficiency program. This change in load may include, implicitly or explicitly, the effects of spillover, free-riders, energy efficiency standards, changes in the level of energy service, and other causes of changes in energy consumption or demand. Net savings are calculated by multiplying verified savings by a NTG ratio.

Net-to-Gross (NTG): A factor representing net program savings divided by gross program savings that is applied to gross program impacts to convert them into net program load impacts.

Nonparticipant: Any consumer who was eligible but did not participate in the subject efficiency program in a given program year.

-O-

Off-Peak Energy kWh Savings: The kWh reduction that occurs during a specified period of off-peak hours for energy savings (see the PA TRM Table 1-1).

On-Peak Energy kWh Savings: The kWh reduction that occurs during a specified period of on-peak hours for energy savings (see the PA TRM Table 1-1).

-P-

Participant: A utility customer partaking in an energy efficiency program, defined as one transaction or one rebate payment in a program. For example, a customer receiving one payment for two measures within one program counts as one participant. A customer receiving two payments in two programs counts as two participants. A customer partaking in one program at two different times receiving two separate payments counts as two participants.

Participant Costs: Costs incurred by a customer participating in an energy efficiency program.

Peak Demand: The maximum level of metered demand during a specified period, such as a billing month or a peak demand period.

Peak Load: The highest electrical demand within a particular period of time. Daily electric peaks on weekdays typically occur in the late afternoon and early evening. Annual peaks typically occur on hot summer days.

Percent of Estimate Committed: The program year-to-date total committed savings as a percent of the savings targets established in each EDC EE&C Plan, calculated by dividing the PYTD total committed by the EE&C Plan program year estimate.

Portfolio: Can be defined as: (1) a collection of programs addressing the same market (e.g., a portfolio of residential programs), technology (e.g., motor efficiency programs), or mechanisms (e.g., loan programs); or (2) the set of all programs conducted by one or more organizations, such as a utility or program administrator, and which could include programs that cover multiple markets, technologies, etc.

Precision: An indication of the closeness of agreement among repeated measurements of the same physical quantity. It is also used to represent the degree to which an estimated result in social science (e.g., energy savings) would be replicated with repeated studies.

Preliminary Program Year-to-Date (PYTD) Net Impact: Net impacts reported in quarterly reports. These net impacts are preliminary in that they are based on preliminary realization rates.

Preliminary Program Year-to-Date (PYTD) Verified Impact: Verified impacts reported in quarterly reports. These verified impacts are preliminary in that they are based on preliminary realization rates.

Preliminary Realization Rate: Realization rates reported in quarterly reports based on the results of M&V activities conducted on the sample to date. These results are preliminary because the sample-to-date is likely not to have met the required levels of confidence and precision.

Prescriptive Program: An energy efficiency program focused on measures that are one-for-one replacements of the existing equipment and for which anticipated similar savings results across participants.

Process Evaluation: A systematic assessment of an energy efficiency program for the purposes of documenting program operations at the time of the examination and identifying and recommending improvements to increase the program's efficiency or effectiveness for acquiring energy resources, while maintaining high levels of participant satisfaction.

Program Administrator: Those entities that oversee the implementation of energy efficiency programs. This generally includes regulated utilities, other organizations chosen to implement such programs, and state energy offices.

Program Year Energy Savings Target: Energy target established for the given program year as approved in each EDC EE&C Plan.

Program Year Sample Participant Target: Estimated sample size for evaluation activities in the given program year.

Program Incentive: An incentive, generally monetary, that is offered to a customer through an energy efficiency program to encourage their participation. The incentive is intended to overcome one or more barriers that keep the customer from taking the energy efficiency action on their own.

Program Participant: A consumer that received a service offered through an efficiency program in a given program year. The term "service" can refer to one or more of a wide variety of services, including

financial rebates, technical assistance, product installations, training, energy efficiency information, or other services, items, or conditions.

Program Year-to-Date (PYTD): Beginning June 1 of the current program year through the end of the current quarter (February 28/29, May 31, August 31, or November 30).

Program Year-to-Date (PYTD) Net Impact: The total change in load that is attributable to an energy efficiency program from June 1 of the current program year through the end of the current quarter (February 28/29, May 31, August 31, or November 30).

Program Year-to-Date (PYTD) Participants: The number of utility customers participating in an energy efficiency program beginning June 1 of the current program year through the end of the current quarter (February 28/29, May 31, August 31, or November 30).

Program Year-to-Date (PYTD) Reported Gross Impact: The change in energy consumption and/or demand that results directly from program-related actions taken by participants in an efficiency program, regardless of why they participated, beginning June 1 of the current program year through the end of the current quarter (February 28/29, May 31, August 31, or November 30). This value is unverified by an independent third-party evaluator.

Program Year-to-Date (PYTD) Sample Participants: Total participant sample beginning June 1 of the current program year through the end of the current quarter (February 28/29, May 31, August 31, or November 30).

Program Year-to-Date (PYTD) Total Committed: The estimated gross impacts, including reported impacts and in-progress impacts, beginning June 1 of the current program year through the end of the current quarter (February 28/29, May 31, August 31, or November 30), calculated by adding PYTD reported gross impacts for projects in progress.

Project: An activity or course of action involving one or multiple energy efficiency measures at a single facility or site.

Projects in Progress: Energy efficiency and demand response projects currently being processed and tracked by the EDC, but that are not yet complete at the time of the report. See *Completed Project*.

-Q,R-

Realization Rate: The term is used in several contexts in the development of reported program savings. The primary applications include the ratio of project tracking system savings data (e.g., initial estimates of project savings) to savings that: 1) are adjusted for data errors, and 2) incorporate the evaluated or verified results of the tracked savings.

Rebate Program: An energy efficiency program in which the program administrator offers a financial incentive for the installation of energy-efficient equipment.

Rebound Effect: Also called “snap back,” defined as a change in energy-using behavior that yields an increased level of service that is accompanied by an increase in energy use and occurs as a result of taking an energy efficiency action. The result of this effect is that the savings associated with the direct energy efficiency action are reduced by the resulting behavioral change.

Regression Analysis: Analysis of the relationship between a *dependent variable* (response variable) to specified *independent variables* (explanatory variables). The mathematical model of their relationship is the *regression equation*.

Regression Model: A mathematical model based on statistical analysis where the dependent variable is quantified based on its relationship to the independent variables that are believed to determine its value. In so doing, the relationship between the variables is estimated statistically from the data used.

Reliability: The quality of a measurement process that would produce similar results on: (1) repeated observations of the same condition or event, or (2) multiple observations of the same condition or event by different observers.

Renewable Energy: Energy derived from resources that are naturally replenishing. They are virtually inexhaustible in duration but limited in the amount of energy that is available per unit of time. Renewable energy resources include biomass, hydro, geothermal, solar, wind, ocean thermal, wave action, and tidal action.

Reported Gross Impact: The change in energy consumption and/or demand that results directly from program-related actions taken by participants in an efficiency program, regardless of why they participated. This value is unverified by an independent third-party evaluator. Also referred to as "ex-postex-post" impact.

Reporting Period: The time following implementation of an energy efficiency activity during which results are to be determined.

Representative Sample: A sample that has approximately the same distribution of characteristics as the population from which it was drawn.

Rigor: The level of effort expended to minimize uncertainty due to factors such as sampling error and bias. The higher the level of rigor, the more confidence there is that the results of the evaluation are accurate and precise.

-S-

Sample: In program evaluation, a portion of the population selected to represent the whole. Differing evaluation approaches rely on simple or stratified samples (based on some characteristic of the population).

Sample Design: The approach used to select the sample units.

Sampling Error: The error in estimating a parameter caused by the fact that all of the disturbances in the sample are not zero.

Savings Factor (SVG): The percent of time the lights are off due to lighting controls relative to the baseline controls system (typically a manual switch). Also referred to as the *lighting controls savings factor*.

Simple Random Sample: A method for drawing a sample from a population such that all samples of a given size have an equal probability of being drawn.

Snap Back: See *Rebound Effect*.

Simulation Model: An assembly of algorithms that calculate energy use based on engineering equations and user-defined parameters.

Spillover: Reductions in energy consumption and/or demand caused by the presence of an energy efficiency program, beyond the program-related gross savings of the participants and without financial or technical assistance from the program. There can be participant and/or nonparticipant spillover. *Participant spillover* is the additional energy savings that occur when a program participant independently

installs energy efficiency measures or applies energy-saving practices after having participated in the efficiency program as a result of the program's influence. *Nonparticipant spillover* refers to energy savings that occur when a program nonparticipant installs energy efficiency measures or applies energy-saving practices as a result of a program's influence.

Spillover Rate: An estimate of energy savings attributable to spillover effects expressed as a percent of savings installed by participants through an energy efficiency program.

Standard Error: A measure of the variability in a data sample indicating how far a typical data point is from the mean of a sample. In a large sample, approximately two-thirds of observations lie within one standard error of the mean, and 95% of observations lie within two standard errors.

Statistically Adjusted Engineering Models: A category of statistical analysis models that incorporate the engineering estimate of savings as a dependent variable. The regression coefficient in these models is the percentage of the engineering estimate of savings observed in changes in energy usage. For example, if the coefficient of the statistically adjusted engineering term is 0.8, the customers are, on average, realizing 80% of the savings from their engineering estimates.

Stipulated Values: See *Deemed Savings*.

Stratified Random Sampling: The population is divided into subpopulations, called *strata*, that are non-overlapping and together comprise the entire population. A simple random sample of each stratum is taken to create a sample based on stratified random sampling.

Stratified Ratio Estimation: A sampling method that combines a stratified sample design with a ratio estimator to reduce the coefficient of variation by using the correlation of a known measure for the unit (e.g., expected energy savings) to stratify the population and allocate a sample from the strata for optimal sampling.

-T-

Take back Effect: See *Rebound Effect*.

Total Resource Cost (TRC) Test: A cost-effectiveness test that measures the net direct economic impact to the utility service territory, state, or region. The TRC Order details the method and assumptions to be used when calculating the TRC Test for EE&C portfolios implemented under Act 129. The results of the TRC Test are to be expressed as both a net present value and a benefit-cost ratio.

Total Resource Cost (TRC) Test Benefits: Benefits calculated in the TRC Test that include the avoided supply costs, such as the reduction in transmission, distribution, generation, and capacity costs, valued at a marginal cost for the periods when there is a consumption reduction. The PA TRC benefits will consider avoided supply costs, such as the reduction in forecasted zonal wholesale electric generation prices, ancillary services, losses, generation capacity, transmission capacity, and distribution capacity. The avoided supply costs will be calculated using net program savings, defined as the savings net of changes in energy use that would have happened in the absence of the program. The persistence of savings over time will also be considered in the net savings.

Total Resource Cost (TRC) Test Costs: The costs calculated in the TRC Test will include the costs of the various programs paid for by an EDC (or by a default service provider) and the participating customers, and costs that reflect any net change in supply costs for the periods in which consumption is increased in the event of load shifting. Note that the TRC Test should use the incremental costs of services and equipment. Thus, for example, this would include costs for equipment, installation, operation and maintenance, removal (less salvage value), and administrative tasks, regardless of who pays for them.

-U-

Uncertainty: The range or interval of doubt surrounding a measured or calculated value within which the true value is expected to fall with some degree of confidence.

Upstream Program: A program that provides information and/or financial assistance to entities in the delivery chain of high-efficiency products at the retail, wholesale, or manufacturing level. Such a program is intended to yield lower retail prices for the products.

-V-

Verification: An independent assessment of the reliability (considering completeness and accuracy) of claimed energy savings or an emissions source inventory.

Verified Gross Impact: Calculated by applying the realization rate to reported gross impacts. Also referred to as "ex-anteex-ante" impact.

-W-

Watt: A unit of measure of electric power at a point in time as capacity or demand. One Watt of power maintained over time is equal to one Joule per second. The Watt is named after Scottish inventor James Watt, and is shortened to W and used with other abbreviations, as in kWh (kilowatt-hours).

Watt-Hour: One Watt of power expended for one hour, or one-thousandth of a kilowatt-hour.

Whole-Building Calibrated Simulation Approach: A savings measurement approach (defined in the International Performance Measurement and Verification Protocol Option D and in the American Society of Heating, Refrigerating and Air-Conditioning Engineers Guideline 14) that involves the use of an approved computer simulation program to develop a physical model of the building in order to determine energy and demand savings. The simulation program is used to model the energy used by the facility before and after the retrofit. The pre- or post-retrofit models are developed by calibration with measured energy use, demand data, and weather data.

Whole-building Metered Approach: A savings measurement approach (defined in the International Performance Measurement and Verification Protocol Option C and in the American Society of Heating, Refrigerating and Air-Conditioning Engineers Guideline 14) that determines energy and demand savings through the use of whole-facility energy (end-use) data, which may be measured by utility meters or data loggers. This approach may involve the use of monthly utility billing data or data gathered more frequently from a main meter.

References

PAH Associations, prepared by Paul Horowitz. Facilitated by the Northeast Energy Efficiency Partnerships. Glossary of Terms Version 1.0. A project of the Regional Evaluation, Measurement and Verification Forum. March 2009.