Final Annual Report to the Pennsylvania Public Utility Commission

Phase III of Act 129

Program Year 9

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For Pennsylvania Act 129 of 2008

Energy Efficiency and Conservation Plan

Prepared by ADM Associates and Tetra Tech

For

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Acronyms

BDR	Behavioral Demand Response
C&I	Commercial and Industrial
CFL	Compact Fluorescent Lamp
CSP	Conservation Service Provider or Curtailment Service Provider
CV	Coefficient of Variation
DLC	Direct Load Control
DR	Demand Response
EDC	Electric Distribution Company
EDT	Eastern Daylight Time
EE&C	Energy Efficiency and Conservation
EM&V	Evaluation, Measurement, and Verification
EUL	Effective Useful Life
GNI	Government, Non-Profit, Institutional
HER	Home Energy Report
HIM	High-Impact Measure
HVAC	Heating, Ventilating, and Air Conditioning
ICSP	Implementation Conservation Service Provider
kW	Kilowatt
kWh	Kilowatt-hour
LED	Light-Emitting Diode
LIURP	Low-Income Usage Reduction Program
M&V	Measurement and Verification
MW	Megawatt
MWh	Megawatt-hour
NPV	Net Present Value
NTG	Net-to-Gross
P3TD	Phase III to Date
PA PUC	Pennsylvania Public Utility Commission
PSA	Phase III to Date Preliminary Savings Achieved; equal to VTD + PYRTD
PSA+CO	PSA savings plus Carryover from Phase II
PY	Program Year: e.g. PY8, from June 1, 2016, to May 31, 2017
PYRTD	Program Year Reported to Date
PYVTD	Program Year Verified to Date
RTD	Phase III to Date Reported Gross Savings
SWE	Statewide Evaluator
TRC	Total Resource Cost
TRM	Technical Reference Manual
VTD	Phase III to Date Verified Gross Savings

Types of Savings

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

Net Savings: The total change in energy consumption and/or peak demand that is attributable to an EE&C program. Depending on the program delivery model and evaluation methodology, the net savings estimates may differ from the gross savings estimate due to adjustments for the effects of free riders, changes in codes and standards, market effects, participant and nonparticipant spillover, and other causes of changes in energy consumption or demand not directly attributable to the EE&C program.

Reported Gross: Also referred to as *ex ante* (Latin for "beforehand") savings. The energy and peak demand savings values calculated by the EDC or its program Implementation Conservation Service Providers (ICSP), and stored in the program tracking system.

Unverified Reported Gross: The Phase III Evaluation Framework allows EDCs and the evaluation contractors the flexibility to not evaluate each program every year. If an EE&C program is being evaluated over a multi-year cycle, the reported savings for a program year where evaluated results are not available are characterized as unverified reported gross until the impact evaluation is completed and verified savings can be calculated and reported.

Verified Gross: Also referred to as *ex post* (Latin for "from something done afterward") gross savings. The energy and peak demand savings estimates reported by the independent evaluation contractor after the gross impact evaluation and associated M&V efforts have been completed.

Verified Net: Also referred to as *ex post* net savings. The energy and peak demand savings estimates reported by the independent evaluation contractor after application of the results of the net impact evaluation. Typically calculated by multiplying the verified gross savings by a net-to-gross (NTG) ratio.

Annual Savings: Energy and demand savings expressed on an annual basis, or the amount of energy and/or peak demand an EE&C measure or program can be expected to save over the course of a typical year. Annualized savings are noted as MWh/year or MW/year. The Pennsylvania TRM provides algorithms and assumptions to calculate annual savings, and Act 129 compliance targets for consumption reduction are based on the sum of the annual savings estimates of installed measures or behavior change.

Lifetime Savings: Energy and demand savings expressed in terms of the total expected savings over the useful life of the measure. Typically calculated by multiplying the annual savings of a measure by its effective useful life. The TRC Test uses savings from the full lifetime of a measure to calculate the cost-effectiveness of EE&C programs.

Program Year Reported to Date (PYRTD): The reported gross energy and peak demand savings achieved by an EE&C program or portfolio within the current program year. PYTD values for energy efficiency will always be reported gross savings in a semi-annual or preliminary annual report.

Program Year Verified to Date (PYVTD): The verified gross energy and peak demand savings achieved by an EE&C program or portfolio within the current program year as determined by the impact evaluation findings of the independent evaluation contractor.

Phase III to Date (P3TD): The energy and peak demand savings achieved by an EE&C program or portfolio within Phase III of Act 129. Reported in several permutations described below.

> **Phase III to Date Reported (RTD):** The sum of the reported gross savings recorded to date in Phase III of Act 129 for an EE&C program or portfolio.
>
> **Phase III to Date Verified (VTD):** The sum of the verified gross savings recorded to date in Phase III of Act 129 for an EE&C program or portfolio, as determined by the impact evaluation finding of the independent evaluation contractor.
>
> **Phase III to Date Preliminary Savings Achieved (PSA):** The sum of the verified gross savings (VTD) from previous program years in Phase III where the impact evaluation is complete plus the reported gross savings from the current program year (PYTD). For PY8, the PSA savings will always equal the PYTD savings because PY8 is the first program year of the phase (no savings will be verified until the PY8 final annual report).
>
> **Phase III to Date Preliminary Savings Achieved + Carryover (PSA+CO):** The sum of the verified gross savings from previous program years in Phase III plus the reported gross savings from the current program year plus any verified gross carryover savings from Phase II of Act 129. This is the best estimate of an EDC's progress toward the Phase III compliance targets.
>
> **Phase III to Date Verified + Carryover (VTD + CO):** The sum of the verified gross savings recorded to date in Phase III plus any verified gross carryover savings from Phase II of Act 129.

1 Introduction

Pennsylvania Act 129 of 2008, 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). Phase II of Act 129 began in June 2013 and concluded in May 2016. In late 2015, each EDC filed a new energy efficiency and conservation (EE&C) plan with the PA PUC detailing the proposed design of its portfolio for Phase III. These plans were updated based on stakeholder input and subsequently approved by the PUC in 2016.

Implementation of Phase III of the Act 129 programs began on June 1, 2016. This report documents the progress and effectiveness of the Phase III EE&C accomplishments in Program Year 9 (PY9) for Metropolitan Edison (Met-Ed), Pennsylvania Electric Company (Penelec), Pennsylvania Power Company (Penn Power), and West Penn Power Company (WPP), collectively referred to herein as the FirstEnergy PA Companies (Companies) or the four PA EDCs, as well as the cumulative accomplishments of the Phase III programs since inception. This report additionally documents the energy savings carried over from Phase II. The Phase II carryover savings count towards EDC savings compliance targets for Phase III.

This report details the participation, spending, reported gross, verified gross, and verified net impacts of the energy efficiency programs in PY9. Compliance with Act 129 savings goals are ultimately based on verified gross savings. This report also includes estimates of cost-effectiveness according to the Total Resource Cost test (TRC).[1] The Companies have retained ADM Associates, Inc. and Tetra Tech MA Inc (the ADM team, or ADM) as an independent evaluation contractor for Phase III of Act 129. The ADM team is responsible for the measurement and verification of the savings and calculation of gross verified and net verified savings.

The ADM team also performed process evaluations to examine the design, administration, implementation, and market response to the EE&C program. This report presents the key findings and recommendations identified by the process evaluation and documents any changes to EE&C program delivery considered based on the recommendations.

Phase III of Act 129 includes a demand response goal for Met-Ed, Penn Power, and WPP. Demand response events are limited to the months of June through September, which are the first four months of the Act 129 program year. Because the demand response season is completed early in the program year, it is possible to complete the independent evaluation of verified gross savings for demand response sooner than is possible for energy efficiency programs. The Companies reported the verified gross demand response impacts for PY9 as well as the cumulative demand response performance of the EE&C program to date for Phase III of Act 129 in the Preliminary Annual Report filed July 15, 2018.

[1] The Pennsylvania TRC Test for Phase I was adopted by PUC order at Docket No. M-2009-2108601 on June 23, 2009 (*2009 PA TRC Test Order*). The TRC Test Order for Phase I later was refined in the same docket on August 2, 2011 (2011 PA TRC Test Order). The 2013 TRC Order for Phase II of Act 129 was issued on August 30, 2012. The 2016 TRC Test Order for Phase III of Act 129 was adopted by PUC order at Docket No. M-2015-2468992 on June 11, 2015.

2 Summary of Achievements

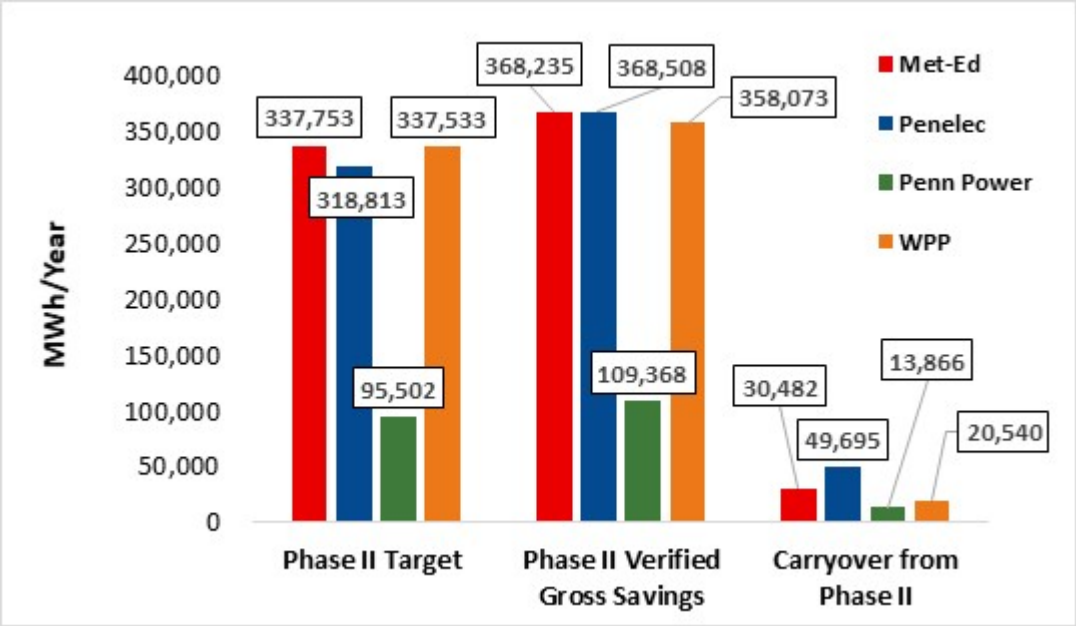
2.1 Carryover Savings from Phase II of Act 129

Table 1 shows total MWh/year carryover savings from Phase II for each of the FirstEnergy EDCs. MWh/year of portfolio-level carryover savings from Phase II. Figure 1 compares Phase II verified gross savings total to the Phase II compliance target to illustrate the carryover calculation.

Table 1: Carryover Savings from Phase II

FirstEnergy EDC	Phase II Carryover Savings (MWh/Year)
Met-Ed	30,482
Penelec	49,695
Penn Power	13,866
West Penn Power	20,540

Figure 1: Carryover Savings from Phase II of Act 129



The Commission's Phase III Implementation Order[2] also allowed EDCs to carry over savings in excess of the Phase II Government, Non-Profit, and Institutional (GNI) savings goal and excess savings from the Low-Income (LI) customer segment.[3] Figure 2 shows the calculation of

[2] Pennsylvania Public Utility Commission, *Energy Efficiency and Conservation Program* Implementation Order, at Docket No. M-2014-2424864, (*Phase III Implementation Order*), entered June 11, 2015.
[3] Proportionate to those savings achieved by dedicated low-income programs in Phase III.

carryover savings for the low-income targets, and Figure 3 shows the calculation of carryover savings for the GNI targets.

Figure 2: Low-Income Carryover from Phase II

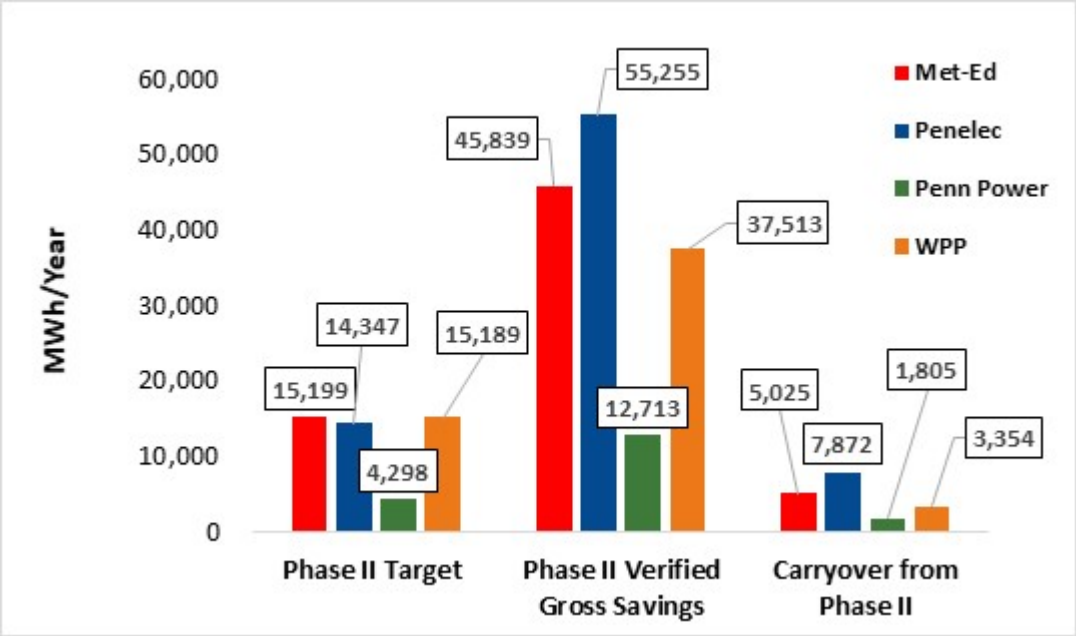
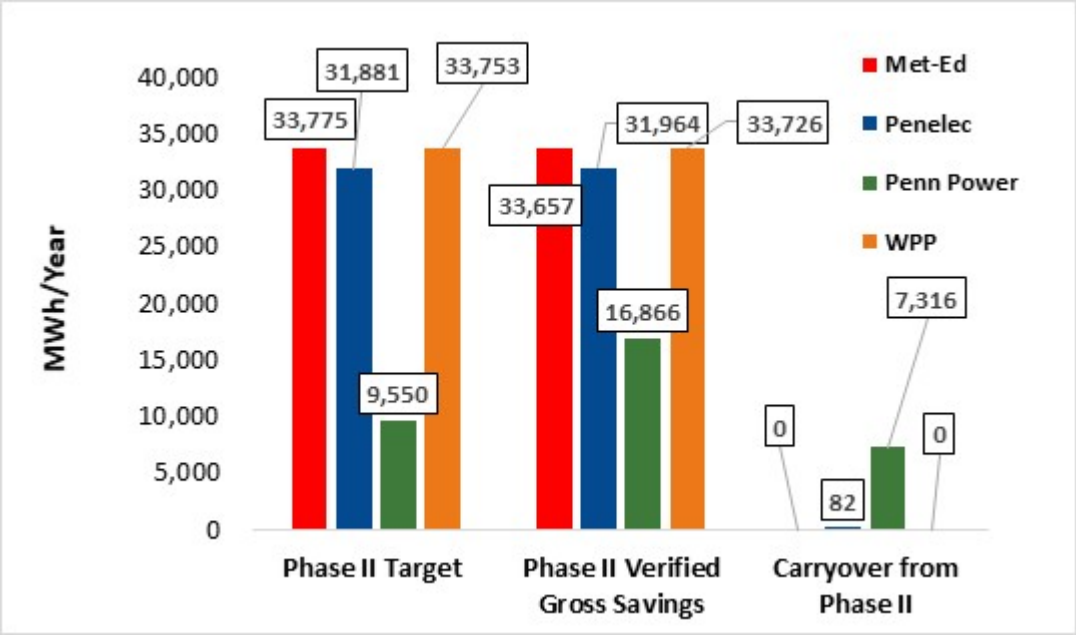


Figure 3: GNI Carryover from Phase II



2.2 Phase III Energy Efficiency Achievements to Date

Since the beginning of Program Year 9 on June 1, 2017, the four FirstEnergy PA EDCs reported and verified gross electric energy savings and gross peak demand savings are shown in Table 2 below.

Table 2: Gross Reported and Verified Electric and Demand Savings for PY9

EDC	PYRTD MWh	PYRTD MW	PYVTD MWh	PYVTD MW
Met-Ed	162,297	22	176,720	23
Penelec	153,766	20	154,704	19
Penn Power	53,225	7	57,354	7
West Penn Power	179,808	23	195,542	23

Since the beginning of Program Year 8 on June 1, 2016, the four FirstEnergy PA EDCs reported and verified gross electric energy savings and gross peak demand savings are shown in Table 3 below.

Table 3: Gross Reported and Verified Electric and Demand Savings since the beginning of Phase III of Act 129

EDC	RTD MWh	RTD MW	VTD MWh	VTD MW
Met-Ed	292,719	39	316,595	42
Penelec	275,300	35	287,154	35
Penn Power	88,071	12	94,484	13
West Penn Power	302,268	40	326,872	40

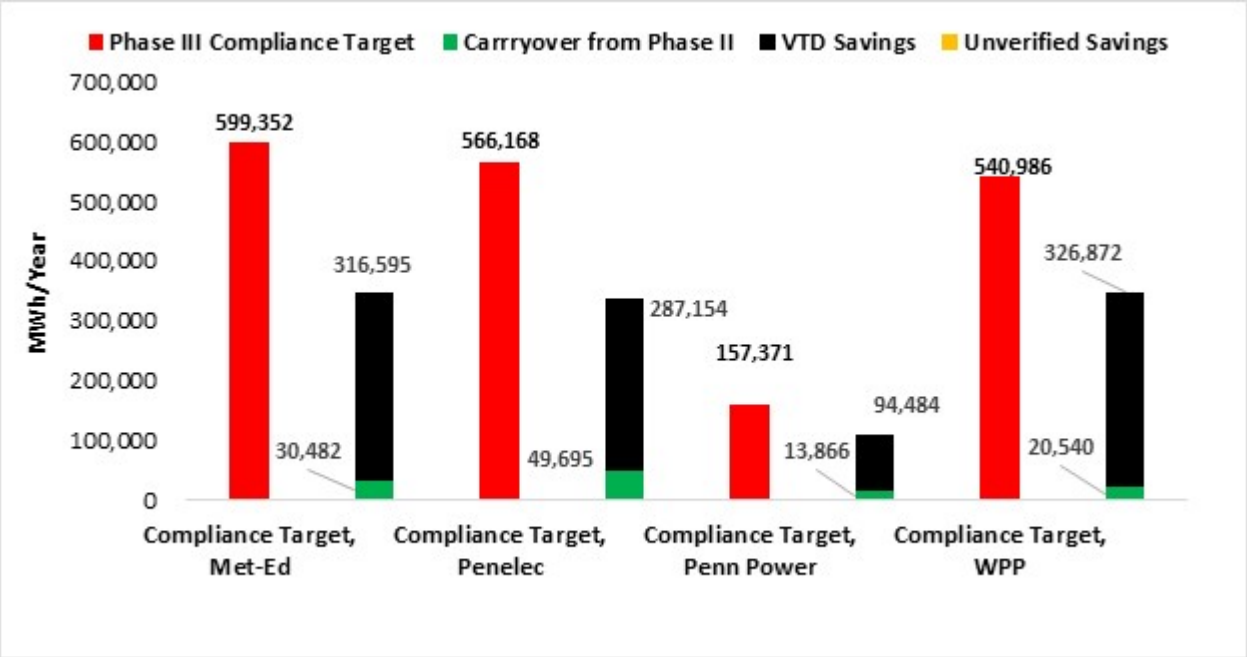
Achievements toward Phase III Energy Savings compliance, including carryover savings from Phase II, are shown in Table 4 below for the four PA EDCs.

Table 4: Phase III Electric Savings including Phase II Carryover

EDC	VTD +CO MWh	Compliance Target	Percent of Target to Date
Met-Ed	347,077	599,352	58%
Penelec	336,849	566,168	59%
Penn Power	108,350	157,371	69%
West Penn Power	347,412	540,986	64%

Figure 4 summarizes progress towards the Phase III portfolio compliance targets for each of the four EDCs.

Figure 4: EE&C Plan Performance toward Phase III Portfolio Compliance Target



The Phase III Implementation Order directed EDCs to offer conservation measures to the low-income customer segment based on the proportion of electric sales attributable to low-income households. The proportionate number of measures targets for the EDCs are listed in the second column of Table 5. The number of EE&C measures offered by each EDC to its residential and non-residential customer classes are shown in the third column. The fourth column shows the number of measures available to the low-income customer segment at no cost to the customer. The last column shows the percentages of total measures offered in the EE&C plan. These percentages exceed the proportionate number of measures targets for each EDC.

Table 5: Proportion of Measures Offered to Low-Income Customers

EDC	% Proportionate Number of Measures Target	Total Measures Offered	Number Measures Available	% Measures Offered
Met-Ed	9%	158	59	37%
Penelec	10%	158	59	37%
Penn Power	11%	158	59	37%
West Penn Power	9%	158	59	37%

The PA PUC also established a low-income energy savings target of 5.5% of the portfolio savings goal. The second column of Table 6 shows the low-income savings targets, based on verified gross savings, for each EDC. The third column of the table shows the verified low-

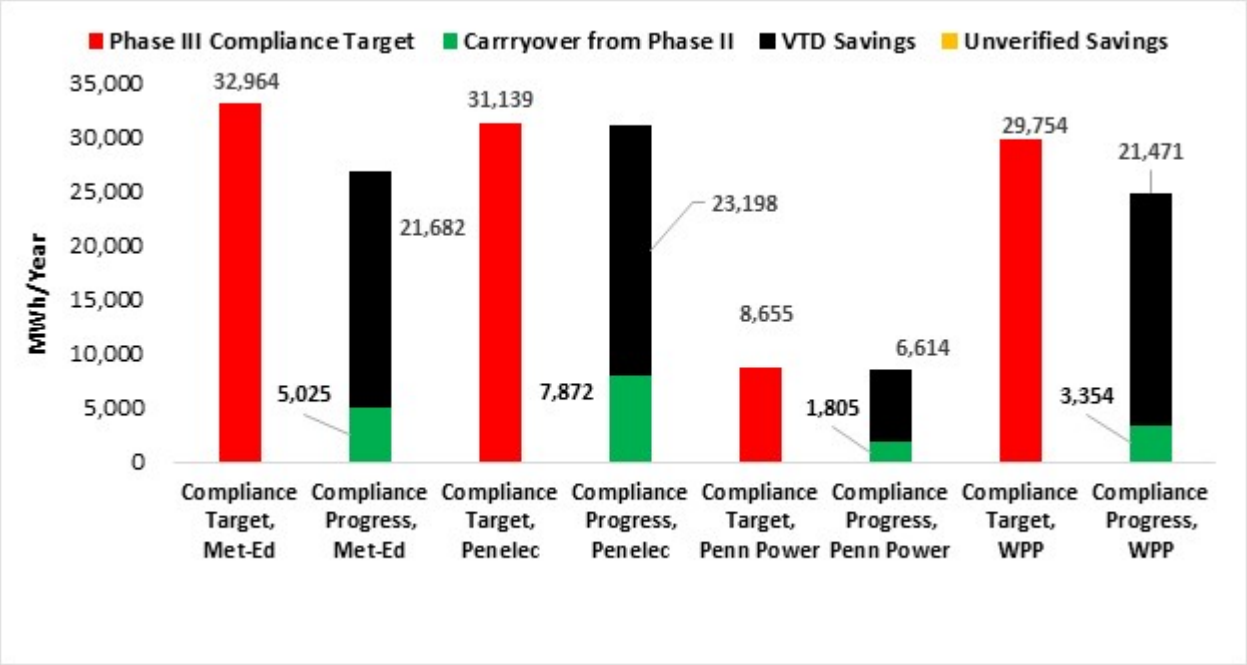
income impacts, inclusive of Phase II carryover. The percentages of the Phase III low-income energy savings targets achieved to date are shown in the last column of the table.

Table 6: Low-Income Program Energy Savings and Targets

EDC	Compliance Target	LI VTD +CO MWh	Percent of Target to Date
Met-Ed	32,964	26,707	81%
Penelec	31,139	31,070	100%
Penn Power	8,655	8,419	97%
West Penn Power	29,754	24,825	83%

Figure 5 compares the VTD performance for the low-income customer segment to the Phase III savings target.

Figure 5: EE&C Plan Performance toward Phase III Low-Income Compliance Target



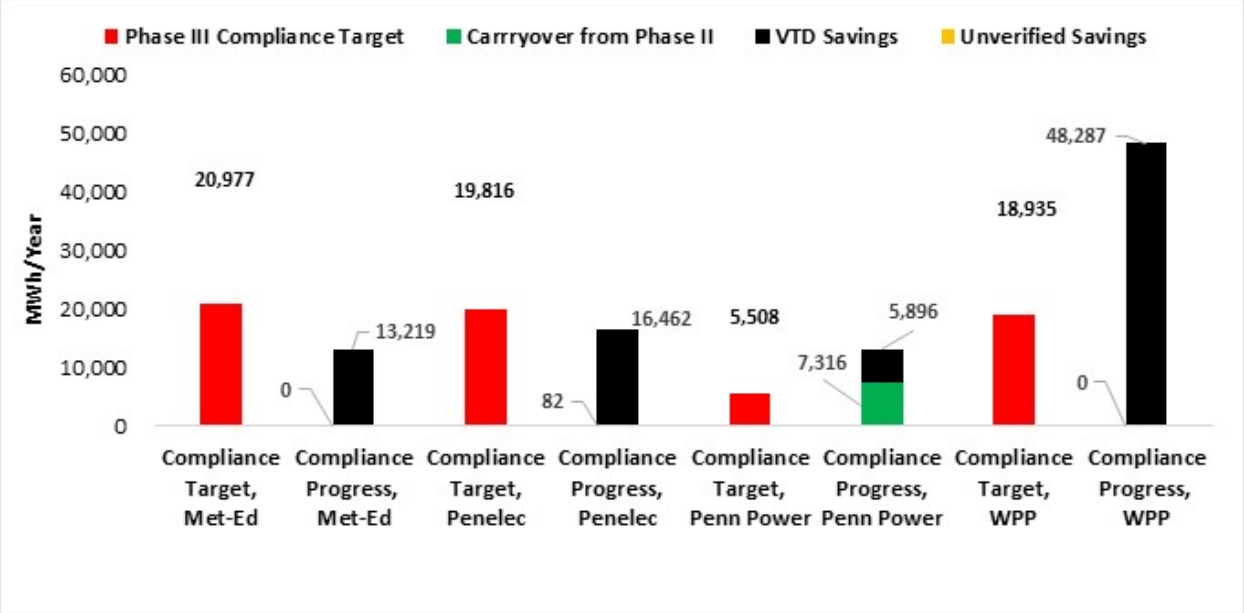
The Phase III Implementation Order established a GNI energy savings target of 3.5% of the portfolio savings goal. The second column of Table 7 shows the GNI savings targets, based on verified gross savings, for each EDC. The third column of the table shows the verified low-income impacts, inclusive of Phase II carryover. The percentages of the Phase III GNI energy savings targets achieved to date are shown in the last column of the table.

Table 7: GNI Savings and Targets

EDC	Compliance Target	GNI VTD +CO MWh	Percent of Target to Date
Met-Ed	20,977	13,219	63%
Penelec	19,816	16,544	83%
Penn Power	5,508	13,212	240%
West Penn Power	18,935	48,287	255%

Figure 6 compares the VTD performance for the GNI customer segment to the Phase III savings target.

Figure 6: EE&C Plan Performance against Phase III GNI Compliance Target



2.3 Phase III Demand Response Achievements to Date

The Phase III demand response performance targets are 49 MW for Met-Ed, 17 MW for Penn Power, and 64 MW for West Penn Power. Penelec does not have DR targets in Phase III. Compliance targets for demand response programs are based on average performance across events for the entire phase, beginning with PY9 and were established at the system level, which means the load reductions measured at the customer meter must be escalated to reflect transmission and distribution losses.

Act 129 demand response events are triggered by PJM's day-ahead load forecast. When the day-ahead forecast is above 96% of the peak load forecast for the year, a demand response event is initiated for the following day. In PY9, there were 3 demand response events called. Table 8 lists the days that DR events were called, along with verified gross demand reductions achieved by each EDC and program for PY9. Table 8 also lists the average DR performance for PY9 and for Phase III to date. The FirstEnergy EDCs' DR performance to date, with

consideration of the measurement confidence intervals reflecting the uncertainty of average values, is 1% above, 203% above, and 75% above the Phase III compliance reduction targets for Met-Ed, Penn Power and West Penn Power respectively. Without consideration of measurement confidence intervals around the average values, the EDC's average DR performance is 6% below, 96% above, and 28% above the Phase III compliance reduction target for Met-Ed, Penn Power and West Penn Power respectively.

Met-Ed's demand response achievement to date demonstrates compliance with Act 129 target, as the confidence interval associated with measurements exceeds the Act 129 target value. The 42.3 – 49.6 MW confidence interval of the measurement exceeds the 49.0 MW target from a statistical point of view.

Penn Power's demand response achievement to date demonstrates compliance with Act 129 target, as the confidence interval associated with measurements exceeds the Act 129 target value. The 15.4 – 51.5 MW confidence interval of the measurement exceeds the 17.0 MW target from a statistical point of view.

West Penn Power's demand response achievement to date demonstrates compliance with Act 129 target, as the confidence interval associated with measurements exceeds the Act 129 target value. The 52.0 – 111.8 MW confidence interval of the measurement exceeds the 64.0 MW target from a statistical point of view.

Table 8: PY9 Demand Response PYVTD Performance by Event

EDC	Event Date	Start Hour	End Hour	Small C&I Load Curtailment	Large C&I Load Curtailment	BDR	Average Portfolio MW Impact
Met-Ed	13-Jun	15	18	3.0 ± 0.3	45.0 ± 5.2	0.0 ± 0.0	48.0 ± 5.2
	20-Jul	15	18	3.0 ± 0.4	44.1 ± 5.7	0.0 ± 0.0	47.1 ± 5.7
	21-Jul	15	18	1.9 ± 0.3	40.8 ± 6.2	0.0 ± 0.0	42.7 ± 6.2
	PYVTD - Average PYX DR Event Performance						46.0 ± 3.6
	VTD - Average Phase III DR Event Performance						**46.0 ± 3.6**
Penn Power	13-Jun	15	18	0.1 ± 0.1	48.7 ± 24.2	2.0 ± 0.5	50.8 ± 24.2
	20-Jul	15	18	0.2 ± 0.2	26.4 ± 24.3	2.5 ± 0.5	29.2 ± 24.2
	21-Jul	15	18	0.2 ± 0.3	18.1 ± 24.1	2.0 ± 0.5	20.4 ± 24.2
	PYVTD - Average PYX DR Event Performance						33.5 ± 18.1
	VTD - Average Phase III DR Event Performance						**33.5 ± 18.1**
West Penn Power	13-Jun	15	18	3.3 ± 1.4	119.9 ± 48.5	0.0 ± 0.0	123.3 ± 24.2
	20-Jul	15	18	2.4 ± 1.6	72.3 ± 46.7	0.0 ± 0.0	74.7 ± 24.2
	21-Jul	15	18	2.3 ± 2.4	45.4 ± 47.0	0.0 ± 0.0	47.7 ± 24.2
	PYVTD - Average PYX DR Event Performance						81.9 ± 29.9
	VTD - Average Phase III DR Event Performance						**81.9 ± 29.9**

The Commission's Phase III Implementation Order also established a requirement that EDCs achieve at least 85% of the Phase III demand reduction target in each DR event. For each DR event, this translates to a 41.7 MW minimum for Met-Ed, a 14.5 MW minimum for Penn Power,

and a 54.4 MW minimum for West Penn Power. Penelec does not have DR targets in Phase III. Figure 7, Figure 8, and Figure 9 compare the performances of each of the DR events in PY9 to the event-specific minimum and average targets for Met-Ed, Penn Power, and West Penn Power respectively.

Figure 7: Met-Ed Event Performance Compared to 85% Per-Event Target

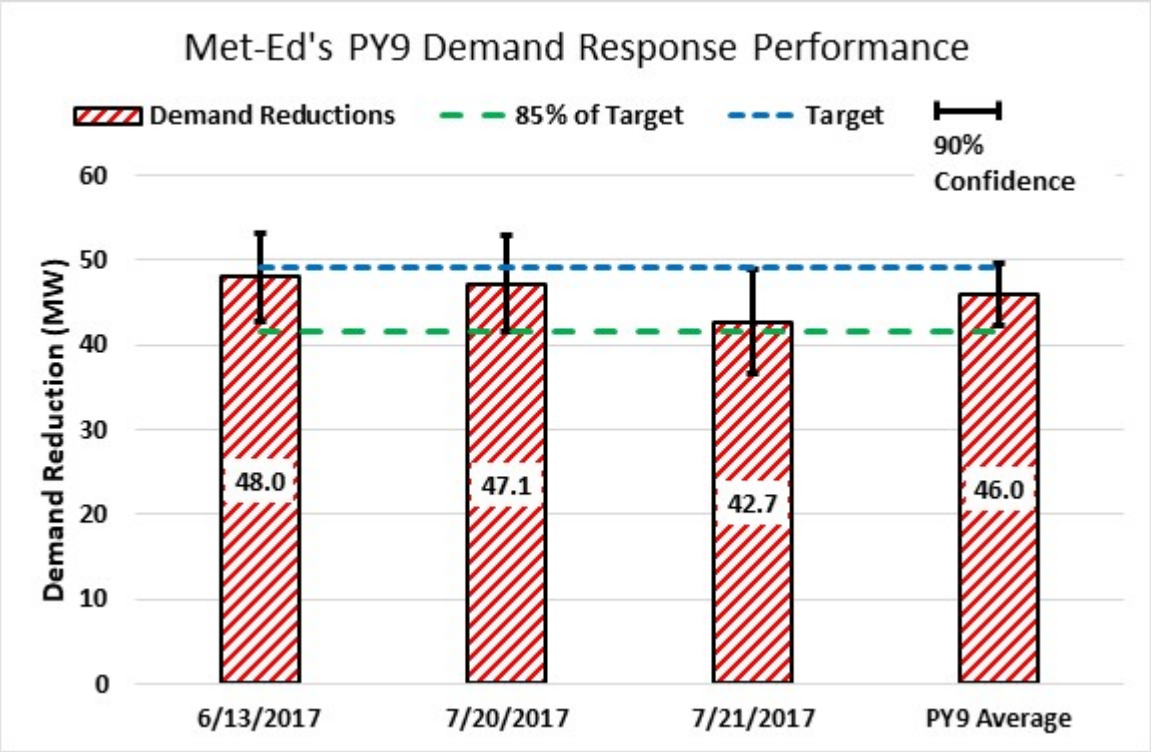


Figure 8: Penn Power Event Performance Compared to 85% Per-Event Target

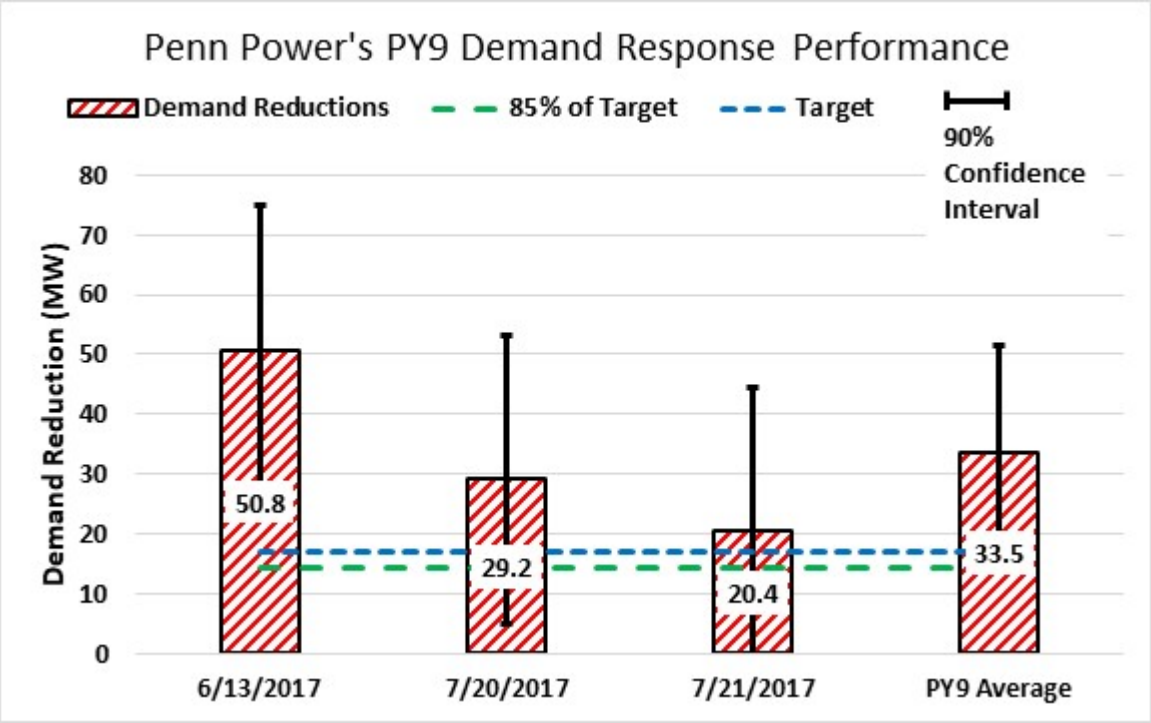
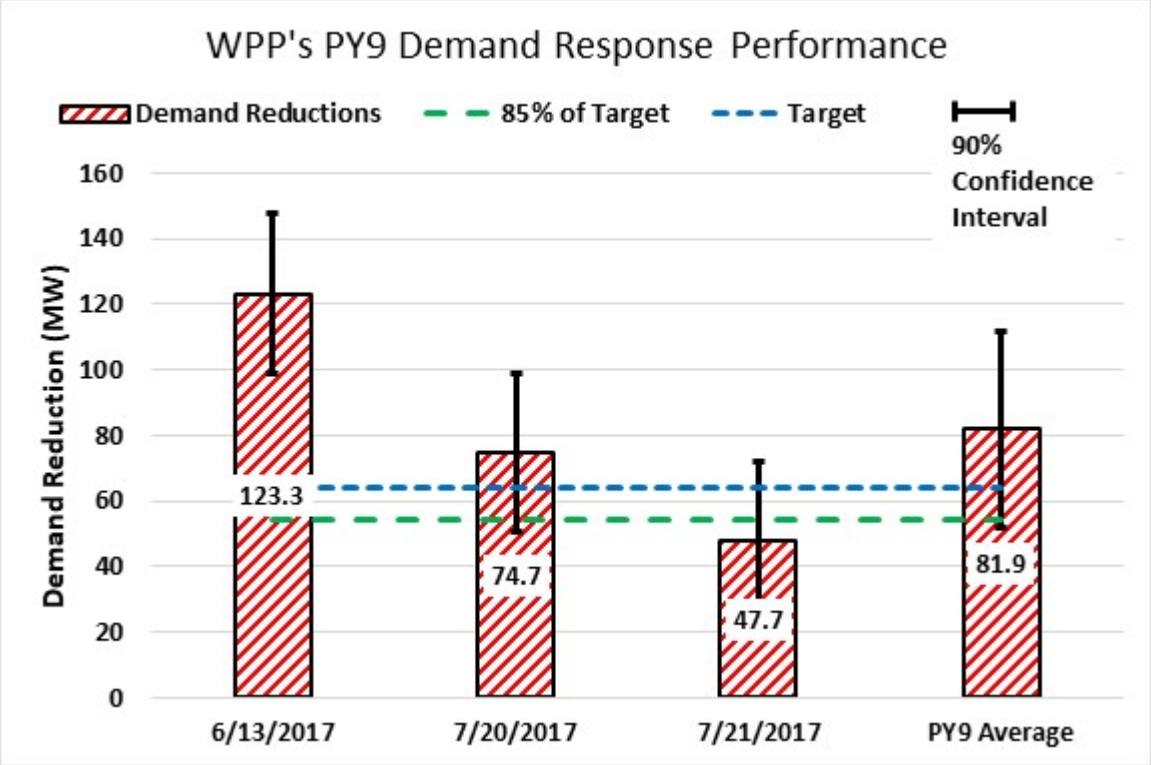


Figure 9: WPP Event Performance Compared to 85% Per-Event Target



2.4 PHASE III PERFORMANCE BY CUSTOMER SEGMENT

Table 9 presents the participation, savings, and spending by customer sector for PY9. The residential, small C&I, large C&I sectors are defined by EDC tariff and the residential low-income and governmental/educational/non-profit sector were defined by statute (66 Pa. C.S. § 2806.1). The residential low-income segment is a subset of the residential customer class and the GNI segment will include customers who are part of the Small C&I or Large C&I rate classes. The savings, spending, and participation values for the LI and GNI segments have been removed from the parent sectors in Table 9. The values in Table 9 and Table 10 below also reflect adjustments related to cross sector sales of upstream lighting. Participant counts, incentive amounts, and reported impacts were removed from the parent (residential) sector, and allocated to Small C&I and GNI sectors, to reflect cross-sector sales adjustments to reported data for the Energy Efficient Products Program in Table 75, Table 76, Table 77, and Table 78 of Section 3.3.1.

Please note that the Companies' acquisition costs through Phase III PY 9 have been heavily influenced by results to date significantly exceeding plan projections in lower cost programs (e.g. lighting, EE kits, behavioral). The Companies' anticipate that their acquisition costs will increase through the end of Phase III as participation among higher cost programs and measures increase to offset the reduction in lighting that will occur through the remainder of Phase III.

Table 9: Program Year 8 Summary Statistics by Customer Segment

EDC	Parameter	Residential (Non-LI)	Residential LI	Small C&I (Non-GNI)	Large C&I (Non-GNI)	GNI
Met-Ed	# participants	530,940	27,522	25,781	193	2,365
	PYRTD MWh/yr	81,298	10,281	37,075	25,810	7,833
	PYRTD MW (Energy Efficiency)	10.22	1.20	5.40	3.65	1.29
	PYVTD MW (Demand Response)	0.00	0.00	1.89	39.22	4.85
	Incentives ($1000)	$5,161.54	$133.41	$1,480.12	$1,254.97	$396.91
Penelec	# participants	485,039	32,588	23,111	125	2,418
	PYRTD MWh/yr	66,778	9,730	24,826	41,228	11,204
	PYRTD MW (Energy Efficiency)	8.38	1.15	3.38	5.29	1.47
	PYVTD MW (Demand Response)	0.00	0.00	0.00	0.00	0.00
	Incentives ($1000)	$4,235.46	$86.26	$1,313.32	$2,012.45	$584.80
Penn Power	# participants	135,885	7,812	7,424	49	769
	PYRTD MWh/yr	23,427	3,215	11,869	11,183	3,531
	PYRTD MW (Energy Efficiency)	3.33	0.41	1.61	1.33	0.42
	PYVTD MW (Demand Response)	2.16	0.00	0.04	31.11	0.15
	Incentives ($1000)	$1,605.28	$50.63	$599.11	$723.56	$222.87
West Penn Power	# participants	522,194	27,925	22,432	108	2,367
	PYRTD MWh/yr	85,431	9,606	26,890	22,360	35,522
	PYRTD MW (Energy Efficiency)	12.20	1.25	3.64	3.18	2.84
	PYVTD MW (Demand Response)	0.00	0.00	2.69	79.21	0.00
	Incentives ($1000)	$5,303.35	$98.80	$1,404.50	$1,678.11	$1,523.79

Table 10 summarizes plan performance by sector since the beginning of Phase III.

Table 10: Phase III Summary Statistics by Customer Segment

EDC	Parameter	Residential (Non-LI)	Residential LI	Small C&I (Non-GNI)	Large C&I (Non-GNI)	GNI
Met-Ed	# participants	889,953	41,343	48,630	272	4,377
	PSA MWh/yr	156,925	19,388	50,302	53,245	12,859
	PSA MW (Energy Efficiency)	20.27	2.34	7.39	7.18	2.03
	Phase III MW (Demand Response)	0.00	0.00	1.89	39.22	4.85
	Incentives ($1000)	$10,336.24	$266.82	$2,903.77	$2,580.70	$736.45
Penelec	# participants	896,846	51,926	51,172	207	5,108
	PSA MWh/yr	139,939	20,679	42,637	54,101	17,944
	PSA MW (Energy Efficiency)	17.17	2.45	6.13	6.87	2.28
	Phase III MW (Demand Response)	0.00	0.00	0.00	0.00	0.00
	Incentives ($1000)	$8,458.15	$172.52	$2,727.77	$3,778.53	$1,327.64
Penn Power	# participants	214,897	12,216	12,235	65	1,377
	PSA MWh/yr	41,344	6,496	20,117	14,219	5,895
	PSA MW (Energy Efficiency)	5.90	0.84	2.94	1.62	0.62
	Phase III MW (Demand Response)	2.16	0.00	0.04	31.11	0.15
	Incentives ($1000)	$3,220.54	$101.26	$1,272.31	$1,231.40	$346.09
West Penn Power	# participants	908,467	43,064	48,047	164	4,792
	PSA MWh/yr	164,589	19,994	42,381	29,793	45,512
	PSA MW (Energy Efficiency)	23.69	2.65	5.92	4.14	3.90
	Phase III MW (Demand Response)	0.00	0.00	2.69	79.21	0.00
	Incentives ($1000)	$10,603.37	$197.60	$2,992.02	$2,955.84	$2,692.12

2.5 Summary of Participation by Program

Participation is defined differently for certain programs depending on the program delivery channel and data tracking practices. The nuances of the participant definition vary by program and are summarized by program in the bullets below. Table 11 provides the current participation totals for PY9 and Phase III.

- For the Appliance Turn-In Program and the low-income Appliance Turn-In components of the Low-Income Energy Efficiency Program and Energy Solutions for Business – Small Program, participation is the count of rebate applications, which corresponds to appliance pick-up events. If a homeowner recycles two refrigerators on one occasion, that counts as one participant.

- For the Home Energy Reports components of the Energy Efficient Homes and Low-Income Energy Efficiency Programs, the number of participants is taken as the maximum number of participants in the treatment group during the year. This definition of participant is selected because it aligns with the gross impact evaluation protocol for Home Energy Reports.
- For the Conservation Kits components of the Energy Efficient Homes Program and Low-Income Energy Efficiency Programs, the participant counts are equal to the overall count of kits distributed by each program. In nearly all cases, one kit is sent to a household.
- For the Residential New Construction components of the Energy Efficient Homes Program and Low-Income Energy Efficiency Programs, the participant count is equal to the number of houses (or in the case of multifamily housing, the number of dwelling units)
- For the Direct Install component of the Energy Efficient Homes Program, the participant count is equal to the number of rebate homes treated in the program.
- For Upstream Lighting component of the Energy Efficient Products Program, the participant count is equal to the number of packs sold. This is approximately equal to number of bulbs divided by three.
- For the Upstream Electronics component of the Energy Efficient Products Program, the participant count is equal to the number of electronics equipment sold.
- For the HVAC component of the Energy Efficient Products Program, the participant count is equal to the sum of HVAC units and HVAC tune-ups rebated by the program. If a customer purchases multiple HVAC units or tune-ups, then the customer counts as two participants. Most rebates applications however, are for a single HVAC system or service.
- For the Appliances components of the Energy Efficient Products Program and the Low-Income Energy Efficiency Program, the participant count is equal to the sum of Appliances rebated by the program. If a customer purchases multiple Appliances, then the customer counts as multiple participants. The majority of rebate applications however, are for a single appliance.
- For the Direct Install component of the Low-Income Energy Efficiency Program, the participant count is equal to the number of rebate homes treated in the program.
- For the downstream rebates in all nonresidential energy efficiency programs, the participant count is equal to the number of unique account numbers associated with rebate applications for the program year.
- For the Commercial and Industrial Demand Response Programs, each unique utility premise is taken to be a unique participant.
- For the Behavioral Demand Response program component, the number of participants is taken as the maximum number of participants in the treatment group during the year.

Table 11: EE&C Portfolio Participation by Program

Utility	Program	PYTD Participation	P3TD Participation
Met-Ed	Appliance Turn-in	4,787	8,761
	Energy Efficient Homes	201,042	264,844
	Energy Efficient Products	352,658	668,339
	Low Income Energy Efficiency	27,522	41,343
	C&I Energy Solutions for Business - Small	424	772
	C&I Demand Response - Small	37	37
	C&I Energy Solutions for Business - Large	207	323
	C&I Demand Response - Large	67	67
	Governmental & Institutional Tariff	57	89
	Portfolio Total	**586,801**	**984,575**
Penelec	Appliance Turn-in	4,155	7,638
	Energy Efficient Homes	198,065	263,796
	Energy Efficient Products	307,249	679,724
	Low Income Energy Efficiency	32,588	51,926
	C&I Energy Solutions for Business - Small	741	1,349
	C&I Demand Response - Small	0	0
	C&I Energy Solutions for Business - Large	176	286
	C&I Demand Response - Large	0	0
	Governmental & Institutional Tariff	307	540
	Portfolio Total	**543,281**	**1,005,259**
Penn Power	Appliance Turn-in	1,528	2,695
	Energy Efficient Homes	41,598	57,044
	Energy Efficient Products	100,510	167,892
	Low Income Energy Efficiency	7,812	12,216
	C&I Energy Solutions for Business - Small	351	600
	C&I Demand Response - Small	3	3
	C&I Energy Solutions for Business - Large	49	67
	C&I Demand Response - Large	6	6
	Governmental & Institutional Tariff	81	267
	Portfolio Total	**151,938**	**240,790**
West Penn Power	Appliance Turn-in	5,500	10,160
	Energy Efficient Homes	222,875	267,461
	Energy Efficient Products	317,479	681,799
	Low Income Energy Efficiency	27,925	43,064
	C&I Energy Solutions for Business - Small	789	1,295
	C&I Demand Response - Small	19	19
	C&I Energy Solutions for Business - Large	126	194
	C&I Demand Response - Large	12	12
	Governmental & Institutional Tariff	301	530
	Portfolio Total	**575,026**	**1,004,534**

2.6 SUMMARY OF IMPACT EVALUATION RESULTS

During PY9 ADM completed impact evaluations for many of the energy efficiency programs in the portfolio. Table 12 and Table 13 summarize the realization rates and net-to-gross ratios by program. Initiative-level evaluation detail is available in the Appendices to this report.

Table 12: Impact Evaluation Results Summary for Met-Ed and Penelec

Program/ Initiative	Met-Ed			Penelec		
	Energy Realization Rate	Demand Realization Rate	Net to Gross Ratio	Energy Realization Rate	Demand Realization Rate	Net to Gross Ratio
Appliance Turn-In	95.5%	93.1%	49.0%	94.2%	91.5%	45.0%
Energy Efficient Homes	111.1%	110.1%	91.8%	112.9%	94.4%	90.7%
Energy Efficient Products	127.8%	137.8%	37.9%	119.2%	126.4%	34.7%
Low Income Program	111.1%	110.8%	100.0%	108.6%	96.5%	100.0%
C&I Solutions for Business Program - Small	101.3%	99.9%	61.6%	87.1%	93.6%	79.2%
C&I Solutions for Business Program - Large	101.0%	95.8%	55.9%	87.3%	92.5%	78.2%
Government and Insitutional Tariff Program	101.5%	99.9%	63.1%	86.0%	95.1%	83.6%

Table 13: Impact Evaluation Results Summary for Penn Power and WPP

Program/ Initiative	Penn Power			West Penn Power		
	Energy Realization Rate	Demand Realization Rate	Net to Gross Ratio	Energy Realization Rate	Demand Realization Rate	Net to Gross Ratio
Appliance Turn-In	83.3%	84.4%	58.0%	98.9%	96.8%	51.0%
Energy Efficient Homes	111.4%	103.9%	89.1%	104.6%	93.2%	91.5%
Energy Efficient Products	128.2%	138.6%	39.5%	121.8%	126.3%	28.9%
Low Income Program	108.2%	102.7%	100.0%	104.4%	95.6%	100.0%
C&I Solutions for Business Program - Small	99.9%	96.0%	72.7%	113.4%	104.9%	82.1%
C&I Solutions for Business Program - Large	98.9%	91.6%	66.8%	102.9%	92.5%	63.6%
Government and Insitutional Tariff Program	98.8%	100.0%	75.1%	115.9%	107.3%	83.3%

Findings from net-to-gross research are not used to adjust compliance savings in Pennsylvania. Instead, net-to-gross research provides directional information for program planning purposes. Most programs, and particularly high impact measures (HIMs), were evaluated for net-to-gross in PY8. Only the appliance turn-in HIM was evaluated for net-to-gross in PY9, with results nearly identical to those in PY8. Table 14 and Table 15 present net-to-gross findings for HIMs studied in PY8, as applied to the PY9 program populations.

Table 14: High-Impact Measure Net-to-Gross for Met-Ed and Penelec

HIM	Met-Ed			Penelec		
	Free ridership	Spillover	Net to Gross Ratio	Free ridership	Spillover	Net to Gross Ratio
Res Appliance Turn-In	51.0%	0.0%	49.0%	55.0%	0.0%	45.0%
Res Upstream Lighting	63.0%	0.0%	37.0%	66.2%	0.0%	33.8%
Res EE Kits	21.0%	3.0%	82.0%	20.0%	3.0%	83.0%
C&I Lighting	38.8%	1.9%	63.1%	19.9%	3.6%	83.7%
C&I Custom	61.3%	0.0%	38.8%	49.0%	0.6%	51.6%

Table 15: High-Impact Measure Net-to-Gross for Penn Power and WPP

HIM	Penn Power			West Penn Power		
	Free ridership	Spillover	Net to Gross Ratio	Free ridership	Spillover	Net to Gross Ratio
Res Appliance Turn-In	42.0%	0.0%	58.0%	49.0%	0.0%	51.0%
Res Upstream Lighting	61.2%	0.0%	38.8%	73.4%	0.0%	26.6%
Res EE Kits	20.0%	2.0%	82.0%	20.0%	2.0%	82.0%
C&I Lighting	27.9%	3.0%	75.1%	21.5%	4.8%	83.3%
C&I Custom	53.9%	0.0%	46.1%	52.8%	0.0%	47.2%

2.7 Summary of Energy Impacts by Program

Act 129 compliance targets are based on annualized savings estimates (MWh/year). Each program year, the annual savings achieved by EE&C program activity are recorded as incremental annual, or "first-year", savings and added to an EDC's progress toward compliance. Incremental annual savings estimates are presented in Section 2.7.1. Lifetime energy savings incorporate the Effective Useful Life (EUL) of installed measures and estimate the total energy savings associated with EE&C program activity. Lifetime savings are used in the TRC test, by program participants when assessing the economics of upgrades, and by the SWE when calculating the emissions benefits of Act 129 programs. Section 2.7.2 presents the lifetime energy savings by program.

2.7.1 Incremental Annual Energy Savings by Program

Figure 10, Figure 11, Figure 12, and Figure 13 present summaries of the PYTD energy savings by program respectively for Met-Ed, Penelec, Penn Power, and WPP for Program Year 9. The energy impacts in this report are presented at the meter level and do not reflect adjustments for

transmission and distribution losses. The verified gross savings are adjusted by energy realization rates and the verified net savings are adjustments by both the gross realization rates and the net-to-gross ratios.

Figure 10: PYTD Energy Savings by Program for Met-Ed

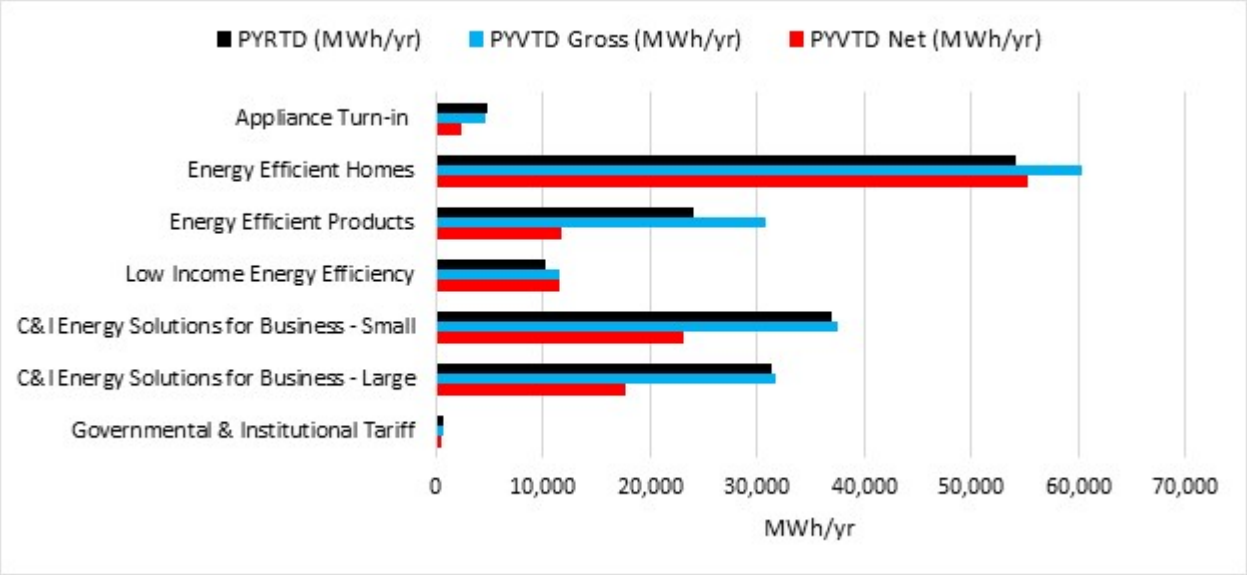


Figure 11: PYTD Energy Savings by Program for Penelec

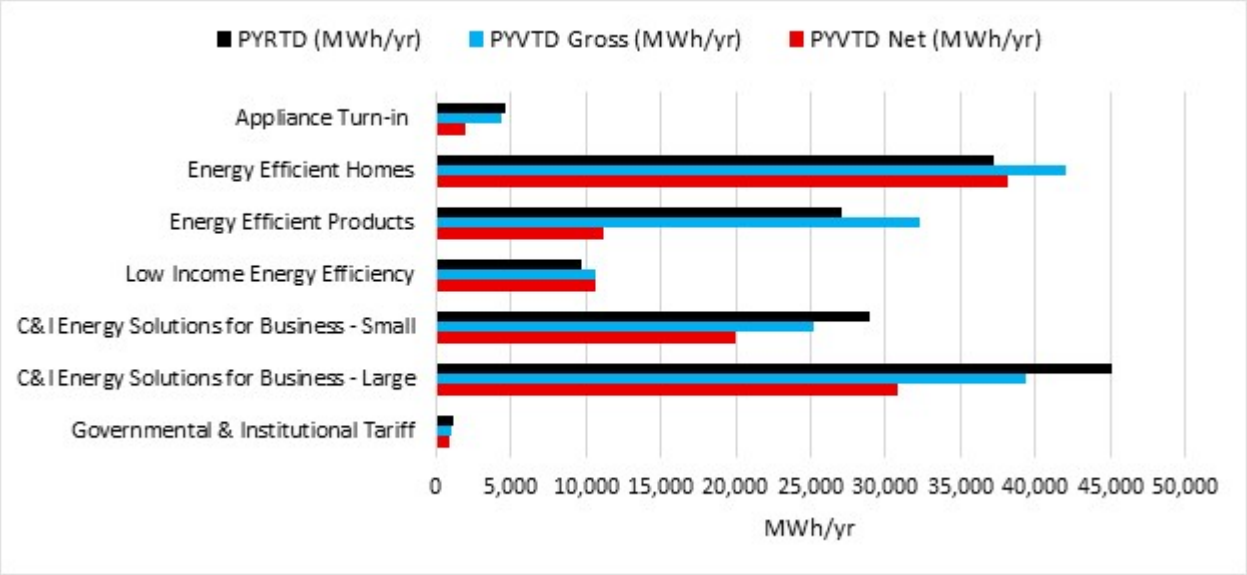


Figure 12: PYTD Energy Savings by Program for Penn Power

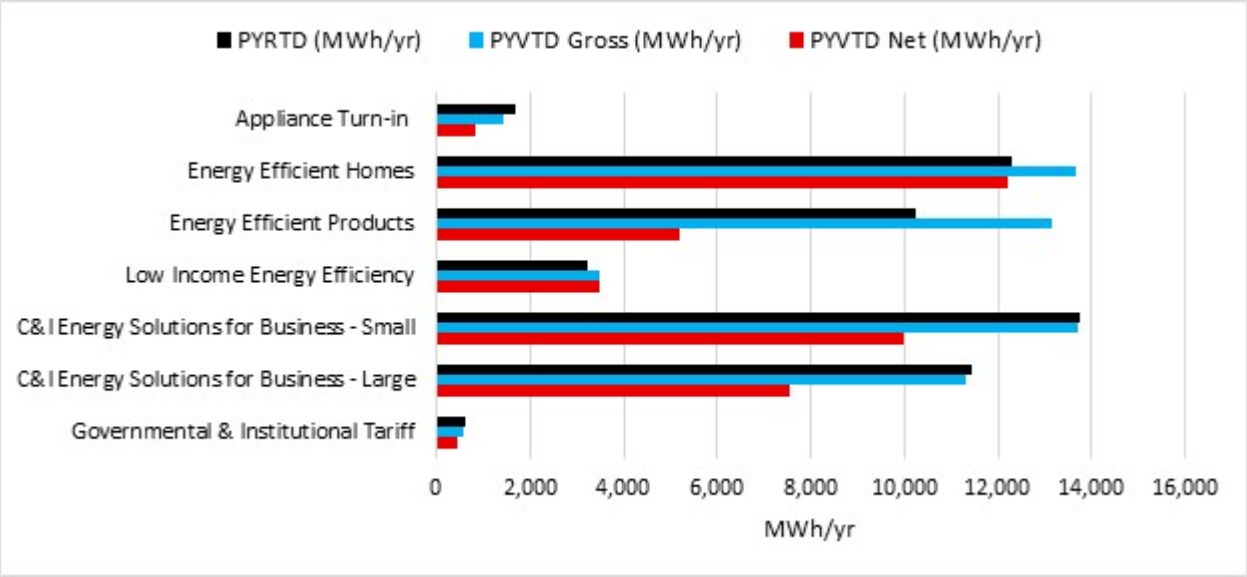


Figure 13: PYTD Energy Savings by Program for WPP

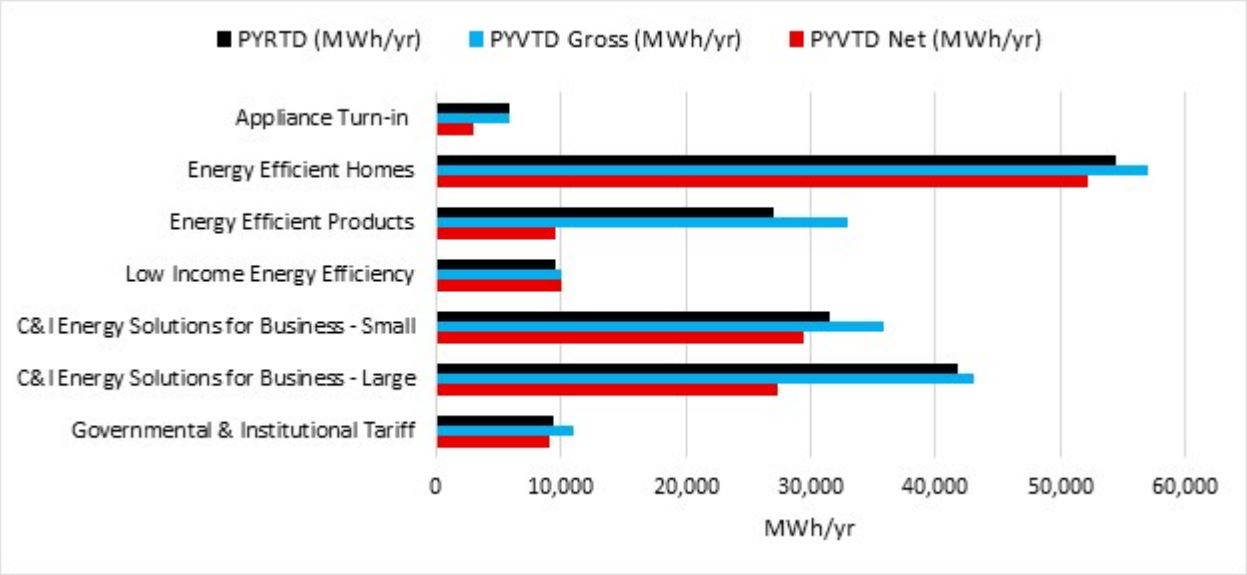


Figure 14, Figure 15, Figure 16, and Figure 17 present summaries of the energy savings by program respectively for Met-Ed, Penelec, Penn Power, and WPP for Phase III of Act 129.

Figure 14: P3TD Energy Savings by Program for Met-Ed

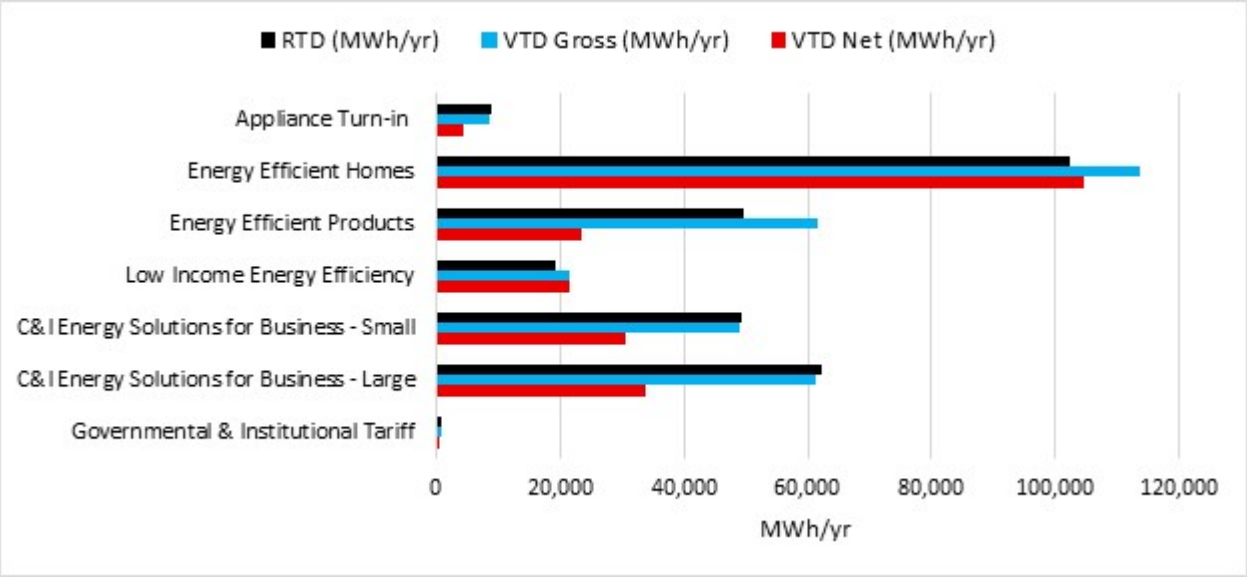


Figure 15: P3TD Energy Savings by Program for Penelec

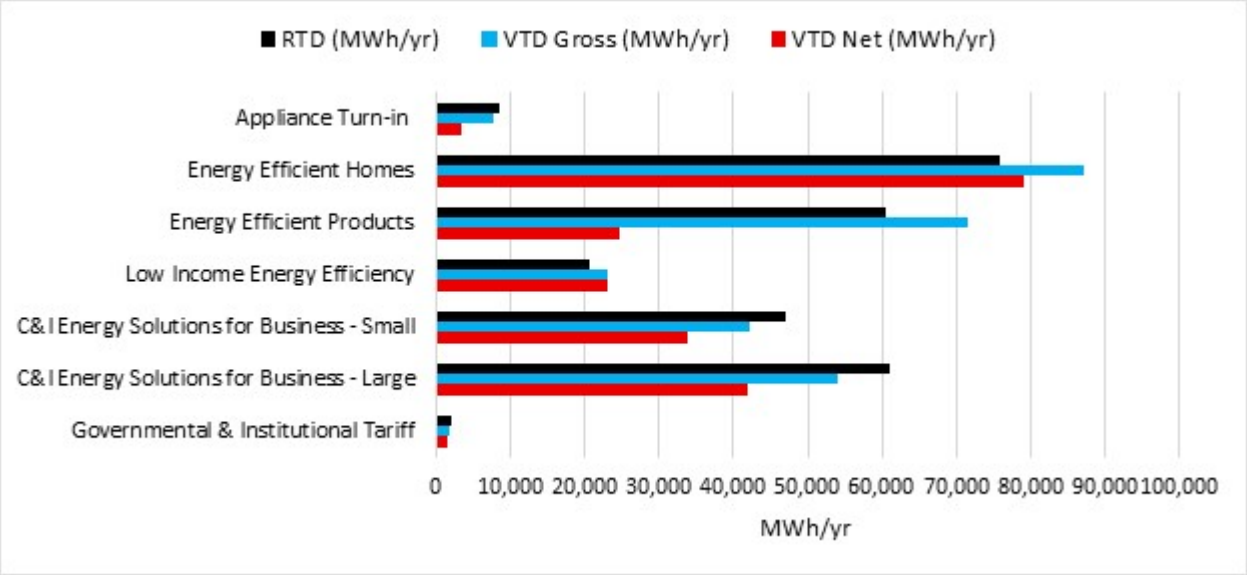


Figure 16: P3TD Energy Savings by Program for Penn Power

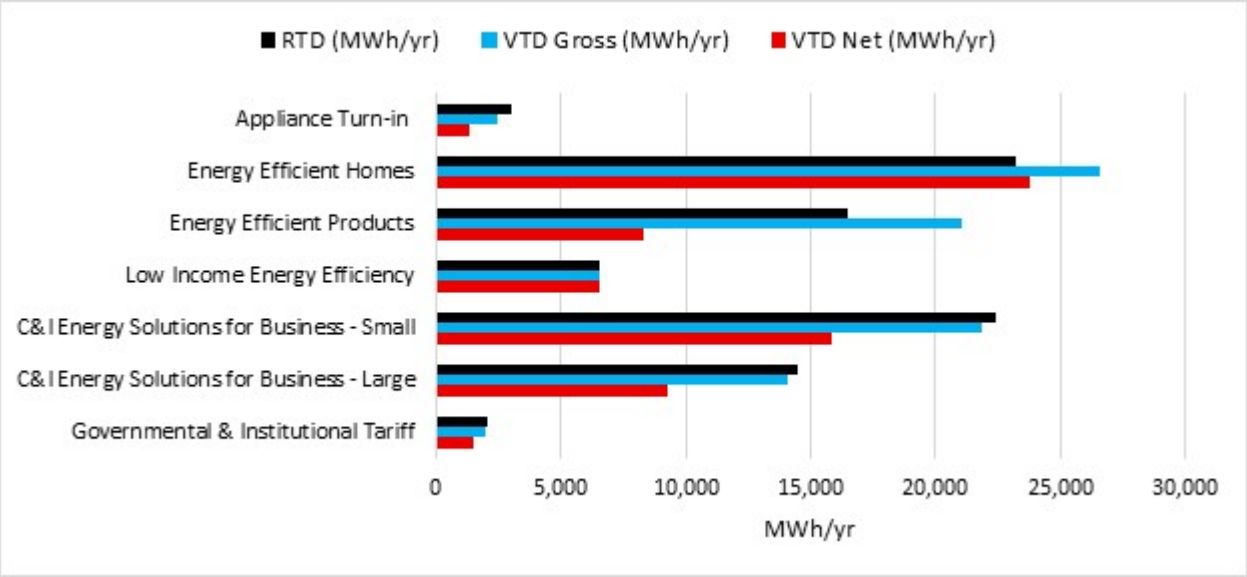
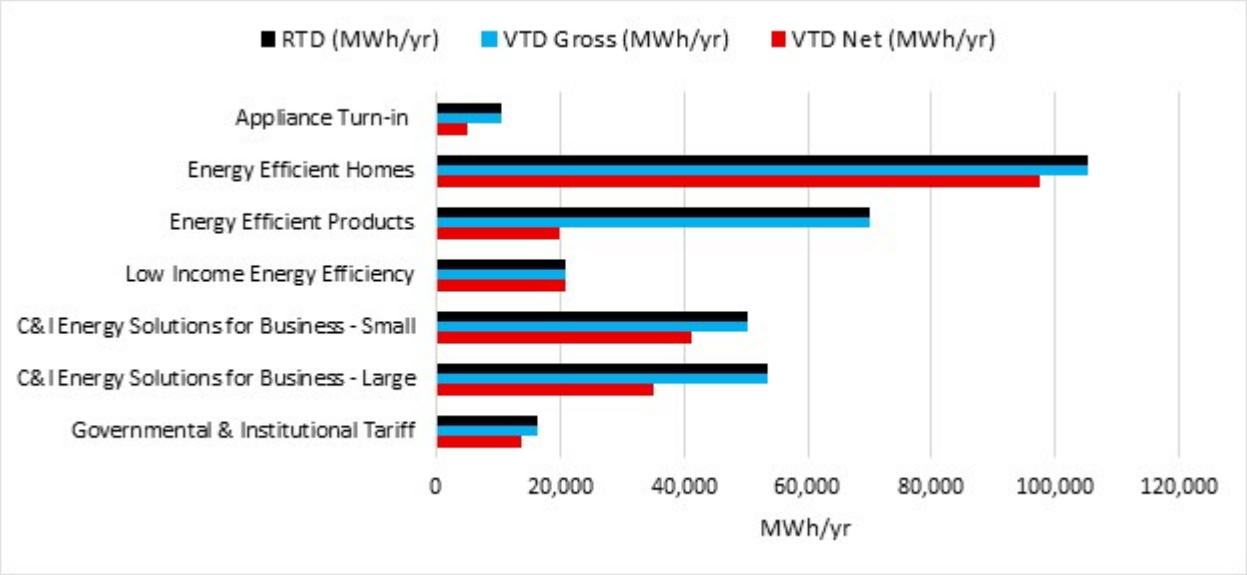


Figure 17: P3TD Energy Savings by Program for WPP



Summaries of energy impacts by program through PY8 are presented in Table 16, Table 17, Table 18, and Table 19 for Met-Ed, Penelec, Penn Power, and WPP respectively.

Table 16: Incremental Annual Energy Savings by Program - Met-Ed

Program	PYRTD (MWh/yr)	PYVTD Gross (MWh/yr)	PYVTD Net (MWh/yr)	RTD (MWh/yr)	VTD Gross (MWh/yr)	VTD Net (MWh/yr)
Appliance Turn-in	4,808	4,593	2,250	8,817	8,607	4,257
Energy Efficient Homes	54,239	60,247	55,322	102,365	113,816	104,767
Energy Efficient Products	24,082	30,778	11,672	49,542	61,603	23,328
Low Income Energy Efficiency	10,281	11,417	11,417	19,388	21,523	21,523
C&I Energy Solutions for Business - Small	36,935	37,424	23,062	49,461	48,893	30,503
C&I Energy Solutions for Business - Large	31,334	31,633	17,693	62,253	61,276	33,881
Governmental & Institutional Tariff	619	628	396	892	878	562
Portfolio Total	**162,297**	**176,720**	**121,814**	**292,719**	**316,595**	**218,821**

Table 17: Incremental Annual Energy Savings by Program - Penelec

Program	PYRTD (MWh/yr)	PYVTD Gross (MWh/yr)	PYVTD Net (MWh/yr)	RTD (MWh/yr)	VTD Gross (MWh/yr)	VTD Net (MWh/yr)
Appliance Turn-in	4,565	4,301	1,935	8,392	7,708	3,400
Energy Efficient Homes	37,281	42,091	38,193	75,804	87,196	79,155
Energy Efficient Products	27,048	32,243	11,203	60,549	71,484	24,731
Low Income Energy Efficiency	9,730	10,563	10,563	20,679	22,921	22,921
C&I Energy Solutions for Business - Small	28,898	25,168	19,929	46,970	42,043	33,818
C&I Energy Solutions for Business - Large	45,092	39,348	30,753	60,902	54,015	41,859
Governmental & Institutional Tariff	1,152	990	827	2,004	1,786	1,501
Portfolio Total	**153,766**	**154,704**	**113,404**	**275,300**	**287,154**	**207,385**

Table 18: Incremental Annual Energy Savings by Program – Penn Power

Program	PYRTD (MWh/yr)	PYVTD Gross (MWh/yr)	PYVTD Net (MWh/yr)	RTD (MWh/yr)	VTD Gross (MWh/yr)	VTD Net (MWh/yr)
Appliance Turn-in	1,695	1,412	819	2,983	2,419	1,322
Energy Efficient Homes	12,282	13,683	12,197	23,184	26,565	23,761
Energy Efficient Products	10,250	13,145	5,192	16,452	21,041	8,323
Low Income Energy Efficiency	3,215	3,478	3,478	6,496	6,558	6,558
C&I Energy Solutions for Business - Small	13,729	13,722	9,975	22,432	21,873	15,854
C&I Energy Solutions for Business - Large	11,449	11,317	7,564	14,495	14,085	9,225
Governmental & Institutional Tariff	605	598	449	2,030	1,943	1,461
Portfolio Total	**53,225**	**57,354**	**39,674**	**88,071**	**94,484**	**66,505**

Table 19: Incremental Annual Energy Savings by Program - WPP

Program	PYRTD (MWh/yr)	PYVTD Gross (MWh/yr)	PYVTD Net (MWh/yr)	RTD (MWh/yr)	VTD Gross (MWh/yr)	VTD Net (MWh/yr)
Appliance Turn-in	5,884	5,820	2,968	10,882	10,385	5,023
Energy Efficient Homes	54,502	57,009	52,143	99,721	105,300	97,467
Energy Efficient Products	27,051	32,952	9,517	58,400	70,047	19,973
Low Income Energy Efficiency	9,606	10,026	10,026	19,994	20,941	20,941
C&I Energy Solutions for Business - Small	31,549	35,789	29,367	46,089	50,312	41,286
C&I Energy Solutions for Business - Large	41,790	43,021	27,359	52,268	53,435	35,032
Governmental & Institutional Tariff	9,426	10,925	9,103	14,915	16,453	13,683
Portfolio Total	**179,808**	**195,542**	**140,483**	**302,268**	**326,872**	**233,404**

2.7.2 Lifetime Energy Savings by Program

Table 20, Table 21, Table 22, and Table 23 present the PYTD and P3TD lifetime energy savings by program for Met-Ed, Penelec, Penn Power, and WPP respectively. Lifetime savings are calculated by using expected useful lives (EULs) listed in the PA TRM for each measure, subject to a 15-year cap. For commercial and industrial projects, the measure lives are first determined for each sampled project during gross impact evaluation. The measure lives are then weighted by sampling initiative and EDC as the ratio between verified lifetime energy savings and program-year verified savings. This step is conducted in part because measure lives, as determined post-verification, may differ from ex-ante measure lives in the tracking database[4], and in part to maintain consistency between verified impacts, measure lives, and incremental costs for all sampled projects. For the residential upstream lighting program, the measure life is reduced to replicate the effect of a dual-baseline benefits stream[5]. To develop the modified measured lives, we perform dual-baseline calculations for five archetypal lamps in the most common baseline wattage bins (72W, 53W, 53W, 29W, and 25W) and perform dual-baseline calculations with lower baseline wattages (23W, 18W, 15W, 9W, and 9W respectively) post 2020. The modified measure life is the product of the original measure life and the ratio of the net-present value of delta-Watt-years for the dual-baseline stream to a single-baseline stream.

[4] For example, a project may consist of various measures with different lifetimes can have different realization rates by measure.
[5] See also comments in Section 2.10.

Table 20: Lifetime Energy Savings by Program for Met-Ed

Program	PYVTD Gross Lifetime (MWh)	PYVTD Net Lifetime (MWh)	VTD Gross Lifetime (MWh)	VTD Net Lifetime (MWh)
Appliance Turn-in	35,850	17,567	35,850	17,567
Energy Efficient Homes	239,723	199,695	239,723	199,695
Energy Efficient Products	221,018	84,634	221,018	84,634
Low Income Energy Efficiency	59,498	59,498	59,498	59,498
C&I Energy Solutions for Business - Small	540,435	333,741	705,447	440,935
C&I Energy Solutions for Business - Large	447,297	252,302	880,625	488,112
Governmental & Institutional Tariff	9,120	5,753	12,728	8,145
Portfolio Total	**1,552,942**	**953,190**	**2,154,889**	**1,298,586**

Table 21: Lifetime Energy Savings by Program for Penelec

Program	PYVTD Gross Lifetime (MWh)	PYVTD Net Lifetime (MWh)	VTD Gross Lifetime (MWh)	VTD Net Lifetime (MWh)
Appliance Turn-in	33,923	15,265	33,923	15,265
Energy Efficient Homes	191,934	162,134	191,934	162,134
Energy Efficient Products	233,140	82,284	233,140	82,284
Low Income Energy Efficiency	63,448	63,448	63,448	63,448
C&I Energy Solutions for Business - Small	364,010	290,375	609,985	493,989
C&I Energy Solutions for Business - Large	567,310	446,853	772,562	604,580
Governmental & Institutional Tariff	14,590	12,199	26,346	22,155
Portfolio Total	**1,468,355**	**1,072,559**	**1,931,338**	**1,443,857**

Table 22: Lifetime Energy Savings by Program for Penn Power

Program	PYVTD Gross Lifetime (MWh)	PYVTD Net Lifetime (MWh)	VTD Gross Lifetime (MWh)	VTD Net Lifetime (MWh)
Appliance Turn-in	11,012	6,387	11,012	6,387
Energy Efficient Homes	67,284	53,942	67,284	53,942
Energy Efficient Products	95,280	37,901	95,280	37,901
Low Income Energy Efficiency	21,429	21,429	21,429	21,429
C&I Energy Solutions for Business - Small	201,882	147,843	322,878	235,176
C&I Energy Solutions for Business - Large	163,149	110,344	204,069	134,934
Governmental & Institutional Tariff	8,953	6,720	28,961	21,773
Portfolio Total	**568,987**	**384,564**	**750,911**	**511,541**

Table 23: Lifetime Energy Savings by Program for WPP

Program	PYVTD Gross Lifetime (MWh)	PYVTD Net Lifetime (MWh)	VTD Gross Lifetime (MWh)	VTD Net Lifetime (MWh)
Appliance Turn-in	45,799	23,357	45,799	23,357
Energy Efficient Homes	234,181	193,822	234,181	193,822
Energy Efficient Products	196,698	59,942	196,698	59,942
Low Income Energy Efficiency	53,922	53,922	53,922	53,922
C&I Energy Solutions for Business - Small	534,678	438,787	744,377	611,639
C&I Energy Solutions for Business - Large	641,742	408,572	780,451	513,747
Governmental & Institutional Tariff	163,700	136,390	244,994	203,750
Portfolio Total	**1,870,719**	**1,314,792**	**2,300,421**	**1,660,180**

2.8 Summary of Demand Impacts by Program

Phase III EE&C programs achieve peak demand reductions in two primary ways. The first is through coincident reductions from energy efficiency measures and the second is through dedicated demand response offerings that exclusively target temporary demand reductions on peak days. Energy efficiency reductions coincident with system peak hours are reported and used in the calculation of benefits in the TRC Test, but do not contribute to Phase III peak demand reduction compliance goals. Phase III peak demand reduction targets are exclusive to demand response programs.

The two types of peak demand reduction savings are also treated differently for reporting purposes. Peak demand reductions from energy efficiency are generally additive across program years, meaning that the P3TD savings reflect the sum of the first-year savings in each program year. Conversely, demand response goals are based on average portfolio impacts across all events so cumulative DR performance is expressed as the *average* performance of each of the DR events called in Phase III to date. Because of these differences, demand impacts from energy efficiency and demand response are reported separately in the following sub-sections.

2.8.1 Energy Efficiency

Act 129 defines peak demand savings from energy efficiency as the average expected reduction in electric demand from 2:00 p.m. to 6:00 p.m. EDT on non-holiday weekdays from June through August. Unlike Phase I and Phase II Act 129 reporting, the peak demand impacts from energy efficiency in this report are presented at the meter level and do not reflect adjustments for transmission and distribution losses. Figure 18, Figure 19, Figure 20, and Figure 21 present summaries of the PYTD demand savings by energy efficiency program for Met-Ed, Penelec, Penn Power, and WPP respectively for Program Year 9.

Figure 18: PYTD Demand Savings by Energy Efficiency Program for Met-Ed

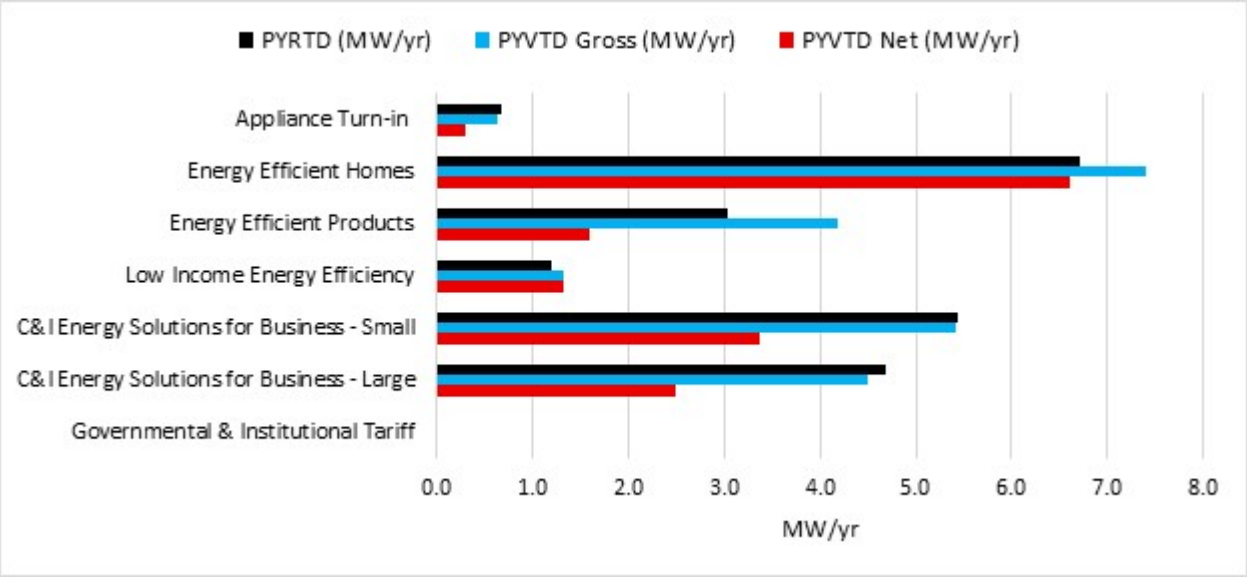


Figure 19: PYTD Demand Savings by Energy Efficiency Program for Penelec

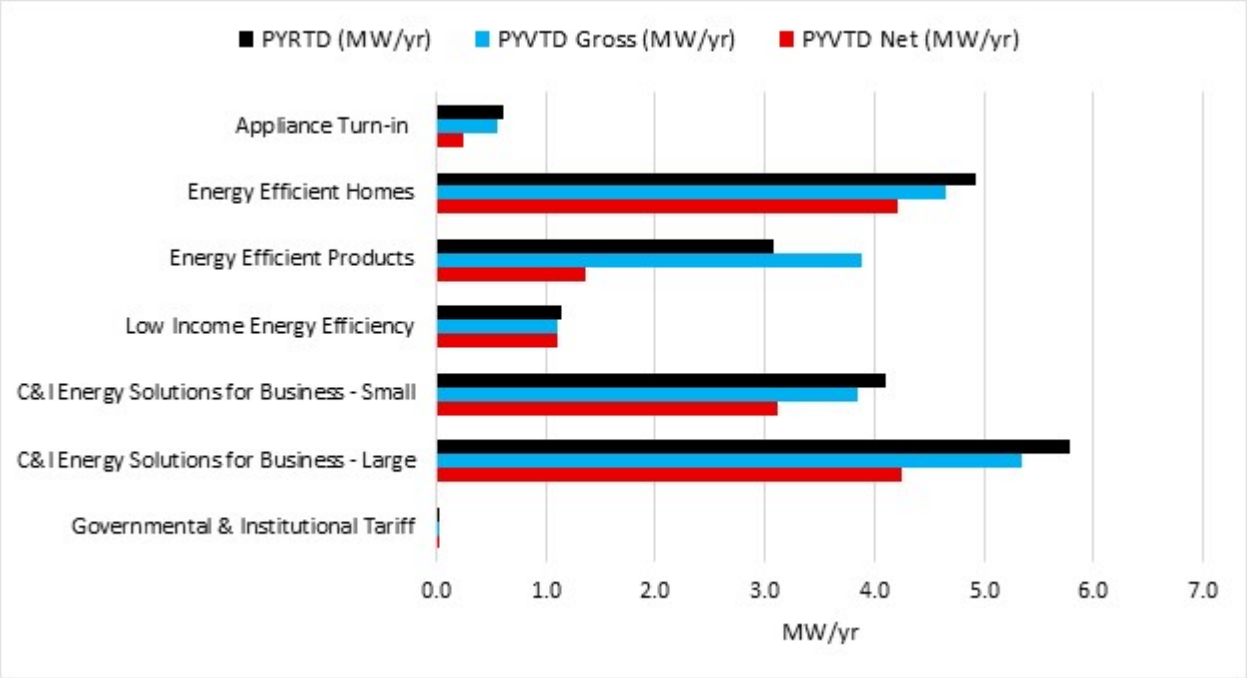


Figure 20: PYTD Demand Savings by Energy Efficiency Program for Penn Power

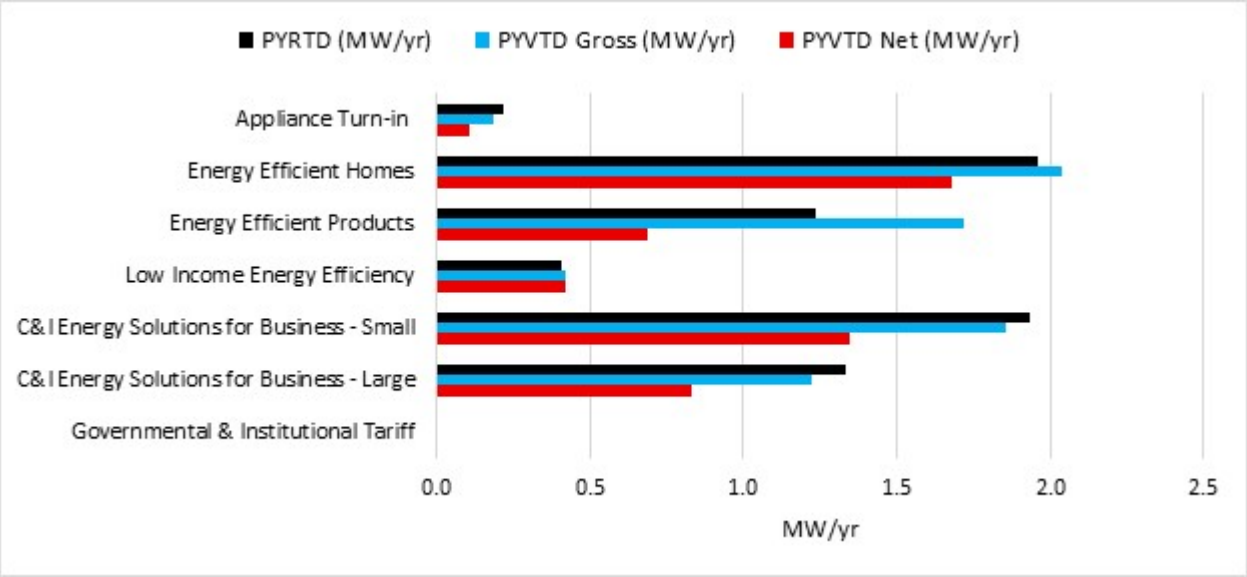


Figure 21: PYTD Demand Savings by Energy Efficiency Program for WPP

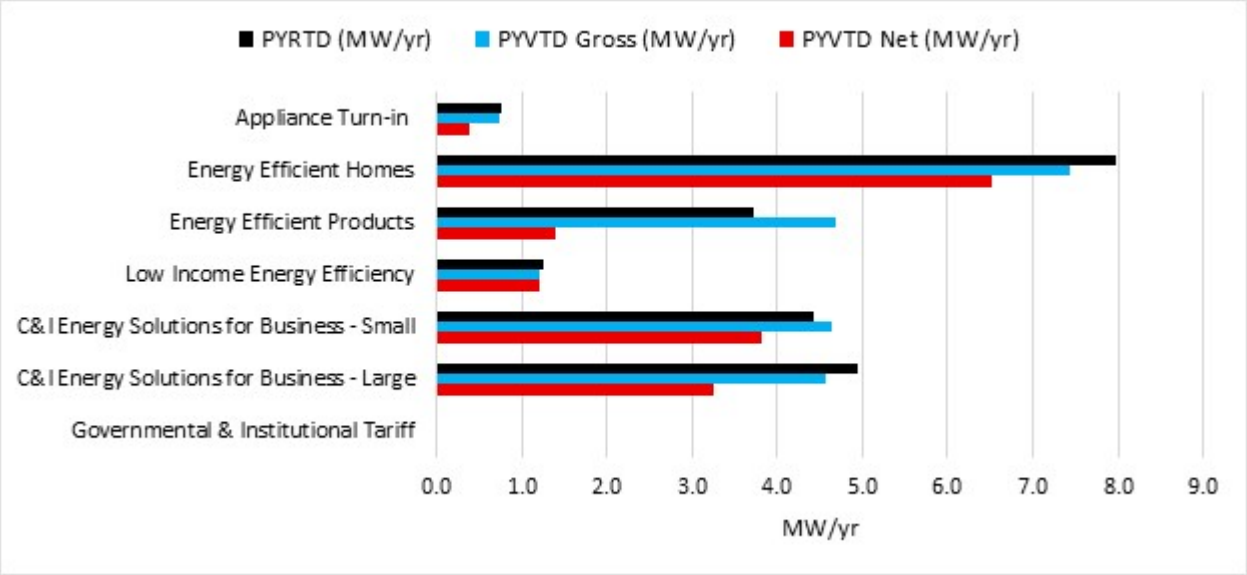


Figure 22, Figure 23, Figure 24, and Figure 25 present summaries of the P3TD demand savings by energy efficiency program for Met-Ed, Penelec, Penn Power, and WPP respectively for Phase III of Act 129.

Figure 22: P3TD Demand Savings by Energy Efficiency Program for Met-Ed

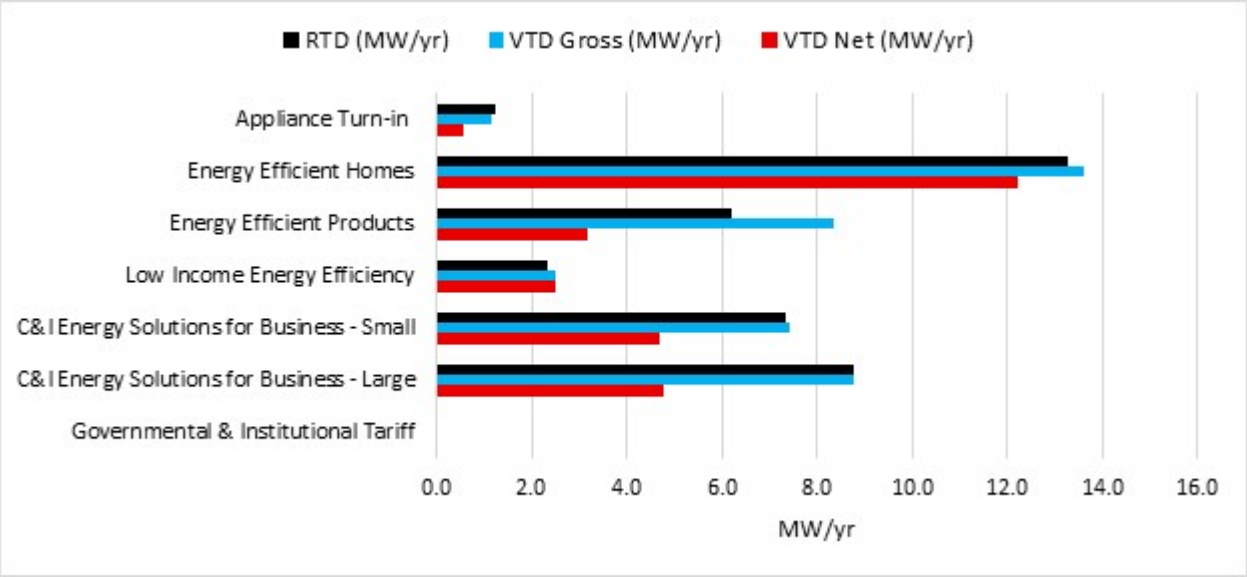


Figure 23: P3TD Demand Savings by Energy Efficiency Program for Penelec

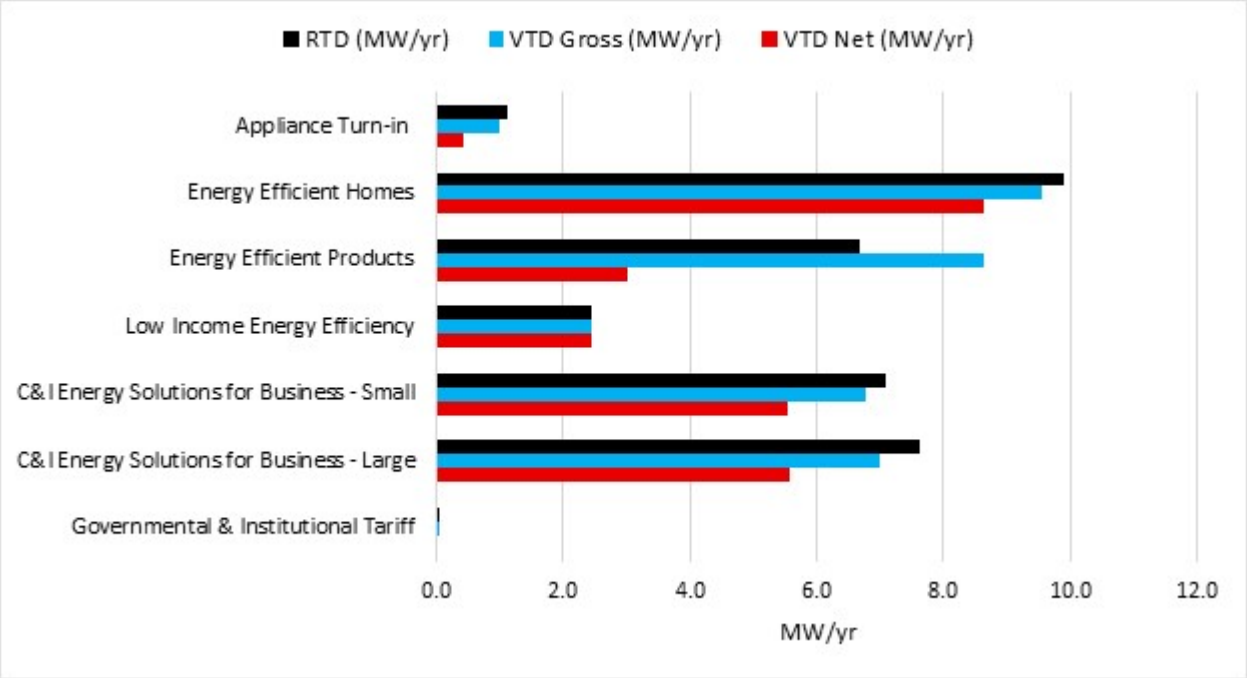


Figure 24: P3TD Demand Savings by Energy Efficiency Program for Penn Power

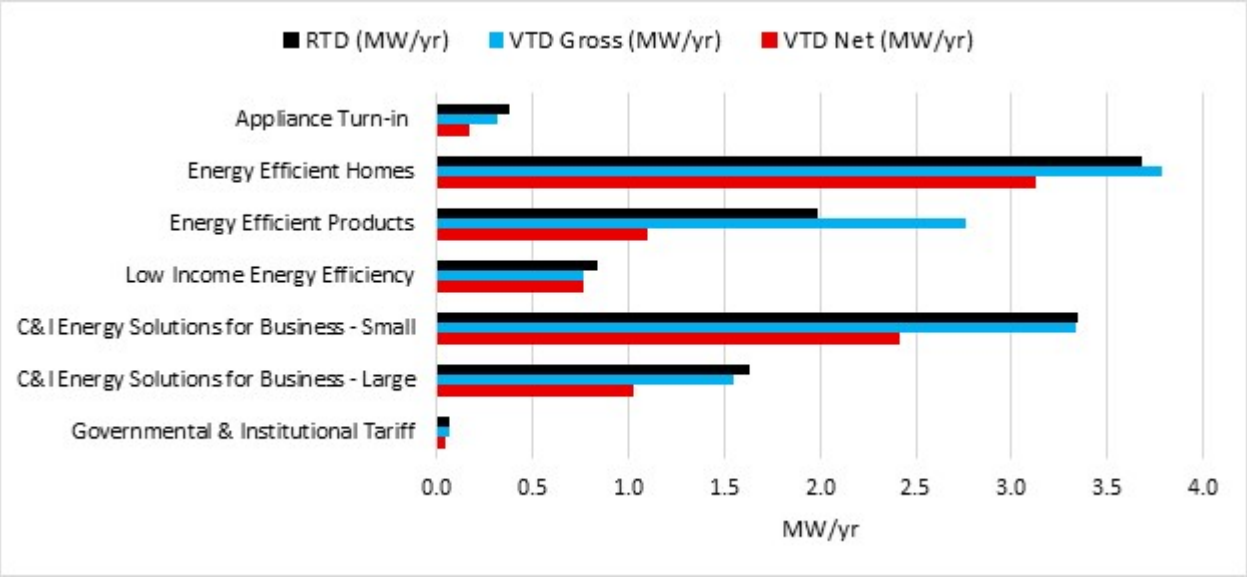
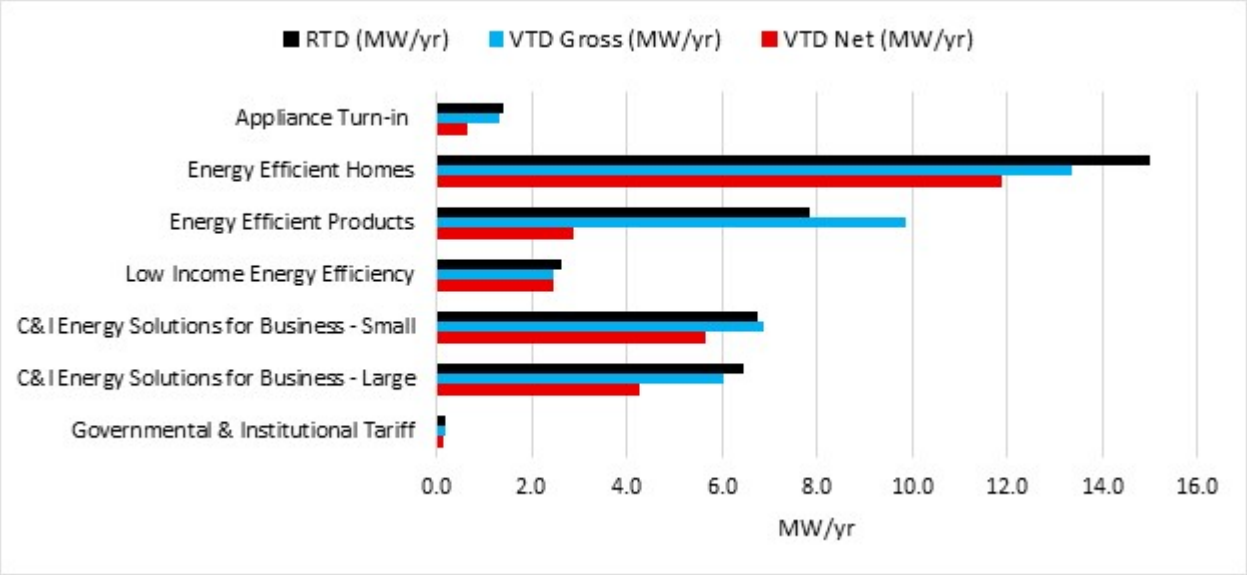


Figure 25: P3TD Demand Savings by Energy Efficiency Program for WPP



Summaries of the peak demand impacts by energy efficiency program through the current reporting period are presented in Table 24, Table 25, Table 26, and Table 27 for Met-Ed, Penelec, Penn Power, and WPP respectively.

Table 24: Peak Demand Savings by Energy Efficiency Program for Met-Ed

Program	PYRTD (MW/yr)	PYVTD Gross (MW/yr)	PYVTD Net (MW/yr)	RTD (MW/yr)	VTD Gross (MW/yr)	VTD Net (MW/yr)
Appliance Turn-in	0.68	0.63	0.31	1.24	1.16	0.57
Energy Efficient Homes	6.72	7.39	6.61	13.27	13.61	12.24
Energy Efficient Products	3.04	4.19	1.60	6.22	8.36	3.19
Low Income Energy Efficiency	1.20	1.33	1.33	2.34	2.48	2.48
C&I Energy Solutions for Business - Small	5.43	5.42	3.37	7.35	7.44	4.68
C&I Energy Solutions for Business - Large	4.69	4.49	2.50	8.79	8.76	4.77
Governmental & Institutional Tariff	0.00	0.00	0.00	0.01	0.01	0.01
Portfolio Total	21.75	23.46	15.72	39.23	41.83	27.95

Table 25: Peak Demand Savings by Energy Efficiency Program for Penelec

Program	PYRTD (MW/yr)	PYVTD Gross (MW/yr)	PYVTD Net (MW/yr)	RTD (MW/yr)	VTD Gross (MW/yr)	VTD Net (MW/yr)
Appliance Turn-in	0.61	0.56	0.25	1.11	1.00	0.44
Energy Efficient Homes	4.92	4.64	4.20	9.88	9.54	8.64
Energy Efficient Products	3.07	3.88	1.36	6.68	8.63	3.01
Low Income Energy Efficiency	1.15	1.11	1.11	2.45	2.44	2.44
C&I Energy Solutions for Business - Small	4.11	3.84	3.11	7.10	6.78	5.54
C&I Energy Solutions for Business - Large	5.78	5.34	4.24	7.64	7.00	5.57
Governmental & Institutional Tariff	0.02	0.02	0.02	0.04	0.03	0.03
Portfolio Total	19.66	19.40	14.30	34.89	35.42	25.67

Table 26: Peak Demand Savings by Energy Efficiency Program for Penn Power

Program	PYRTD (MW/yr)	PYVTD Gross (MW/yr)	PYVTD Net (MW/yr)	RTD (MW/yr)	VTD Gross (MW/yr)	VTD Net (MW/yr)
Appliance Turn-in	0.22	0.18	0.11	0.38	0.31	0.17
Energy Efficient Homes	1.96	2.04	1.68	3.68	3.79	3.13
Energy Efficient Products	1.24	1.72	0.69	1.98	2.76	1.10
Low Income Energy Efficiency	0.41	0.42	0.42	0.84	0.77	0.77
C&I Energy Solutions for Business - Small	1.93	1.86	1.35	3.35	3.33	2.41
C&I Energy Solutions for Business - Large	1.34	1.22	0.83	1.63	1.55	1.03
Governmental & Institutional Tariff	0.00	0.00	0.00	0.06	0.07	0.05
Portfolio Total	7.10	7.44	5.07	11.93	12.57	8.67

Table 27: Peak Demand Savings by Energy Efficiency Program for WPP

Program	PYRTD (MW/yr)	PYVTD Gross (MW/yr)	PYVTD Net (MW/yr)	RTD (MW/yr)	VTD Gross (MW/yr)	VTD Net (MW/yr)
Appliance Turn-in	0.76	0.74	0.38	1.39	1.35	0.65
Energy Efficient Homes	7.98	7.44	6.53	14.99	13.37	11.89
Energy Efficient Products	3.72	4.69	1.40	7.86	9.87	2.89
Low Income Energy Efficiency	1.25	1.20	1.20	2.65	2.46	2.46
C&I Energy Solutions for Business - Small	4.43	4.65	3.82	6.74	6.87	5.65
C&I Energy Solutions for Business - Large	4.95	4.58	3.24	6.47	6.05	4.28
Governmental & Institutional Tariff	0.02	0.02	0.02	0.18	0.18	0.15
Portfolio Total	23.11	23.31	16.59	40.28	40.15	27.97

2.8.2 Demand Response

Act 129 defines peak demand savings from demand response as the average reduction in electric demand during the hours when a demand response event is initiated. Phase III DR events are initiated according to the following guidelines:

1) Curtailment events shall be limited to the months of June through September.
2) Curtailment events shall be called for the first six days of each program year (starting in PY9) in which the peak hour of PJM's day-ahead forecast for the PJM RTO is greater than 96% of the PJM RTO summer peak demand forecast for the months of June through September.
3) Each curtailment event shall last four hours.
4) Each curtailment event shall be called such that it will occur during the day's forecasted peak hour(s) above 96% of the PJM RTO summer peak demand forecast.
5) Once six curtailment events have been called in a program year, the peak demand reduction program shall be suspended for that program year.

The peak demand impacts from demand response in this report are presented at the system level and reflect adjustments to account for transmission and distribution losses. Table 28 lists the line loss multipliers by EDC and by sector. These values are taken from Table 1-4 of the 2016 PA TRM.

Table 28: Line Loss Multipliers by EDC and Customer Sector

Sector	Met-Ed	Penelec	Penn Power	WPP
Residential	1.0945	1.0945	1.0949	1.0943
Small C&I	1.0720	1.0720	1.0545	1.0790
Large C&I	1.0720	1.0720	1.0545	1.0790

Table 29 summarizes the PYVTD and VTD demand reductions for each of the demand response programs in the EE&C plan and for the demand response portfolio as a whole. VTD demand reductions are the average performance across all Phase III demand response events independent of how many events occurred in a given program year. The relative precision

columns in Table 10 indicate the margin of error (at the 90% confidence interval) around the PYVTD and VTD demand reductions. The table shows zero values in each cell because there were no demand response events in PY9.

Table 29: Verified Gross Demand Response Impacts by Program

EDC	Program	PYVTD Gross MW	Relative Precision	VTD Gross MW	Relative Precision
Met-Ed	Residential Behavioral Demand Response	0.0	0%	0.0	0%
Met-Ed	C&I Demand Response Program – Small	2.7	8%	2.7	8%
Met-Ed	C&I Demand Response Program – Large	43.3	8%	43.3	8%
Penn Power	Residential Behavioral Demand Response	2.2	13%	2.2	13%
Penn Power	C&I Demand Response Program – Small	0.2	58%	0.2	58%
Penn Power	C&I Demand Response Program – Large	31.1	58%	31.1	58%
WPP	Residential Behavioral Demand Response	0.0	0%	0.0	0%
WPP	C&I Demand Response Program – Small	2.7	38%	2.7	38%
WPP	C&I Demand Response Program – Large	79.2	38%	79.2	38%

2.9 Summary of Fuel Switching Impacts

Act 129 allows EDCs to achieve electric savings by converting electric equipment to non-electric equipment. Table 11 summarizes for each EDC, key fuel switching metrics to date in Phase III. Combined Heat and Power (CHP) and solar water heating are the only fuel switching measures offered by the Companies in Phase III. There was one rebate approved by West Penn Power for a CHP project in PY9.

Table 30: Fuel Switching Summary

	Met-Ed	Penelec	Penn Power	WPP
Fuel Switching Measures Offered	CHP, Solar Water Heater			
Fuel Switching Measures Implemented	None	None	None	CHP
VTD Energy Savings Achieved via Fuel Switching (MWh/yr)	0	0	0	14,003
P3TD Increased Fossil Fuel Consumption Due to Fuel Switching Measures (MMBTU/yr)	0	0	0	4,779
P3TD Incentive Payments for Fuel Switching Measures ($1000)	0	0	0	420

2.10 SUMMARY OF COST-EFFECTIVENESS RESULTS

TRC benefit-cost ratios are calculated by comparing the total NPV TRC benefits and the total NPV TRC costs. It is important to note that TRC costs are materially different from the EDC spending and rate recovery tables presented later in the report. TRC costs include estimates of the full cost incurred by program participants to install efficient equipment, not just the portion covered by the EDC rebate. Table 32, Table 33, Table 34, and Table 35 show the TRC ratios by program and for the portfolio for Met-Ed, Penelec, Penn Power, and WPP respectively. The benefits in the tables were calculated using gross verified impacts. PYTD costs and benefits are expressed in the base dollars for the calendar year in which the program starts. For PY9, cost and benefits are expressed in 2017 dollars.

The TRCs for residential lighting presented in this report are considered conservative, as they reflect a dual baseline protocol for residential lighting measures consistent with the current TRM. The TRM specifies that "*calculations for bulbs expected to be installed or remain in use past 2020. For these bulbs, [post EISA 2007 baseline wattages] should be used for the savings calculations until 2020, followed by the [post 2020 baseline wattages] for the remainder of the measure life."* The Companies note that since the TRM was adopted in 2015, there is growing uncertainty about the likelihood of DOE enforcement of EISA 2020 standard changes as well as the availability of pre-2020 baseline bulbs in the market. This has resulted in most states not adopting the prospective change in standards in cost effectiveness calculations, resulting in higher lifetime savings and benefits.

If TRCs were to not use the dual baselines, gross and net TRCs for the Energy Efficient Products program would increase by 30% and 27%, portfolio gross TRCs would increase by 8 to 10% and portfolio net TRCs would increase by 4% to 6% depending on EDC. Gross and Net TRCs for the Portfolio with and without dual baseline treatment are presented in the following table:

Table 31 – Portfolio TRC with and without Dual Baseline Calculations

	Gross		Net	
EDC	Dual Baseline	Without Dual Baseline	Dual Baseline	Without Dual Baseline
Met-Ed	1.88	2.05	1.69	1.78
Penelec	1.29	1.42	1.12	1.18
Penn Power	1.49	1.65	1.38	1.46
WPP	1.28	1.40	1.18	1.22
Average	1.49	1.63	1.34	1.41

Note that the TRC Order specifies, for Demand Response, the that *"All peak demand reduction values would be multiplied by the avoided cost of generation capacity ($/kW-year for the Annual Product Type) for the delivery year as set by PJM's Base Residual Auction."* For 2017, Base

Residual Auction (BRA) Annual Product Type clearing prices were the same and are used in the tables below.

> The TRC values for the C&I Demand Response Programs appear to be anomalously high for PY9. There are several reasons for the apparent high TRC values. There were only three events causing program incremental costs, which scale with the number of events, to be lower than planned. In PY10, we expect higher costs per MW of load reduction because there were six events.

Furthermore, the Companies present reasonable, alternative cost-effectiveness calculations that yield much lower TRC ratios. Other considerations raise potential issues with the TRC values presented. Use of the Annual Resource Type overstates the avoided cost for Summer Only DR program. For 2017, PJM clearing prices are available for: a) Limited (Summer-Only) Resources; b) Extended Summer Resources; and c) Annual Resources. The Limited value is $106.02/MW-day rather than the value for Annual Resources of $120/MW-day. Use of the Limited value would reduce the average TRC for Demand Response programs from 4.06 to 3.81.

Another consideration is that the three DR events in PY9 occurred on three of five critical peak days, as defined by PJM. It is reasonable to prorate DR program benefits by a factor of 3/5, given that the DR program had no impact on two of five PJM critical peak days. This would reduce the average TRC from 4.06 to 2.43

Avoided Transmission and Distribution (T&D) prices comprise 48% of total avoided costs associated with demand response in PY9. The Companies have previously recommended exclusion of avoided T&D from cost effectiveness tests for demand response. If T&D benefits were to be excluded, the average TRC for all C&I DR programs offered by the three Companies in PY9 would decrease by 48%, from 4.06 to 2.09.

The combination of the three scenarios would reduce TRC from 4.06 to 1.11. In addition, there is some evidence that larger customers manage loads on high PJM days to reduce peak load share costs in subsequent years. While ADM has not performed an assessment of net-to-gross for the program, this would further reduce TRC. The Companies formally report the higher TRC values for the DR programs but offer these alternative scenarios for consideration.

Table 32: PY9 Gross TRC Ratios by Program ($1,000) for Met-Ed

Program	TRC NPV Benefits	TRC NPV Costs	TRC Ratio	TRC Net Benefits (Benefits – Costs)
Appliance Turn-in	$1,482	$757	1.96	$726
Energy Efficient Homes	$15,060	$7,272	2.07	$7,788
Energy Efficient Products	$13,487	$8,002	1.69	$5,484
Low Income Energy Efficiency	$2,582	$3,568	0.72	-$986
Residential Subtotal	**$32,611**	**$19,599**	**1.66**	**$13,012**
C&I Energy Solutions for Business - Small	$17,721	$7,580	2.34	$10,141
C&I Energy Solutions for Business - Large	$14,990	$8,304	1.81	$6,686
Governmental & Institutional Tariff	$228	$163	1.40	$65
C&I Demand Response Program – Small	$226	$91	2.47	$134
C&I Demand Response Program – Large	$3,675	$1,192	3.08	$2,483
Non-Residential Subtotal	**$36,840**	**$17,331**	**2.13**	**$19,509**
Portfolio Total	**$69,451**	**$36,930**	**1.88**	**$32,521**

Table 33: PY9 Gross TRC Ratios by Program ($1,000) for Penelec

Program	TRC NPV Benefits	TRC NPV Costs	TRC Ratio	TRC Net Benefits (Benefits – Costs)
Appliance Turn-in	$1,323	$687	1.93	$637
Energy Efficient Homes	$11,431	$6,111	1.87	$5,320
Energy Efficient Products	$12,917	$6,270	2.06	$6,647
Low Income Energy Efficiency	$2,559	$3,441	0.74	-$882
Residential Subtotal	**$28,230**	**$16,508**	**1.71**	**$11,722**
C&I Energy Solutions for Business - Small	$11,350	$10,905	1.04	$445
C&I Energy Solutions for Business - Large	$17,244	$16,456	1.05	$787
Governmental & Institutional Tariff	$348	$517	0.67	-$169
Non-Residential Subtotal	**$28,941**	**$27,879**	**1.04**	**$1,063**
Portfolio Total	**$57,171**	**$44,386**	**1.29**	**$12,785**

Table 34: PY9 Gross TRC Ratios by Program ($1,000) for Penn Power

Program	TRC NPV Benefits	TRC NPV Costs	TRC Ratio	TRC Net Benefits (Benefits – Costs)
Appliance Turn-in	$434	$261	1.66	$173
Energy Efficient Homes	$4,266	$2,817	1.51	$1,449
Energy Efficient Products	$5,175	$2,379	2.17	$2,796
Low Income Energy Efficiency	$865	$1,265	0.68	-$400
Residential Subtotal	**$10,741**	**$6,723**	**1.60**	**$4,018**
C&I Energy Solutions for Business - Small	$5,873	$4,876	1.20	$997
C&I Energy Solutions for Business - Large	$4,788	$3,898	1.23	$890
Governmental & Institutional Tariff	$194	$223	0.87	-$29
C&I Demand Response Program – Small	$16	$10	1.59	$6
C&I Demand Response Program – Large	$2,641	$493	5.35	$2,147
Non-Residential Subtotal	**$13,512**	**$9,501**	**1.42**	**$4,011**
Portfolio Total	**$24,252**	**$16,224**	**1.49**	**$8,028**

Table 35: PY9 Gross TRC Ratios by Program ($1,000) for WPP

Program	TRC NPV Benefits	TRC NPV Costs	TRC Ratio	TRC Net Benefits (Benefits – Costs)
Appliance Turn-in	$1,782	$835	2.14	$947
Energy Efficient Homes	$14,541	$7,975	1.82	$6,566
Energy Efficient Products	$12,110	$8,595	1.41	$3,514
Low Income Energy Efficiency	$2,266	$3,160	0.72	-$894
Residential Subtotal	**$30,698**	**$20,565**	**1.49**	**$10,133**
C&I Energy Solutions for Business - Small	$15,496	$16,010	0.97	-$514
C&I Energy Solutions for Business - Large	$19,629	$16,641	1.18	$2,987
Governmental & Institutional Tariff	$3,585	$4,849	0.74	-$1,264
C&I Demand Response Program – Small	$229	$51	4.44	$177
C&I Demand Response Program – Large	$6,724	$1,491	4.51	$5,233
Non-Residential Subtotal	**$45,662**	**$39,043**	**1.17**	**$6,620**
Portfolio Total	**$76,361**	**$59,608**	**1.28**	**$16,753**

Table 36, Table 37, Table 38, and Table 39 present PY9 cost-effectiveness for Met-Ed, Penelec, Penn Power, and WPP respectively, using net verified savings to calculate benefits.

Table 36: PY9 Net TRC Ratios by Program ($1,000) for Met-Ed

Program	TRC NPV Benefits	TRC NPV Costs	TRC Ratio	TRC Net Benefits (Benefits – Costs)
Appliance Turn-in	$726	$757	0.96	-$30
Energy Efficient Homes	$12,423	$6,816	1.82	$5,607
Energy Efficient Products	$5,131	$3,819	1.34	$1,312
Low Income Energy Efficiency	$2,582	$3,568	0.72	-$986
Residential Subtotal	**$20,863**	**$14,960**	**1.39**	**$5,903**
C&I Energy Solutions for Business - Small	$10,931	$5,026	2.17	$5,905
C&I Energy Solutions for Business - Large	$8,356	$4,699	1.78	$3,657
Governmental & Institutional Tariff	$144	$127	1.13	$17
C&I Demand Response Program – Small	$226	$91	2.47	$134
C&I Demand Response Program – Large	$3,675	$1,192	3.08	$2,483
Non-Residential Subtotal	**$23,332**	**$11,137**	**2.10**	**$12,196**
Portfolio Total	**$44,195**	**$26,097**	**1.69**	**$18,099**

Table 37: PY9 Net TRC Ratios by Program ($1,000) for Penelec

Program	TRC NPV Benefits	TRC NPV Costs	TRC Ratio	TRC Net Benefits (Benefits – Costs)
Appliance Turn-in	$596	$687	0.87	-$91
Energy Efficient Homes	$9,622	$5,811	1.66	$3,811
Energy Efficient Products	$4,518	$2,965	1.52	$1,553
Low Income Energy Efficiency	$2,559	$3,441	0.74	-$882
Residential Subtotal	**$17,294**	**$12,903**	**1.34**	**$4,391**
C&I Energy Solutions for Business - Small	$9,046	$9,016	1.00	$30
C&I Energy Solutions for Business - Large	$13,530	$13,359	1.01	$171
Governmental & Institutional Tariff	$291	$451	0.64	-$161
Non-Residential Subtotal	**$22,866**	**$22,825**	**1.00**	**$41**
Portfolio Total	**$40,160**	**$35,729**	**1.12**	**$4,432**

Table 38: PY9 Net TRC Ratios by Program ($1,000) for Penn Power

Program	TRC NPV Benefits	TRC NPV Costs	TRC Ratio	TRC Net Benefits (Benefits – Costs)
Appliance Turn-in	$252	$261	0.96	-$9
Energy Efficient Homes	$3,406	$2,508	1.36	$898
Energy Efficient Products	$2,054	$1,160	1.77	$895
Low Income Energy Efficiency	$865	$1,265	0.68	-$400
Residential Subtotal	**$6,577**	**$5,194**	**1.27**	**$1,383**
C&I Energy Solutions for Business - Small	$4,271	$3,624	1.18	$647
C&I Energy Solutions for Business - Large	$3,172	$2,707	1.17	$465
Governmental & Institutional Tariff	$146	$176	0.83	-$30
C&I Demand Response Program – Small	$16	$10	1.59	$6
C&I Demand Response Program – Large	$2,641	$493	5.35	$2,147
Non-Residential Subtotal	**$10,245**	**$7,009**	**1.46**	**$3,236**
Portfolio Total	**$16,823**	**$12,203**	**1.38**	**$4,619**

Table 39: PY9 Net TRC Ratios by Program ($1,000) for WPP

Program	TRC NPV Benefits	TRC NPV Costs	TRC Ratio	TRC Net Benefits (Benefits – Costs)
Appliance Turn-in	$909	$835	1.09	$74
Energy Efficient Homes	$11,907	$7,324	1.63	$4,582
Energy Efficient Products	$3,582	$3,840	0.93	-$257
Low Income Energy Efficiency	$2,266	$3,160	0.72	-$894
Residential Subtotal	**$18,663**	**$15,158**	**1.23**	**$3,505**
C&I Energy Solutions for Business - Small	$12,689	$13,439	0.94	-$751
C&I Energy Solutions for Business - Large	$12,425	$11,450	1.09	$975
Governmental & Institutional Tariff	$2,987	$4,090	0.73	-$1,103
C&I Demand Response Program – Small	$229	$51	4.44	$177
C&I Demand Response Program – Large	$6,724	$1,491	4.51	$5,233
Non-Residential Subtotal	**$35,053**	**$30,522**	**1.15**	**$4,531**
Portfolio Total	**$53,717**	**$45,680**	**1.18**	**$8,036**

Table 40, Table 41, Table 42, and Table 43 summarize cost-effectiveness by program respectively for Met-Ed, Penelec, Penn Power, and WPP for Phase III of Act 129. P3TD costs and benefits are expressed in 2016 dollars regardless of program or reporting year.

Table 40: P3TD Gross TRC Ratios by Program ($1,000) for Met-Ed

Program	TRC NPV Benefits	TRC NPV Costs	TRC Ratio	TRC Net Benefits (Benefits – Costs)
Appliance Turn-in	$2,903	$1,361	2.13	$1,542
Energy Efficient Homes	$24,127	$13,973	1.73	$10,154
Energy Efficient Products	$26,295	$14,574	1.80	$11,721
Low Income Energy Efficiency	$4,984	$6,756	0.74	-$1,772
Residential Subtotal	**$58,310**	**$36,665**	**1.59**	**$21,645**
C&I Energy Solutions for Business - Small	$22,490	$11,244	2.00	$11,246
C&I Energy Solutions for Business - Large	$29,118	$18,566	1.57	$10,553
Governmental & Institutional Tariff	$310	$267	1.16	$43
C&I Demand Response Program – Small	$212	$126	1.68	$86
C&I Demand Response Program – Large	$3,447	$1,478	2.33	$1,969
Non-Residential Subtotal	**$55,577**	**$31,681**	**1.75**	**$23,896**
Portfolio Total	**$113,887**	**$68,346**	**1.67**	**$45,541**

Table 41: P3TD Gross TRC Ratios by Program ($1,000) for Penelec

Program	TRC NPV Benefits	TRC NPV Costs	TRC Ratio	TRC Net Benefits (Benefits – Costs)
Appliance Turn-in	$2,396	$1,291	1.86	$1,105
Energy Efficient Homes	$20,332	$11,849	1.72	$8,483
Energy Efficient Products	$29,013	$12,437	2.33	$16,577
Low Income Energy Efficiency	$5,445	$6,727	0.81	-$1,282
Residential Subtotal	**$57,186**	**$32,303**	**1.77**	**$24,883**
C&I Energy Solutions for Business - Small	$19,080	$16,505	1.16	$2,575
C&I Energy Solutions for Business - Large	$22,636	$21,984	1.03	$652
Governmental & Institutional Tariff	$608	$820	0.74	-$212
Non-Residential Subtotal	**$42,324**	**$39,309**	**1.08**	**$3,015**
Portfolio Total	**$99,510**	**$71,612**	**1.39**	**$27,898**

Table 42: P3TD Gross TRC Ratios by Program ($1,000) for Penn Power

Program	TRC NPV Benefits	TRC NPV Costs	TRC Ratio	TRC Net Benefits (Benefits – Costs)
Appliance Turn-in	$725	$470	1.54	$255
Energy Efficient Homes	$6,744	$5,069	1.33	$1,674
Energy Efficient Products	$8,274	$3,965	2.09	$4,309
Low Income Energy Efficiency	$1,598	$2,157	0.74	-$559
Residential Subtotal	**$17,340**	**$11,661**	**1.49**	**$5,679**
C&I Energy Solutions for Business - Small	$9,705	$6,355	1.53	$3,350
C&I Energy Solutions for Business - Large	$5,796	$4,712	1.23	$1,084
Governmental & Institutional Tariff	$702	$456	1.54	$246
C&I Demand Response Program – Small	$15	$22	0.69	-$7
C&I Demand Response Program – Large	$2,470	$572	4.32	$1,898
Non-Residential Subtotal	**$18,689**	**$12,117**	**1.54**	**$6,571**
Portfolio Total	**$36,029**	**$23,779**	**1.52**	**$12,250**

Table 43: P3TD Gross TRC Ratios by Program ($1,000) for WPP

Program	TRC NPV Benefits	TRC NPV Costs	TRC Ratio	TRC Net Benefits (Benefits – Costs)
Appliance Turn-in	$3,115	$1,557	2.00	$1,558
Energy Efficient Homes	$20,741	$14,023	1.48	$6,718
Energy Efficient Products	$26,675	$15,833	1.68	$10,842
Low Income Energy Efficiency	$4,723	$6,535	0.72	-$1,812
Residential Subtotal	**$55,254**	**$37,948**	**1.46**	**$17,307**
C&I Energy Solutions for Business - Small	$21,500	$21,181	1.02	$319
C&I Energy Solutions for Business - Large	$22,981	$19,772	1.16	$3,209
Governmental & Institutional Tariff	$5,396	$6,723	0.80	-$1,328
C&I Demand Response Program – Small	$214	$104	2.06	$110
C&I Demand Response Program – Large	$6,303	$1,899	3.32	$4,403
Non-Residential Subtotal	**$56,394**	**$49,680**	**1.14**	**$6,714**
Portfolio Total	**$111,648**	**$87,628**	**1.27**	**$24,021**

Table 44, Table 45, Table 46, and Table 47 present P3TD cost-effectiveness results for Met-Ed, Penelec, Penn Power, and WPP respectively using net verified savings to calculate benefits. Cost and benefits are expressed in 2016 dollars.

Table 44: P3TD Net TRC Ratios by Program ($1,000) for Met-Ed

Program	TRC NPV Benefits	TRC NPV Costs	TRC Ratio	TRC Net Benefits (Benefits – Costs)
Appliance Turn-in	$1,438	$1,361	1.06	$76
Energy Efficient Homes	$19,908	$13,000	1.53	$6,907
Energy Efficient Products	$9,978	$7,080	1.41	$2,899
Low Income Energy Efficiency	$4,984	$6,756	0.74	-$1,772
Residential Subtotal	**$36,307**	**$28,197**	**1.29**	**$8,111**
C&I Energy Solutions for Business - Small	$14,065	$7,698	1.83	$6,367
C&I Energy Solutions for Business - Large	$15,874	$10,609	1.50	$5,265
Governmental & Institutional Tariff	$199	$210	0.94	-$12
C&I Demand Response Program – Small	$212	$126	1.68	$86
C&I Demand Response Program – Large	$3,447	$1,478	2.33	$1,969
Non-Residential Subtotal	**$33,796**	**$20,122**	**1.68**	**$13,674**
Portfolio Total	**$70,103**	**$48,319**	**1.45**	**$21,785**

Table 45: P3TD Net TRC Ratios by Program ($1,000) for Penelec

Program	TRC NPV Benefits	TRC NPV Costs	TRC Ratio	TRC Net Benefits (Benefits – Costs)
Appliance Turn-in	$1,055	$1,291	0.82	-$236
Energy Efficient Homes	$17,146	$11,441	1.50	$5,705
Energy Efficient Products	$10,085	$5,897	1.71	$4,188
Low Income Energy Efficiency	$5,445	$6,727	0.81	-$1,282
Residential Subtotal	**$33,731**	**$25,355**	**1.33**	**$8,376**
C&I Energy Solutions for Business - Small	$15,453	$13,740	1.12	$1,713
C&I Energy Solutions for Business - Large	$17,658	$17,409	1.01	$249
Governmental & Institutional Tariff	$511	$723	0.71	-$212
Non-Residential Subtotal	**$33,622**	**$31,872**	**1.05**	**$1,750**
Portfolio Total	**$67,353**	**$57,228**	**1.18**	**$10,126**

Table 46: P3TD Net TRC Ratios by Program ($1,000) for Penn Power

Program	TRC NPV Benefits	TRC NPV Costs	TRC Ratio	TRC Net Benefits (Benefits – Costs)
Appliance Turn-in	$395	$470	0.84	-$75
Energy Efficient Homes	$5,299	$4,408	1.20	$891
Energy Efficient Products	$3,286	$1,956	1.68	$1,329
Low Income Energy Efficiency	$1,598	$2,157	0.74	-$559
Residential Subtotal	**$10,578**	**$8,991**	**1.18**	**$1,586**
C&I Energy Solutions for Business - Small	$7,022	$4,698	1.49	$2,324
C&I Energy Solutions for Business - Large	$3,756	$3,182	1.18	$574
Governmental & Institutional Tariff	$528	$364	1.45	$164
C&I Demand Response Program – Small	$15	$22	0.69	-$7
C&I Demand Response Program – Large	$2,470	$572	4.32	$1,898
Non-Residential Subtotal	**$13,791**	**$8,839**	**1.56**	**$4,953**
Portfolio Total	**$24,369**	**$17,830**	**1.37**	**$6,539**

Table 47: P3TD Net TRC Ratios by Program ($1,000) for WPP

Program	TRC NPV Benefits	TRC NPV Costs	TRC Ratio	TRC Net Benefits (Benefits – Costs)
Appliance Turn-in	$1,502	$1,557	0.96	-$55
Energy Efficient Homes	$17,003	$12,851	1.32	$4,152
Energy Efficient Products	$7,692	$7,139	1.08	$553
Low Income Energy Efficiency	$4,723	$6,535	0.72	-$1,812
Residential Subtotal	**$30,921**	**$28,083**	**1.10**	**$2,838**
C&I Energy Solutions for Business - Small	$17,640	$17,874	0.99	-$234
C&I Energy Solutions for Business - Large	$15,055	$14,041	1.07	$1,014
Governmental & Institutional Tariff	$4,486	$5,672	0.79	-$1,186
C&I Demand Response Program – Small	$214	$104	2.06	$110
C&I Demand Response Program – Large	$6,303	$1,899	3.32	$4,403
Non-Residential Subtotal	**$43,698**	**$39,591**	**1.10**	**$4,107**
Portfolio Total	**$74,618**	**$67,674**	**1.10**	**$6,945**

2.11 Comparison of Performance to Approved EE&C Plan

Table 48, Table 49, Table 50, and Table 51 present P3TD expenditures, by program, compared to the budget estimates set forth in the EE&C plan through PY9 for Met-Ed, Penelec, Penn Power, and WPP respectively. All the dollars in Table 16 are presented in 2016 dollars.

Please note that the Companies' acquisition costs through Phase III PY 9 have been heavily influenced by results to date significantly exceeding plan projections in lower cost programs (e.g. lighting, EE kits, behavioral). The Companies' anticipate that their acquisition costs will increase through the end of Phase III as participation among higher cost programs and measures increase to offset the reduction in lighting that will occur in the remainder of Phase III.

Table 48: Comparison of P3TD Expenditures to EE&C Plan ($1,000) Met-Ed

Program	Phase III Budget from EE&C Plan through PY9	P3TD Actual Expenditures	Ratio (Actual/Plan)
Appliance Turn In Program	$ 2,240.63	$ 1,845.64	0.82
Energy Efficient Homes Program	$ 12,595.35	$ 11,241.12	0.89
Energy Efficient Products Program	$ 8,038.02	$ 4,821.77	0.60
Low Income Energy Efficiency Program	$ 7,271.07	$ 6,713.46	0.92
C&I Energy Solutions for Business Program - Small	$ 7,701.01	$ 4,187.00	0.54
C&I Demand Response Program - Small	$ 235.86	$ 126.12	0.53
C&I Energy Solutions for Business Program - Large	$ 6,058.11	$ 5,139.87	0.85
C&I Demand Response Program - Large	$ 2,117.56	$ 1,281.57	0.61
Governmental & Institutional Tariff Program	$ 526.47	$ 150.97	0.29
Total	**$ 46,784.10**	**$ 35,507.53**	**0.76**

Table 49: Comparison of P3TD Expenditures to EE&C Plan ($1,000) Penelec

Program	Phase III Budget from EE&C Plan through PY9	P3TD Actual Expenditures	Ratio (Actual/Plan)
Appliance Turn In Program	$ 2,328.07	$ 1,708.17	0.73
Energy Efficient Homes Program	$ 11,757.76	$ 10,141.64	0.86
Energy Efficient Products Program	$ 7,730.13	$ 4,796.85	0.62
Low Income Energy Efficiency Program	$ 7,995.79	$ 6,705.20	0.84
C&I Energy Solutions for Business Program - Small	$ 7,982.14	$ 4,758.06	0.60
C&I Energy Solutions for Business Program - Large	$ 5,482.63	$ 4,836.21	0.88
Governmental & Institutional Tariff Program	$ 915.78	$ 307.75	0.34
Total	**$ 44,192.30**	**$ 33,253.89**	**0.75**

Table 50: Comparison of P3TD Expenditures to EE&C Plan ($1,000) Penn Power

Program	Phase III Budget from EE&C Plan through PY9	P3TD Actual Expenditures	Ratio (Actual/Plan)
Appliance Turn In Program	$ 537.12	$ 615.67	1.15
Energy Efficient Homes Program	$ 3,463.45	$ 3,487.71	1.01
Energy Efficient Products Program	$ 1,910.61	$ 1,209.85	0.63
Low Income Energy Efficiency Program	$ 2,463.60	$ 2,113.26	0.86
C&I Energy Solutions for Business Program - Small	$ 2,183.88	$ 1,914.93	0.88
C&I Demand Response Program - Small	$ 78.15	$ 21.81	0.28
C&I Energy Solutions for Business Program - Large	$ 1,246.97	$ 1,105.69	0.89
C&I Demand Response Program - Large	$ 701.29	$ 626.58	0.89
Governmental & Institutional Tariff Program	$ 217.88	$ 192.33	0.88
Total	**$ 12,802.95**	**$ 11,287.83**	**0.88**

Table 51: Comparison of P3TD Expenditures to EE&C Plan ($1,000) WPP

Program	Phase III Budget from EE&C Plan through PY9	P3TD Actual Expenditures	Ratio (Actual/Plan)
Appliance Turn In Program	$ 2,230.80	$ 2,105.81	0.94
Energy Efficient Homes Program	$ 9,376.06	$ 10,626.48	1.13
Energy Efficient Products Program	$ 7,588.03	$ 5,600.59	0.74
Low Income Energy Efficiency Program	$ 7,632.70	$ 6,504.36	0.85
C&I Energy Solutions for Business Program - Small	$ 7,501.42	$ 4,744.71	0.63
C&I Demand Response Program - Small	$ 294.16	$ 104.57	0.36
C&I Energy Solutions for Business Program - Large	$ 5,434.19	$ 4,056.84	0.75
C&I Demand Response Program - Large	$ 2,647.42	$ 2,033.94	0.77
Governmental & Institutional Tariff Program	$ 721.23	$ 1,202.75	1.67
Total	**$ 43,426.00**	**$ 36,980.05**	**0.85**

Table 52, Table 53, Table 54, and Table 55 compare Phase III verified gross program savings compare to the energy savings projections filed in the EE&C plan for Met-Ed, Penelec, Penn Power, and WPP respectively.

Table 52: Comparison of Phase III Actual Program Savings to EE&C Plan Projections for Phase III for Met-Ed

Program	EE&C Plan through PY9	VTD Gross MWh Savings	Ratio (Actual/Plan)
Appliance Turn In Program	12,259	8,607	0.70
Energy Efficient Homes Program	69,404	113,816	1.64
Energy Efficient Products Program	46,098	61,603	1.34
Low Income Energy Efficiency Program	15,253	21,523	1.41
C&I Energy Solutions for Business Program - Small	47,729	48,893	1.02
C&I Demand Response Program - Small	0	0	n/a
C&I Energy Solutions for Business Program - Large	53,048	61,276	1.16
C&I Demand Response Program - Large	0	0	n/a
Governmental & Institutional Tariff Program	1,800	878	0.49
Total	**245,590**	**316,595**	**1.29**

Table 53: Comparison of Phase III Actual Program Savings to EE&C Plan Projections for Phase III for Penelec

Program	EE&C Plan through PY9	VTD Gross MWh Savings	Ratio (Actual/Plan)
Appliance Turn In Program	13,851	7,708	0.56
Energy Efficient Homes Program	59,546	87,196	1.46
Energy Efficient Products Program	48,778	71,484	1.47
Low Income Energy Efficiency Program	14,569	22,921	1.57
C&I Energy Solutions for Business Program - Small	48,067	42,043	0.87
C&I Energy Solutions for Business Program - Large	47,747	54,015	1.13
Governmental & Institutional Tariff Program	2,360	1,786	0.76
Total	**234,918**	**287,154**	**1.22**

Table 54: Comparison of Phase III Actual Program Savings to EE&C Plan Projections for Phase III for Penn Power

Program	EE&C Plan through PY9	VTD Gross MWh Savings	Ratio (Actual/Plan)
Appliance Turn In Program	3,290	2,419	0.74
Energy Efficient Homes Program	16,976	26,565	1.56
Energy Efficient Products Program	12,915	21,041	1.63
Low Income Energy Efficiency Program	4,104	6,558	1.60
C&I Energy Solutions for Business Program - Small	15,237	21,873	1.44
C&I Demand Response Program - Small	0	0	n/a
C&I Energy Solutions for Business Program - Large	11,236	14,085	1.25
C&I Demand Response Program - Large	0	0	n/a
Governmental & Institutional Tariff Program	908	1,943	2.14
Total	**64,666**	**94,484**	**1.46**

Table 55: Comparison of Phase III Actual Program Savings to EE&C Plan Projections for Phase III for WPP

Program	EE&C Plan through PY9	VTD Gross MWh Savings	Ratio (Actual/Plan)
Appliance Turn In Program	13,342	10,385	0.78
Energy Efficient Homes Program	59,778	105,300	1.76
Energy Efficient Products Program	44,645	70,047	1.57
Low Income Energy Efficiency Program	13,762	20,941	1.52
C&I Energy Solutions for Business Program - Small	45,166	50,312	1.11
C&I Demand Response Program - Small	0	0	n/a
C&I Energy Solutions for Business Program - Large	46,027	53,435	1.16
C&I Demand Response Program - Large	0	0	n/a
Governmental & Institutional Tariff Program	2,330	16,453	7.06
Total	**225,050**	**326,872**	**1.45**

Overall, the Companies exceeded their annual MWh targets while staying within budget. Participation levels in the Appliance Turn-In program were lower than planned amounts for all four PA Companies. As of this writing this is not a major concern, as marketing efforts can be increased if participation continues to fall short of targets.

All other residential programs generally exceeded expectations, while remaining within budget (normalized to MWh). Part of the reason for the apparent over performance of the Energy Efficient Homes and Low-Income Energy Efficiency programs is attributable to the Home Energy Reports ("HER") program component. On average, HER customers saved 10% to 15% more than the 180 kWh/home that was used in portfolio planning assumptions. This may be due to several reasons including increased savings with the duration of messaging and weather-related factors. Energy efficiency kits also constituted a greater proportion of the Energy Efficient Homes program, with approximately ten percent more participation than planned. This tends to increase savings and cost-effectiveness as kits are generally more cost effective than the direct install and new homes program components. The Energy Efficient Products program was buoyed by higher than expected participation in the upstream lighting component, and also by cross-sector sales (which are only accounted for in the verified impacts, not in planned or reported impacts). The Companies monitor overall spending and achievements for the residential sector as well as specific achievements in the low-income sector. As of this writing there are no significant program changes pending.

Please note that the Companies' acquisition costs through Phase III PY 9 have been heavily influenced by results to date significantly exceeding plan projections in lower cost programs (e.g. lighting, EE kits, behavioral). The Companies' anticipate that their acquisition costs will increase through the end of Phase III as participation among higher cost programs and measures increase to offset the reduction in lighting that will occur in the remainder of Phase III.

The Commercial and Industrial Programs grew considerably since PY8. This is to be expected for the first year of a phase since the typical backlog of projects is nearly eliminated between phases. Participation for the small rate-restricted Government and Institutional Tariff Program was volatile, as expected for such programs. For the second consecutive year, Penn Power and West Penn Power had far higher savings than planned, while Met-Ed and Penelec fell short of participation and savings targets. The Companies monitor overall spending and achievements for the nonresidential sector as well as specific achievements in the GNI sector. As of this writing there are no significant program changes pending.

Costs for the Commercial and Industrial Demand Response Programs were lower than budgeted amounts in the EE&C plan. This is in part because there were only three demand response events in PY9, while the Companies reserved budgets for six events.

2.12 FINDINGS AND RECOMMENDATIONS

The impact and process evaluation activities completed by the ADM and Tetra Tech team led to recommendations for program improvement. Table 56 lists the overarching recommendations that affect more than one program, the evaluation activity(s) that uncovered the finding, and the ADM and Tetra Tech team's recommendation(s) to the Companies to address the finding. As the tracking and reporting system affects all programs, the overarching comments address this key operational element. Program specific recommendations can be found in subsections 3.1.7, 3.2.7, 3.3.7, 3.4.7, and 3.5.7.

Table 56: Summary of Evaluation Recommendations

Evaluation Activity	Finding	Recommendation
Impact Evaluation	Ex Ante impact values for most downstream and upstream residential programs are typically underestimated, and this leads to high realization rates.	Consider adjusting ex-ante values in the tracking and reporting system, or keep track of expected verified savings to accurately track progress toward goals.
Process Evaluation	No overarching findings in PY9.	No overarching recommendation.

3 Evaluation Results by Program

This section documents the gross impact, net impact, and process evaluation activities conducted in Phase III along with the outcomes of those activities. Not every program receives an evaluation every year. Planned evaluation activities for Phase III are shown in Figure 26. Activities shown beyond this program year are subject to change, but the table provides the reader with a general idea of the frequency and timing of evaluation activities. In Figure 26 below, the letter "G" denotes gross impact evaluation, "N" denotes net impact evaluation, and "P" denotes process evaluation.

Figure 26: Evaluation Activity Matrix

Program/ Initiative	PY8			PY9			PY10			PY11			PY12		
	G	N	P	G	N	P	G	N	P	G	N	P	G	N	P
Res Appliance Turn-In	✓	✓	✓	✓			✓	✓	✓	✓			✓		
Res Appliances	✓	✓	✓	✓			✓	✓	✓	✓			✓		
Res HVAC	✓	✓	✓	✓			✓	✓	✓	✓			✓		
Res Upstream Lighting	✓	✓	✓	✓			✓	✓	✓	✓			✓		
Res Upstream Electronics	✓		✓	✓			✓	✓	✓	✓			✓		
Res EE Kits	✓	✓	✓	✓			✓	✓	✓	✓			✓		
Res Direct Install	✓			✓				✓	✓				✓		
Res Home Energy Reports	✓	✓		✓			✓	✓	✓	✓			✓		
Res New Homes	✓			✓				✓	✓	✓					
Res Behavioral DR				✓		✓	✓	✓		✓			✓		
Res LI Appliance Turn-In	✓		✓	✓			✓		✓	✓			✓		
Res LI Appliance Rebates	✓		✓	✓			✓		✓	✓			✓		
Res LI Kits	✓			✓			✓			✓			✓		
Res LI Home Energy Reports	✓			✓			✓			✓			✓		
Res LI Direct Install	✓		✓	✓			✓		✓	✓			✓		
C&I Appliance Recycling	✓			✓			✓	✓	✓	✓			✓		
C&I Audits/DI				✓			✓	✓	✓	✓			✓		
C&I Kits				✓			✓	✓	✓	✓			✓		
C&I Lighting	✓	✓	✓	✓			✓	✓	✓	✓			✓		
C&I Prescriptive	✓	✓	✓	✓			✓	✓	✓	✓			✓		
C&I Custom	✓	✓	✓	✓			✓	✓	✓	✓			✓		
Small CI DR				✓	✓	✓	✓			✓			✓		
Large CI DR				✓	✓	✓	✓			✓			✓		

3.1 Appliance Turn-In Program

The Companies have retained ARCA to administer the Appliance Turn-In Program. Through this 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) or dehumidifiers per household per calendar year. All units must be working and meet established

size requirements. The participation count for reporting purposes is the count of rebate applications, which corresponds to appliance pick-up events.

3.1.1 Participation and Reported Savings by Customer Segment

Table 57 presents the participation counts, reported energy and demand savings, and incentive payments for the Appliance Turn-In Program in PY9 by customer segment and EDC. This program serves only the residential customer segment. The EE&C portfolios include separate Appliance Turn-In program components, also administered by ARCA, to serve the low-income residential and the nonresidential customer segments.

Table 57: Appliance Turn-In Program Participation and Reported Impacts

Parameter	Met-Ed Residential (Non-LI)	Penelec Residential (Non-LI)	Penn Power Residential (Non-LI)	WPP Residential (Non-LI)
PYTD # Participants	4,787	4,155	1,528	5,500
PYRTD MWh/yr	4,808	4,565	1,695	5,884
PYRTD MW/yr	0.68	0.61	0.22	0.76
PYTD Incentives ($1000)	272.90	234.48	86.13	307.65

3.1.2 Gross Impact Evaluation

The impact evaluation of this program is described in detail in Appendix D.1. Table 58 summarizes program verified impacts and realization rates for each EDC.

Table 58: Appliance Turn-In Program Gross Impact Evaluation Summary for PY9

EDC	Sampling Initiative	Gross Verified MWh	Gross Verified MW	MWh Realization Rate	MW Realization Rate
Met-Ed	Appliance Turn-In	4,593	0.63	95.5%	93.1%
Penelec	Appliance Turn-In	4,301	0.56	94.2%	91.5%
Penn Power	Appliance Turn-In	1,412	0.18	83.3%	84.4%
WPP	Appliance Turn-In	5,820	0.74	98.9%	96.8%

The gross realization rates for energy savings were driven primarily by part-use factors for refrigerators and freezers as determined through verification surveys, and by the unit energy consumptions for refrigerators and freezers, as determined through measure attributes recorded in the tracking and reporting system. Although verification rates determined through surveys were approximately 100%, the realization rates are generally lower than 100% because the part-use factors are lower than the TRM default values, and the calculated unit energy consumptions were lower than what would expect from application of default parameters in the TRM.

3.1.3 Net Impact Evaluation

Tetra-Tech conducted a Net-to-Gross evaluation for this program in PY8, and updated results in PY9. The net impact evaluation for this program is described in Appendix D.2. Table 59

summarizes program verified gross and net energy impacts and net-to-gross ratios for each EDC. The NTG results are similar to PY8.

Table 59: Appliance Turn-In Program Net Impact Evaluation Summary for PY9

EDC	Sampling Initiative	Gross Verified MWh	NTG	Net Verified MWh
Met-Ed	Appliance Turn-In	4,593	49.0%	2,250
Penelec	Appliance Turn-In	4,301	45.0%	1,935
Penn Power	Appliance Turn-In	1,412	58.0%	819
WPP	Appliance Turn-In	5,820	51.0%	2,968

3.1.3.1 High-Impact Measure Research

The Appliance Turn-In Initiative was not treated as a High-Impact Measure for Net Impact Evaluation purposes in PY9. However, a full net impact evaluation was conducted by Tetra Tech. Details of the net impact evaluation can be found in Appendix D.2.

3.1.4 Verified Savings Estimates

In Table 60 the realization rates and net-to-gross ratios determined by ADM are applied to the reported energy and demand savings estimates to calculate the verified savings estimates for the Appliance Turn-In Program in PY9. These totals are added to the verified savings achieved in previous program years to calculate the P3TD program impacts.

Table 60: PYTD and P3TD Savings Summary

	Met-Ed		Penelec		Penn Power		WPP	
Savings Type	Energy (MWh/yr)	Demand (MW/yr)	Energy (MWh/yr)	Demand (MW/yr)	Energy (MWh/yr)	Demand (MW/yr)	Energy (MWh/yr)	Demand (MW/yr)
PYRTD	4,808	0.68	4,565	0.61	1,695	0.22	5,884	0.76
PYVTD Gross	4,593	0.63	4,301	0.56	1,412	0.18	5,820	0.74
PYVTD Net	2,250	0.31	1,935	0.25	819	0.11	2,968	0.38
RTD	8,817	1.24	8,392	1.11	2,983	0.38	10,882	1.39
VTD Gross	8,607	1.16	7,708	1.00	2,419	0.31	10,385	1.35
VTD Net	4,257	0.57	3,400	0.44	1,322	0.17	5,023	0.65

3.1.5 Process Evaluation

The appliance turn-in program process evaluation relied on program staff and ICSP interviews as well as participant customer surveys. The survey was streamlined given that the program design has not changed since Phase II evaluation and was administered through a combination of web and phone. The researchable issues for process evaluation related to customer satisfaction and program awareness. The results of both metrics remain similar to Phase II, suggesting that program operation was stable during PY9. The results are also similar across the FirstEnergy EDCs. The sample for the survey was randomly selected for each EDC.

The sample design is shown in Table 61.

Table 61: ATI Program Process Evaluation Sample Design

EDC	Population Size	Achieved Sample Size	Response Rate
Met-Ed	4,787	184	34.9%
Penelec	4,155	197	34.9%
Penn Power	1,528	152	32.7%
WPP	5,500	173	32.0%

Key findings and recommendations are listed in Section 3.1.7.

3.1.6 Cost-Effectiveness Reporting[6] [7]

A detailed breakdown of program finances and cost-effectiveness is presented in Table 62, Table 63, Table 64, and Table 65 for Met-Ed, Penelec, Penn Power, and WPP respectively. The last two columns of the tables show benefits as calculated with net verified impacts, along with net participant costs (if applicable). The third and fourth columns show results as calculated on a gross basis. PYTD costs and benefits are net present values (NPV) expressed in 2017 dollars. NPV costs and benefits for P3TD financials are expressed in the 2016 dollars.

[6] Any negative values reflected within this section are due to issues such as, but not limited to, reversals of prior period accruals, accounting journal entries, and/or revenues received from participation in historic capacity auctions during prior Phases of Act 129.
[7] Certain cost categories presented in the "Summary of Program Finances" tables reflect allocated percentages of actual costs.

Table 62: Summary of Program Finances – Met-Ed

Row #	Cost Category	Gross PYTD ($1,000)		Gross P3TD ($1,000)		Net PYTD ($1,000)		Net P3TD ($1,000)	
1	EDC Incentives to Participants [1]	273		501		273		501	
2	EDC Incentives to Trade Allies	0		0		0		0	
3	Participant Costs (net of incentives/rebates paid by utilities)	0		0		0		0	
4	**Incremental Measure Costs (Just row 3 for Appliance Recycling)**	**0**		**0**		**0**		**0**	
		EDC	CSP	EDC	CSP	EDC	CSP	EDC	CSP
5	Design & Development [2]	0	54	0	97	0	54	0	97
6	Administration, Management, and Technical Assistance [3]	42	108	96	192	42	108	96	192
7	Marketing [4]	13	124	28	220	13	124	28	220
8	Program Delivery [5]	0	377	0	672	0	377	0	672
9	EDC Evaluation Costs	19		50		19		50	
10	SWE Audit Costs	19		53		19		53	
11	**Program Overhead Costs (Sum of rows 5 through 10)**	**757**		**1,408**		**757**		**1,408**	
12	NPV of increases in costs of natural gas (or other fuels) for fuel switching programs	0		0		0		0	
13	**Total NPV TRC Costs [6] (Net present value of sum of rows 4, 11, and 12)**	**757**		**1,361**		**757**		**1,361**	
14	Total NPV Lifetime Electric Energy Benefits	1,162		2,110		570		1,044	
15	Total NPV Lifetime Electric Capacity Benefits	320		793		157		393	
16	Total NPV Lifetime Operation and Maintenance (O&M) Benefits	0		0		0		0	
17	Total NPV Lifetime Non-Electric Benefits (Fossil Fuel, Water)	0		0		0		0	
18	**Total NPV TRC Benefits [7] (Sum of rows 14 through 17)**	**1,482**		**2,903**		**726**		**1,438**	
19	**TRC Benefit-Cost Ratio [8]**	**1.96**		**2.13**		**0.96**		**1.06**	

[1] Includes direct install equipment costs and costs for EE&C kits.

[2] Includes direct costs attributable to plan and advance the programs. Note: The design of the HERs program should be included here, while the actual development and mailing of HERs would be attributable to Program Delivery.

[3] Includes rebate processing, tracking system, general administration, program management, general management and legal, and technical assistance. Any common portfolio costs that are allocated across programs should be shown in this row.

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

[5] Direct program implementation costs. Labor, fuel, and vehicle operation costs for appliance recycling and direct install programs. For behavioral programs, this includes the printing and postage of HERs.

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

[7] Total TRC Benefits equals the sum of Total Lifetime Electric and Non-Electric Benefits. 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. Savings carried over from Phase II are not included as a part of Total TRC Benefits for Phase III.

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

* Rows 1-11 are presented in nominal dollars

Table 63: Summary of Program Finances – Penelec

Row #	Cost Category	Gross PYTD ($1,000)		Gross P3TD ($1,000)		Net PYTD ($1,000)		Net P3TD ($1,000)	
1	EDC Incentives to Participants [1]	234		432		234		432	
2	EDC Incentives to Trade Allies	0		0		0		0	
3	Participant Costs (net of incentives/rebates paid by utilities)	0		0		0		0	
4	**Incremental Measure Costs (Just row 3 for Appliance Recycling)**	**0**		**0**		**0**		**0**	
		EDC	CSP	EDC	CSP	EDC	CSP	EDC	CSP
5	Design & Development [2]	0	48	0	90	0	48	0	90
6	Administration, Management, and Technical Assistance [3]	45	96	106	178	45	96	106	178
7	Marketing [4]	13	108	27	199	13	108	27	199
8	Program Delivery [5]	0	335	0	623	0	335	0	623
9	EDC Evaluation Costs	21		54		21		54	
10	SWE Audit Costs	21		58		21		58	
11	**Program Overhead Costs (Sum of rows 5 through 10)**	**687**		**1,335**		**687**		**1,335**	
12	NPV of increases in costs of natural gas (or other fuels) for fuel switching programs	0		0		0		0	
13	**Total NPV TRC Costs [6] (Net present value of sum of rows 4, 11, and 12)**	**687**		**1,291**		**687**		**1,291**	
14	Total NPV Lifetime Electric Energy Benefits	1,041		1,729		468		763	
15	Total NPV Lifetime Electric Capacity Benefits	282		667		127		292	
16	Total NPV Lifetime Operation and Maintenance (O&M) Benefits	0		0		0		0	
17	Total NPV Lifetime Non-Electric Benefits (Fossil Fuel, Water)	0		0		0		0	
18	**Total NPV TRC Benefits [7] (Sum of rows 14 through 17)**	**1,323**		**2,396**		**596**		**1,055**	
19	**TRC Benefit-Cost Ratio [8]**	**1.93**		**1.86**		**0.87**		**0.82**	

[1] Includes direct install equipment costs and costs for EE&C kits.

[2] Includes direct costs attributable to plan and advance the programs. Note: The design of the HERs program should be included here, while the actual development and mailing of HERs would be attributable to Program Delivery.
[3] Includes rebate processing, tracking system, general administration, program management, general management and legal, and technical assistance. Any common portfolio costs that are allocated across programs should be shown in this row.
[4] Includes the marketing CSP and marketing costs by program CSPs.
[5] Direct program implementation costs. Labor, fuel, and vehicle operation costs for appliance recycling and direct install programs. For behavioral programs, this includes the printing and postage of HERs.
[6] Total TRC Costs includes Total EDC Costs and Participant Costs.
[7] Total TRC Benefits equals the sum of Total Lifetime Electric and Non-Electric Benefits. 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. Savings carried over from Phase II are not included as a part of Total TRC Benefits for Phase III.
[8] TRC Ratio equals Total NPV TRC Benefits divided by Total NPV TRC Costs.
* Rows 1-11 are presented in nominal dollars

Table 64: Summary of Program Finances – Penn Power

Row #	Cost Category	Gross PYTD ($1,000)		Gross P3TD ($1,000)		Net PYTD ($1,000)		Net P3TD ($1,000)	
1	EDC Incentives to Participants [1]	86		151		86		151	
2	EDC Incentives to Trade Allies	0		0		0		0	
3	Participant Costs (net of incentives/rebates paid by utilities)	0		0		0		0	
4	**Incremental Measure Costs (Just row 3 for Appliance Recycling)**	**0**		**0**		**0**		**0**	
		EDC	CSP	EDC	CSP	EDC	CSP	EDC	CSP
5	Design & Development [2]	0	20	0	36	0	20	0	36
6	Administration, Management, and Technical Assistance [3]	11	39	25	72	11	39	25	72
7	Marketing [4]	3	40	7	70	3	40	7	70
8	Program Delivery [5]	0	138	0	251	0	138	0	251
9	EDC Evaluation Costs	5		12		5		12	
10	SWE Audit Costs	5		14		5		14	
11	**Program Overhead Costs (Sum of rows 5 through 10)**	**261**		**487**		**261**		**487**	
12	NPV of increases in costs of natural gas (or other fuels) for fuel switching programs	0		0		0		0	
13	**Total NPV TRC Costs [6] (Net present value of sum of rows 4, 11, and 12)**	**261**		**470**		**261**		**470**	
14	Total NPV Lifetime Electric Energy Benefits	342		566		198		308	
15	Total NPV Lifetime Electric Capacity Benefits	92		160		53		87	
16	Total NPV Lifetime Operation and Maintenance (O&M) Benefits	0		0		0		0	
17	Total NPV Lifetime Non-Electric Benefits (Fossil Fuel, Water)	0		0		0		0	
18	**Total NPV TRC Benefits [7] (Sum of rows 14 through 17)**	**434**		**725**		**252**		**395**	
19	**TRC Benefit-Cost Ratio [8]**	**1.66**		**1.54**		**0.96**		**0.84**	

[1] Includes direct install equipment costs and costs for EE&C kits.
[2] Includes direct costs attributable to plan and advance the programs. Note: The design of the HERs program should be included here, while the actual development and mailing of HERs would be attributable to Program Delivery.
[3] Includes rebate processing, tracking system, general administration, program management, general management and legal, and technical assistance. Any common portfolio costs that are allocated across programs should be shown in this row.
[4] Includes the marketing CSP and marketing costs by program CSPs.
[5] Direct program implementation costs. Labor, fuel, and vehicle operation costs for appliance recycling and direct install programs. For behavioral programs, this includes the printing and postage of HERs.
[6] Total TRC Costs includes Total EDC Costs and Participant Costs.
[7] Total TRC Benefits equals the sum of Total Lifetime Electric and Non-Electric Benefits. 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. Savings carried over from Phase II are not included as a part of Total TRC Benefits for Phase III.
[8] TRC Ratio equals Total NPV TRC Benefits divided by Total NPV TRC Costs.
* Rows 1-11 are presented in nominal dollars

Table 65: Summary of Program Finances – WPP

Row #	Cost Category	Gross PYTD ($1,000)		Gross P3TD ($1,000)		Net PYTD ($1,000)		Net P3TD ($1,000)	
1	EDC Incentives to Participants [1]	308		568		308		568	
2	EDC Incentives to Trade Allies	0		0		0		0	
3	Participant Costs (net of incentives/rebates paid by utilities)	0		0		0		0	
4	**Incremental Measure Costs (Just row 3 for Appliance Recycling)**	**0**		**0**		**0**		**0**	
		EDC	CSP	EDC	CSP	EDC	CSP	EDC	CSP
5	Design & Development [2]	0	60	0	112	0	60	0	112
6	Administration, Management, and Technical Assistance [3]	43	120	102	223	43	120	102	223
7	Marketing [4]	13	143	28	266	13	143	28	266
8	Program Delivery [5]	0	419	0	780	0	419	0	780
9	EDC Evaluation Costs	19		49		19		49	
10	SWE Audit Costs	18		49		18		49	
11	**Program Overhead Costs (Sum of rows 5 through 10)**	**835**		**1,609**		**835**		**1,609**	
12	NPV of increases in costs of natural gas (or other fuels) for fuel switching programs	0		0		0		0	
13	**Total NPV TRC Costs [6] (Net present value of sum of rows 4, 11, and 12)**	**835**		**1,557**		**835**		**1,557**	
14	Total NPV Lifetime Electric Energy Benefits	1,404		2,420		716		1,168	
15	Total NPV Lifetime Electric Capacity Benefits	378		695		193		334	
16	Total NPV Lifetime Operation and Maintenance (O&M) Benefits	0		0		0		0	
17	Total NPV Lifetime Non-Electric Benefits (Fossil Fuel, Water)	0		0		0		0	
18	**Total NPV TRC Benefits [7] (Sum of rows 14 through 17)**	**1,782**		**3,115**		**909**		**1,502**	
19	**TRC Benefit-Cost Ratio [8]**	**2.14**		**2.00**		**1.09**		**0.96**	

[1] Includes direct install equipment costs and costs for EE&C kits.
[2] Includes direct costs attributable to plan and advance the programs. Note: The design of the HERs program should be included here, while the actual development and mailing of HERs would be attributable to Program Delivery.
[3] Includes rebate processing, tracking system, general administration, program management, general management and legal, and technical assistance. Any common portfolio costs that are allocated across programs should be shown in this row.
[4] Includes the marketing CSP and marketing costs by program CSPs.
[5] Direct program implementation costs. Labor, fuel, and vehicle operation costs for appliance recycling and direct install programs. For behavioral programs, this includes the printing and postage of HERs.
[6] Total TRC Costs includes Total EDC Costs and Participant Costs.
[7] Total TRC Benefits equals the sum of Total Lifetime Electric and Non-Electric Benefits. 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. Savings carried over from Phase II are not included as a part of Total TRC Benefits for Phase III.
[8] TRC Ratio equals Total NPV TRC Benefits divided by Total NPV TRC Costs.
* Rows 1-11 are presented in nominal dollars

3.1.7 Status of Recommendations

The impact and process evaluation activities in PY9 led to the following findings and recommendations from Tetra Tech to the Companies, along with a summary of how the Companies plan to address the recommendation in program delivery.

Finding #1: As was the case in PY8, bill inserts continue to be the most common source of program information. Approximately 58 percent of respondents indicated bill inserts as a source of program information.

Recommendation #1: Continue to market the program through bill inserts and consider other marketing channels if additional participation is needed.

EDC Status Report #1: Recommendation accepted.

Finding #2: Program satisfaction remains high. About 75 percent of respondents reported they were "very satisfied" with program overall, with a mean score of 4.7 out of 5. This is the same mean rating as PY8. A follow-up question was asked of those reporting being dissatisfied with the program. Pick up delays, meaning the pick-up did not occur within the timeframe provided, and bad pick up experiences (e.g., damage to home, impolite staff) were the most frequently mentioned reasons for dissatisfaction.

Recommendation #2: Continue to operate the program with the current design. Work with the ICSP to address the areas of dissatisfaction as a focus to improve customer service

EDC Status Report #2: Recommendation accepted.

Finding #3: The participant survey resulted in an overall net-to-gross (NTG) ratio of 50 percent for the program. NTG values for individual FirstEnergy EDCs range from 45 to 58 percent. Overall NTG in PY8 was 49 percent.

3.2 ENERGY EFFICIENT HOMES PROGRAM

The Energy Efficiency Homes Program has four distinct program components: Energy Efficiency Kits (EE Kits), Home Energy Reports, Residential Direct Install, and New Homes.

The EE Kits component has two subcomponents: Energy Efficiency Kits distributed by PowerDirect, and School Education Kits distributed by AM Conservation Group (AMCG). Customers that received energy efficiency kits from PowerDirect either completed an online audit, phone audit, or submitted an online or telephonic request. Customers that received kits from the School Education program had students that completed a special energy efficiency curriculum developed by AMGC. The participant counts for this program component are equal to the overall count of kits distributed by each program.

The Home Energy Reports program component is administered by Oracle (formerly Opower). Home energy reports provide customers with comparative electric energy usage data and offer tips and advice on behavioral and low-cost energy saving measures. The number of participants for this program component is taken as the maximum number of participants in the treatment group during the year.

The Companies have retained GoodCents to administer the Direct Install (branded as Home Audit) component in Phase III. Through this program component, customers receive diagnostic assessments, followed by the direct installation of low-cost measures or incentivized installation of building shell measures. The participant count for this program component is equal to the number of rebate homes treated in the program.

The New Homes component is again administered by Performance System Development (PSD). The New Homes program 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 participant count for the New Homes program component is equal to the number of houses (or in the case of multifamily housing, the number of dwelling units).

The program also includes a Behavioral Demand Response (BDR) program component, which is administered by Oracle. The BDR program component is discussed separately in Section 3.8. However, costs and benefits for BDR are included in the EE Homes cost effectiveness tables in Section 3.2.6.

3.2.1 Participation and Reported Savings by Customer Segment

Table 66 presents the participation counts, reported energy and demand savings, and incentive payments for the Energy Efficient Homes Program in PY9 by customer segment and EDC. This program serves only the residential customer segment. The EE&C portfolios include separate and corresponding program components, administered by the same ICSPs, to serve the low-income residential customer segment.

Table 66: EEH Program Participation and Reported Impacts

Parameter	Met-Ed Residential (Non-LI)	Penelec Residential (Non-LI)	Penn Power Residential (Non-LI)	WPP Residential (Non-LI)
PYTD # Participants	201,042	198,065	41,598	222,875
PYRTD MWh/yr	54,239	37,281	12,282	54,502
PYRTD MW/yr	6.72	4.92	1.96	7.98
PYTD Incentives ($1000)	3,292.52	2,601.08	1,032.94	3,259.99

3.2.2 Gross Impact Evaluation

Each program component is treated as a separate evaluation initiative. The gross impact evaluation of the EE Kits Initiative is described in Appendix E. The impact evaluation of the HER Initiative is described in Appendix E. The impact evaluation of the Res DI Initiative is described in Appendix G. The impact evaluation of the Res NC Initiative is described in Table 67 summarizes program verified impacts and realization rates for each EDC.

Table 67: EEH Program Gross Impact Evaluation Summary for PY9

EDC	Sampling Initiative	Gross Verified MWh	Gross Verified MW	MWh Realization Rate	MW Realization Rate
Met-Ed	EE Kits	25,230	2.90	128.3%	133.5%
Met-Ed	Home Energy Reports	33,997	3.84	102.3%	93.8%
Met-Ed	Direct Install	111	0.01	92.1%	100.2%
Met-Ed	New Homes	909	0.63	74.2%	146.7%
Met-Ed Total		**60,247**	**7.39**	**111%**	**110%**
Penelec	EE Kits	22,491	2.37	122.1%	131.1%
Penelec	Home Energy Reports	19,346	2.18	104.2%	71.7%
Penelec	Direct Install	122	0.01	124.6%	108.1%
Penelec	New Homes	131	0.08	70.2%	126.5%
PenelecTotal		**42,091**	**4.64**	**113%**	**94%**
Penn Power	EE Kits	6,613	0.79	121.7%	133.0%
Penn Power	Home Energy Reports	6,304	0.71	106.6%	74.6%
Penn Power	Direct Install	48	0.01	115.6%	110.3%
Penn Power	New Homes	717	0.53	80.4%	130.0%
Penn PowerTotal		**13,683**	**2.04**	**111%**	**104%**
WPP	EE Kits	24,290	3.00	123.3%	128.8%
WPP	Home Energy Reports	31,407	3.50	94.7%	69.8%
WPP	Direct Install	141	0.02	117.5%	122.4%
WPP	New Homes	1,170	0.92	77.5%	147.9%
WPP Total		**57,009**	**7.44**	**105%**	**93%**

The gross realization rates for energy savings were driven primarily by part-use factors for refrigerators and freezers as determined through verification surveys, and by the unit energy consumptions for refrigerators and freezers, as determined through measure attributes recorded in the tracking and reporting system. Although verification rates determined through surveys

were approximately 100%, the realization rates are generally lower than 100% because the part-use factors are lower than the TRM default values, and the calculated unit energy consumptions were lower than what would expect from application of default parameters in the TRM.

3.2.3 Net Impact Evaluation

Tetra-Tech conducted a Net-to-Gross evaluation for the EE Kits Initiative in PY8. The net impact evaluation for the EE Kits Initiative is described in Appendix E.2. Net Impact Evaluation was not conducted for the other three program components in PY8. The NTG for the HER program is estimated to be 1.0, which is a feature of the randomized control trial gross impact evaluation approach[8]. In PY8, the NTG for the Res DI and Res NC Initiatives were estimated as 0.5 for the purpose net cost effectiveness calculations. These two program components, when combined, account for less than 4% of the gross impacts for the Energy Efficiency Homes Program, and as such they have not been scheduled for NTG research in PY8 or PY9. NTG studies for these two Initiatives are planned for PY10. We have updated our NTG estimates for these program components in PY9 to increase reporting rigor until the formal NTG results are available in PY10. For the New Homes program, Tetra Tech conducted secondary NTG research and found that the average evaluated NTG for six comparable programs (two in PA, two in MD, one in MO and one in UT) is 0.6. This value is used for cost effectiveness calculations of the New Homes program component in PY9. For the Direct Install program component, we reviewed gross impacts and found that 87% of gross impacts are attributable to lighting, showerheads, aerators, night lights, and smart strips. These are measures that are included in the Energy Efficiency Kits, and net-to-gross data for kits are available from the PY8 NTG effort. The remaining 13% of gross impacts are attributable to attic insulation, air sealing, and wall insulation. In the absence of a formal NTG study for the Direct Install program component, the NTG value of 0.82 for kits is applied as a proxy, rather than the 0.5 value applied in PY8.

Table 68 summarizes program verified gross and net energy impacts and net-to-gross ratios for each EDC.

[8] This estimation assumes that non-participant spillover is negligible.

Table 68: EEH Program Net Impact Evaluation Summary for PY9

EDC	Sampling Initiative	Gross Verified MWh	NTG	Net Verified MWh
Met-Ed	EE Kits	25,230	82.0%	20,688
Met-Ed	Home Energy Reports	33,997	100.0%	33,997
Met-Ed	Direct Install	111	82.3%	91
Met-Ed	New Homes	909	60.0%	545
Met-Ed Total		**60,247**	**91.8%**	**55,322**
Penelec	EE Kits	22,491	83.0%	18,668
Penelec	Home Energy Reports	19,346	100.0%	19,346
Penelec	Direct Install	122	82.3%	100
Penelec	New Homes	131	60.0%	79
Penelec Total		**42,091**	**90.7%**	**38,193**
Penn Power	EE Kits	6,613	82.0%	5,423
Penn Power	Home Energy Reports	6,304	100.0%	6,304
Penn Power	Direct Install	48	82.3%	40
Penn Power	New Homes	717	60.0%	430
Penn Power Total		**13,683**	**89.1%**	**12,197**
WPP	EE Kits	24,290	82.0%	19,918
WPP	Home Energy Reports	31,407	100.0%	31,407
WPP	Direct Install	141	82.3%	116
WPP	New Homes	1,170	60.0%	702
WPP Total		**57,009**	**91.5%**	**52,143**

3.2.3.1 High-Impact Measure Research

The EE Kits Initiative, which includes the EE Kits distributed in the Energy Efficient Homes Program, was treated as a High-Impact Measure for Net Impact Evaluation purposes in PY8. Details of the net impact evaluation can be found in Appendix E.2. No Initiatives from this program have been designated as high impact measures for PY9, as the only other program element with high impacts is Home Energy Reports, which has a net-to-gross of approximately 1.0 (and deemed to be such) because of the gross impact evaluation methodology.

3.2.4 Verified Savings Estimates

In Table 69 the realization rates and net-to-gross ratios determined by ADM and Tetra Tech team are applied to the reported energy and demand savings estimates to calculate the verified savings estimates for the Energy Efficient Homes Program] in PY9. These totals are added to the verified savings achieved in previous program years to calculate the P3TD program impacts.

Table 69: PYTD and P3TD Savings Summary

Savings Type	Met-Ed		Penelec		Penn Power		WPP	
	Energy (MWh/yr)	Demand (MW/yr)	Energy (MWh/yr)	Demand (MW/yr)	Energy (MWh/yr)	Demand (MW/yr)	Energy (MWh/yr)	Demand (MW/yr)
PYRTD	54,239	6.72	37,281	4.92	12,282	1.96	54,502	7.98
PYVTD Gross	60,247	7.39	42,091	4.64	13,683	2.04	57,009	7.44
PYVTD Net	55,322	6.61	38,193	4.20	12,197	1.68	52,143	6.53
RTD	102,365	13.27	75,804	9.88	23,184	3.68	99,721	14.99
VTD Gross	113,816	13.61	87,196	9.54	26,565	3.79	105,300	13.37
VTD Net	104,767	12.24	79,155	8.64	23,761	3.13	97,467	11.89

3.2.5 Process Evaluation

Process evaluation activities were conducted for the EE Kits and Home Energy Reports program components in PY8, and for the New Homes component in PY9. The participant survey sample design for multi-year process evaluation effort is shown in Table 70. Note that the participant counts correspond to PY8 and PY9, depending on the survey effort, although most Home Energy Report participants are the same from year to year.

Table 70: EEH Program Process Evaluation Sample Design

EDC	Population Size	Achieved Sample Size	Response Rate
ME-Kits	61,344	172	14%
PN-Kits	54,474	171	14%
PP-Kits	16,105	181	15%
WP-Kits	58,301	193	16%
ME-Behavioral	152,288	195	10%
PN-Behavioral	161,348	201	10%
PP-Behavioral	28,035	202	10%
WP-Behavioral	179,934	203	10%
Behavioral (Phase II Only)	250,590	114	6%
Program Total	**962,419**	**1,632**	**11.0%**

Key findings and recommendations are listed in Section 3.2.7.

3.2.5.1 Kits

The Energy Efficient Homes programs contains several subprograms that deliver kits of energy-efficient measures to customers through different channels. The evaluation began with program staff and ICSP interviews, and the bulk of the evaluation was conducted through a participant survey. The participant survey was administered through a combination of web and phone. Researchable issues for the kits sub-programs focused on participant satisfaction, program marketing, and awareness. The sample for the survey was randomly selected for each EDC.

3.2.5.2 Behavioral

We conducted both qualitative and quantitative research as part of the process evaluation activities. The qualitative research included semi-structured interviews with FirstEnergy program managers and the program implementer. A survey of participating customers was the primary source of data to assess experiences of participants and their engagement with the program. The survey was primarily a quantitative study, but we asked open-ended questions to provide context for the quantitative results.

FirstEnergy and ICSP staff noted a low drop-out rate, and low volume of feedback from participants to the program, suggesting that there are not issues that cause participants to be dissatisfied. Both FirstEnergy and the ICSP felt the program design was working well, which is unchanged since Phase II. The participant survey provided consistent findings. The participant survey researched customer engagement with the home energy reports, energy-saving behaviors, and barriers to energy-saving behaviors. The survey sample was randomly selected for each EDC from all customers receiving home energy reports, including a stratum for the low-income subprogram. An additional, smaller stratum was contacted who received reports during Phase II but was discontinued in Phase III. These customers proved particularly unresponsive to the survey.

3.2.5.3 New Homes

The process evaluation effort included a documentation review and interviews. The documentation review included reviews of sample rebate applications, of the program website, and of FirstEnergy's program implementation plan. FirstEnergy program managers were interviewed first, followed by an interview with managers at Performance Systems Development, Inc. (PSD), the program implementer. Tetra Tech also conducted in-depth interviews with nine participating builders and four participating HERS raters. Both the builders and raters reported high satisfaction rates with program communications via PSD and had positive feedback regarding steps that PSD has taken to reduce the rebate application burden. One of the biggest changes between the previous process evaluation of the FirstEnergy PA New Homes program and this PY9 evaluation was the rate of participation in ENERGY STAR® certifications. All interviewed builders observed that the value of the ENERGY STAR® New Home Certification was declining, and many reported their intention to create their own energy efficiency packages.

3.2.6 Cost-Effectiveness Reporting

A detailed breakdown of program finances and cost-effectiveness is presented Table 71, Table 72, Table 73, and Table 74 for Met-Ed, Penelec, Penn Power, and WPP respectively. The last two columns of the tables show benefits as calculated with net verified impacts, along with net participant costs (if applicable). The third and fourth columns show results as calculated on a gross basis. PYTD costs and benefits are net present values (NPV) expressed in 2017 dollars. NPV costs and benefits for P3TD financials are expressed in the 2016 dollars. Note that the program costs and benefits include costs and benefits for the Behavioral Demand Response

program component. The Behavioral Demand Response benefits and costs are also reported individually in Section 3.8.5.

Table 71: Summary of Program Finances – Met-Ed

Row #	Cost Category	Gross PYTD ($1,000)		Gross P3TD ($1,000)		Net PYTD ($1,000)		Net P3TD ($1,000)	
1	EDC Incentives to Participants [1]	3,293		5,927		3,293		5,927	
2	EDC Incentives to Trade Allies	0		0		0		0	
3	Participant Costs (net of incentives/rebates paid by utilities)	1,749		2,841		1,293		1,839	
4	**Incremental Measure Costs (Sum of rows 1 through 3)**	**5,041**		**8,768**		**4,586**		**7,766**	
		EDC	CSP	EDC	CSP	EDC	CSP	EDC	CSP
5	Design & Development [2]	0	221	1	633	0	221	1	633
6	Administration, Management, and Technical Assistance [3]	151	751	365	2,259	151	751	365	2,259
7	Marketing [4]	11	264	25	504	11	264	25	504
8	Program Delivery [5]	0	619	0	1,480	0	619	0	1,480
9	EDC Evaluation Costs	146		209		146		209	
10	SWE Audit Costs	66		181		66		181	
11	**Program Overhead Costs (Sum of rows 5 through 10)**	**2,230**		**5,658**		**2,230**		**5,658**	
12	NPV of increases in costs of natural gas (or other fuels) for fuel switching programs	0		0		0		0	
13	**Total NPV TRC Costs [6] (Net present value of sum of rows 4, 11, and 12)**	**7,272**		**13,973**		**6,816**		**13,000**	
14	Total NPV Lifetime Electric Energy Benefits	8,184		14,665		6,863		12,273	
15	Total NPV Lifetime Electric Capacity Benefits	2,476		5,336		1,979		4,276	
16	Total NPV Lifetime Operation and Maintenance (O&M) Benefits	121		114		73		68	
17	Total NPV Lifetime Non-Electric Benefits (Fossil Fuel, Water)	4,278		4,012		3,508		3,290	
18	**Total NPV TRC Benefits [7] (Sum of rows 14 through 17)**	**15,060**		**24,127**		**12,423**		**19,908**	
19	**TRC Benefit-Cost Ratio [8]**	**2.07**		**1.73**		**1.82**		**1.53**	

[1] Includes direct install equipment costs and costs for EE&C kits.
[2] Includes direct costs attributable to plan and advance the programs. Note: The design of the HERs program should be included here, while the actual development and mailing of HERs would be attributable to Program Delivery.
[3] Includes rebate processing, tracking system, general administration, program management, general management and legal, and technical assistance. Any common portfolio costs that are allocated across programs should be shown in this row.
[4] Includes the marketing CSP and marketing costs by program CSPs.
[5] Direct program implementation costs. Labor, fuel, and vehicle operation costs for appliance recycling and direct install programs. For behavioral programs, this includes the printing and postage of HERs.
[6] Total TRC Costs includes Total EDC Costs and Participant Costs.
[7] Total TRC Benefits equals the sum of Total Lifetime Electric and Non-Electric Benefits. 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. Savings carried over from Phase II are not included as a part of Total TRC Benefits for Phase III.
[8] TRC Ratio equals Total NPV TRC Benefits divided by Total NPV TRC Costs.
* Rows 1-11 are presented in nominal dollars

Table 72: Summary of Program Finances – Penelec

Row #	Cost Category	Gross PYTD ($1,000)		Gross P3TD ($1,000)		Net PYTD ($1,000)		Net P3TD ($1,000)	
1	EDC Incentives to Participants [1]	2,601		5,116		2,601		5,116	
2	EDC Incentives to Trade Allies	0		0		0		0	
3	Participant Costs (net of incentives/rebates paid by utilities)	1,552		1,806		1,252		1,379	
4	**Incremental Measure Costs (Sum of rows 1 through 3)**	**4,153**		**6,922**		**3,853**		**6,495**	
		EDC	CSP	EDC	CSP	EDC	CSP	EDC	CSP
5	Design & Development [2]	0	200	1	612	0	200	1	612
6	Administration, Management, and Technical Assistance [3]	143	713	358	2,237	143	713	358	2,237
7	Marketing [4]	13	219	27	441	13	219	27	441
8	Program Delivery [5]	0	468	0	1,271	0	468	0	1,271
9	EDC Evaluation Costs	138		192		138		192	
10	SWE Audit Costs	64		176		64		176	
11	**Program Overhead Costs (Sum of rows 5 through 10)**	**1,958**		**5,314**		**1,958**		**5,314**	
12	NPV of increases in costs of natural gas (or other fuels) for fuel switching programs	0		0		0		0	
13	**Total NPV TRC Costs [6] (Net present value of sum of rows 4, 11, and 12)**	**6,111**		**11,849**		**5,811**		**11,441**	
14	Total NPV Lifetime Electric Energy Benefits	6,280		12,714		5,337		10,799	
15	Total NPV Lifetime Electric Capacity Benefits	1,529		4,226		1,289		3,541	
16	Total NPV Lifetime Operation and Maintenance (O&M) Benefits	37		35		22		21	
17	Total NPV Lifetime Non-Electric Benefits (Fossil Fuel, Water)	3,585		3,358		2,974		2,785	
18	**Total NPV TRC Benefits [7] (Sum of rows 14 through 17)**	**11,431**		**20,332**		**9,622**		**17,146**	
19	**TRC Benefit-Cost Ratio [8]**	**1.87**		**1.72**		**1.66**		**1.50**	

[1] Includes direct install equipment costs and costs for EE&C kits.

[2] Includes direct costs attributable to plan and advance the programs. Note: The design of the HERs program should be included here, while the actual development and mailing of HERs would be attributable to Program Delivery.
[3] Includes rebate processing, tracking system, general administration, program management, general management and legal, and technical assistance. Any common portfolio costs that are allocated across programs should be shown in this row.
[4] Includes the marketing CSP and marketing costs by program CSPs.
[5] Direct program implementation costs. Labor, fuel, and vehicle operation costs for appliance recycling and direct install programs. For behavioral programs, this includes the printing and postage of HERs.
[6] Total TRC Costs includes Total EDC Costs and Participant Costs.
[7] Total TRC Benefits equals the sum of Total Lifetime Electric and Non-Electric Benefits. 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. Savings carried over from Phase II are not included as a part of Total TRC Benefits for Phase III.
[8] TRC Ratio equals Total NPV TRC Benefits divided by Total NPV TRC Costs.
* Rows 1-11 are presented in nominal dollars

Table 73: Summary of Program Finances – Penn Power

Row #	Cost Category	Gross PYTD ($1,000)		Gross P3TD ($1,000)		Net PYTD ($1,000)		Net P3TD ($1,000)	
1	EDC Incentives to Participants [1]	1,033		1,859		1,033		1,859	
2	EDC Incentives to Trade Allies	0		0		0		0	
3	Participant Costs (net of incentives/rebates paid by utilities)	896		1,639		587		958	
4	**Incremental Measure Costs (Sum of rows 1 through 3)**	**1,929**		**3,499**		**1,619**		**2,817**	
		EDC	CSP	EDC	CSP	EDC	CSP	EDC	CSP
5	Design & Development [2]	0	75	0	163	0	75	0	163
6	Administration, Management, and Technical Assistance [3]	49	208	151	510	49	208	151	510
7	Marketing [4]	2	87	5	159	2	87	5	159
8	Program Delivery [5]	0	349	0	587	0	349	0	587
9	EDC Evaluation Costs	98		122		98		122	
10	SWE Audit Costs	20		55		20		55	
11	**Program Overhead Costs (Sum of rows 5 through 10)**	**889**		**1,752**		**889**		**1,752**	
12	NPV of increases in costs of natural gas (or other fuels) for fuel switching programs	0		0		0		0	
13	**Total NPV TRC Costs [6] (Net present value of sum of rows 4, 11, and 12)**	**2,817**		**5,069**		**2,508**		**4,408**	
14	Total NPV Lifetime Electric Energy Benefits	2,189		3,978		1,775		3,201	
15	Total NPV Lifetime Electric Capacity Benefits	1,091		1,842		846		1,365	
16	Total NPV Lifetime Operation and Maintenance (O&M) Benefits	111		104		67		62	
17	Total NPV Lifetime Non-Electric Benefits (Fossil Fuel, Water)	875		819		718		672	
18	**Total NPV TRC Benefits [7] (Sum of rows 14 through 17)**	**4,266**		**6,744**		**3,406**		**5,299**	
19	**TRC Benefit-Cost Ratio [8]**	**1.51**		**1.33**		**1.36**		**1.20**	

[1] Includes direct install equipment costs and costs for EE&C kits.
[2] Includes direct costs attributable to plan and advance the programs. Note: The design of the HERs program should be included here, while the actual development and mailing of HERs would be attributable to Program Delivery.
[3] Includes rebate processing, tracking system, general administration, program management, general management and legal, and technical assistance. Any common portfolio costs that are allocated across programs should be shown in this row.
[4] Includes the marketing CSP and marketing costs by program CSPs.
[5] Direct program implementation costs. Labor, fuel, and vehicle operation costs for appliance recycling and direct install programs. For behavioral programs, this includes the printing and postage of HERs.
[6] Total TRC Costs includes Total EDC Costs and Participant Costs.
[7] Total TRC Benefits equals the sum of Total Lifetime Electric and Non-Electric Benefits. 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. Savings carried over from Phase II are not included as a part of Total TRC Benefits for Phase III.
[8] TRC Ratio equals Total NPV TRC Benefits divided by Total NPV TRC Costs.
* Rows 1-11 are presented in nominal dollars

Table 74: Summary of Program Finances – WPP

Row #	Cost Category	Gross PYTD ($1,000)		Gross P3TD ($1,000)		Net PYTD ($1,000)		Net P3TD ($1,000)	
1	EDC Incentives to Participants [1]	3,260		5,128		3,260		5,128	
2	EDC Incentives to Trade Allies	0		0		0		0	
3	Participant Costs (net of incentives/rebates paid by utilities)	2,426		3,548		1,775		2,336	
4	**Incremental Measure Costs (Sum of rows 1 through 3)**	**5,686**		**8,676**		**5,035**		**7,464**	
		EDC	CSP	EDC	CSP	EDC	CSP	EDC	CSP
5	Design & Development [2]	0	236	1	687	0	236	1	687
6	Administration, Management, and Technical Assistance [3]	188	826	440	2,514	188	826	440	2,514
7	Marketing [4]	8	256	19	449	8	256	19	449
8	Program Delivery [5]	0	566	0	1,363	0	566	0	1,363
9	EDC Evaluation Costs	147		204		147		204	
10	SWE Audit Costs	61		168		61		168	
11	**Program Overhead Costs (Sum of rows 5 through 10)**	**2,289**		**5,846**		**2,289**		**5,846**	
12	NPV of increases in costs of natural gas (or other fuels) for fuel switching programs	0		0		0		0	
13	**Total NPV TRC Costs [6] (Net present value of sum of rows 4, 11, and 12)**	**7,975**		**14,023**		**7,324**		**12,851**	
14	Total NPV Lifetime Electric Energy Benefits	7,677		12,354		6,421		10,340	
15	Total NPV Lifetime Electric Capacity Benefits	2,669		4,455		2,084		3,475	
16	Total NPV Lifetime Operation and Maintenance (O&M) Benefits	178		167		107		100	
17	Total NPV Lifetime Non-Electric Benefits (Fossil Fuel, Water)	4,017		3,765		3,294		3,088	
18	**Total NPV TRC Benefits [7] (Sum of rows 14 through 17)**	**14,541**		**20,741**		**11,907**		**17,003**	
19	**TRC Benefit-Cost Ratio [8]**	**1.82**		**1.48**		**1.63**		**1.32**	

[1] Includes direct install equipment costs and costs for EE&C kits.
[2] Includes direct costs attributable to plan and advance the programs. Note: The design of the HERs program should be included here, while the actual development and mailing of HERs would be attributable to Program Delivery.
[3] Includes rebate processing, tracking system, general administration, program management, general management and legal, and technical assistance. Any common portfolio costs that are allocated across programs should be shown in this row.
[4] Includes the marketing CSP and marketing costs by program CSPs.
[5] Direct program implementation costs. Labor, fuel, and vehicle operation costs for appliance recycling and direct install programs. For behavioral programs, this includes the printing and postage of HERs.
[6] Total TRC Costs includes Total EDC Costs and Participant Costs.
[7] Total TRC Benefits equals the sum of Total Lifetime Electric and Non-Electric Benefits. 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. Savings carried over from Phase II are not included as a part of Total TRC Benefits for Phase III.
[8] TRC Ratio equals Total NPV TRC Benefits divided by Total NPV TRC Costs.
* Rows 1-11 are presented in nominal dollars

3.2.7 Status of Recommendations

A process evaluation was conducted for the New Homs program component in PY9. The impact and process evaluation activities for this program component in PY9 led to the following

findings and recommendations from Tetra Tech to the Companies along with a summary of how the Companies plan to address the recommendation in program delivery. The findings and recommendations from the PY8 evaluation effort are also retained below for completeness.

3.2.7.1 Energy Efficiency Kits

Finding #1: FirstEnergy customers participating across all the Kits subprograms report high levels of satisfaction (> 4 on a 5-pt scale) with all surveyed program components.

Recommendation #1: Continue to monitor program satisfaction in coordination with the ICSP and evaluation. No changes are needed because satisfaction suggests the program is operating smoothly.

EDC Status Report #1: Recommendation accepted.

Finding #2: Nearly half (48 percent) of Kits participants name e-mail as their preferred communication channel with their utility.

Recommendation #2: FirstEnergy should consider exploring e-mail marketing options for future campaigns given participants' comfort with electronic communications.

EDC Status Report #2: Recommendation accepted.

3.2.7.2 Home Energy Reports

The process evaluation resulted in several noteworthy findings and recommendations. Not all findings and recommendations have a one-to-one correspondence, therefore the findings are disclosed first, followed by recommendations.

Finding #1: Program participants express high levels of satisfaction with the overall quality of service provided by their utility.

Finding #2: Customer engagement with the Home Energy Reports (HERs) is high. Most households read the reports and say they have read all or almost all of the reports they have been sent. Readership is somewhat higher among low-income households.

Finding #3: Program participants engage in energy-saving behaviors and about 30 to 40 percent report doing these things more now than in previous years. Low-Income participants are somewhat more likely to engage in the energy-saving actions that were measured by the survey.

Finding #4: The main barriers to doing more to save energy are the cost of doing things and finding the time to do things. Knowing what to do, or how to prioritize their actions, is also a significant barrier as participants report they need more detailed tips or itemization of the main energy consuming equipment in their homes.

Finding #5: Participants generally rate the HERs positively, but they express concerns about the accuracy of the neighbor comparison and feel the tips can be too general or repetitive. Some suggestions for improvement are available from the program (e.g., electronic access) or through other FirstEnergy programs (e.g., home energy audits).

Recommendation #1: Continue the program and continue sending the HERs regularly. Many participants find the information useful and motivational. They study the reports for ideas on what to do to save energy and, even if the suggestions are already known to them, find the HERs to be helpful reminders.

EDC Status Report #1: Recommendation accepted.

Recommendation #2: Work with the program implementer to identify ways to present a "model" or "typical" household that defines its characteristics, how it is equipped, and the actions taken to save energy. Participants are eager to better understand the neighbor comparison or what the "most efficient" households represent, but there is limited information provided by the program implementer for participants to understand the comparison group. Providing participants with a "model household" and enumerating how the characteristics of that home and its occupants achieve energy-savings can address participants' concerns and may yield additional energy-saving insights.

EDC Status Report #2: This is an interesting idea but is not in the scope of the current ICSP contract and cannot be accommodated within budgets negotiated with the ICSP.

Recommendation #3: Work with the program implementer to include charts comparing a household's energy consumption over time more often. The historical comparison of their own energy usage was deemed most useful by participants.

EDC Status Report #3: Recommendation accepted.

Recommendation #4: Work with the program implementer to raise awareness of electronic and online resources. Participants who cited concerns about the cost of paper reports or a desire for access to information online may be not be aware that HERs can be sent by email (including email-only options) or that the program has a web portal with more information.

EDC Status Report #4: Recommendation accepted.

Recommendation #5: Work with the program implementer to raise awareness about the availability and value of home energy audits. Participants seeking more detailed energy-saving tips mention a desire to know which of their appliances are using the most energy and how to prioritize their energy-saving investments. While promotion of other energy efficiency programs is already a component of the HERs, consider more prominent messaging that emphasizes that audits will provide more personalized and prioritized feedback.

EDC Status Report #5: Recommendation accepted.

3.2.7.3 New Homes

Finding #1: Participating program builder overall mean satisfaction has increased this program year (score of 4.3, compared to 3.0 in Phase II) on a scale of 1 to 5 where 1 was "very dissatisfied" and 5 was "very satisfied". Raters also report very high satisfaction with the program overall with a mean score of 4.75 on a 1 to 5 scale, where 1 is "very dissatisfied" and 5 is "very satisfied". Raters' satisfaction with PSD, remains very high, as it has been in previous years' evaluations.

Recommendation #1: Continue to monitor program satisfaction in coordination with the ICSP and evaluation. No changes are needed because satisfaction suggests the program is operating smoothly.

EDC Status Report #1: Recommendation accepted.

Finding #2: Builders reported key PY9 program changes improved their program participation experience. For example, nearly all builders are working with their raters in some way to submit program paperwork, thereby reducing a program barrier reported by interviewees in our Phase II evaluation. Participating raters also indicated the PY9 program changes have improved their participation experience. For example, raters report that taking ownership of the program paperwork experience (instead of the responsibility being with the builders, as it was in previous years) has provided an opportunity to show additional program value to the builders. In turn, the builders allocating a portion of their program incentive to their raters in exchange for this service has increased the rater satisfaction within this program

Recommendation #2: Continue to streamline rebate payment (such as encouraging more builders moving to direct deposit program payments) and monitor paperwork processes to continue to increase program participant satisfaction; PSD has notably improved program process for both builders and raters this year in terms of program paperwork and rebate processing.

EDC Status Report #2: Recommendation accepted.

Finding #3: Only one of nine builders we interviewed for PY9 reported seeking ENERGY STAR® certifications in the new homes they built for the program, and nearly all noted creating their own energy efficiency equipment packages or marketing messages for the program. All participating builders interviewed in our Phase II evaluation reported they observed the value of the ENERGY STAR® New Home Certification was declining in the market; many reported creating their own Energy Efficiency packages at that time.

Recommendation #3: PSD could consider increasing their focus in the near-term working with builders on their program marketing strategies as builders fine-tune their marketing messages and energy efficiency offerings outside of seeking ENERGY STAR® certifications. This could be done in two ways: PSD could focus on increasing builders' awareness of program-provided marketing materials and encouraging them to use those materials; or, PSD could work with builders on a case-by-case basis to assist in crafting more personalized marketing messages that promote the program and its offering.

EDC Status Report #3: Recommendation under consideration.

Finding #4: Builders who are aware of the PSD-offered communication tools are highly satisfied with the services. However, awareness of some program tools was low – such as the program web site, the COMPASS reservation system, or the builder dashboard –and these are not utilized by most builders interviewed for this evaluation.

Recommendation #4: The program has more opportunity to increase builders' and raters' awareness of program communication tools. While both builders and raters were highly satisfied with the program tools they were aware of, awareness of some program communication tools was low among both groups.

EDC Status Report #4: Recommendation accepted.

3.3 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. 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, efficient electric water heaters, and solar water heaters. The program also provides incentives to retailers for point of sale price cuts for customers purchasing energy efficient light bulbs and ENERGY STAR® qualified computers, printers, monitors, and televisions. The Companies have retained Honeywell to administer the program.

For the appliance's component of the program, the participant count is equal to the sum of Appliances rebated by the program. For the HVAC component, the participant count is equal to the sum of HVAC units and HVAC tune-ups rebated by the program. For the upstream electronics component of the program, the participant count is equal to the number of electronics equipment sold. For Upstream Lighting component of the program, the participant count is equal to the number of packs sold.

3.3.1 Participation and Reported Savings by Customer Segment

This program serves primarily the residential customer segment. However, some small commercial and GNI contributions result from "cross sector" sales, where a small fraction of the efficient lighting is purchased from participating retailers and installed in nonresidential settings. Table 75, Table 76, Table 77, and Table 78 present the participation counts, reported energy and demand savings, and incentive payments for the EEP Program in PY9 by customer segment and EDC.

Table 75: EEP Program Participation and Reported Impacts for Met-Ed

Parameter	Residential (Non-LI)	Small C&I (Non-GNI)	GNI	Total
PYTD # Participants	325,111	25,395	2,152	352,658
PYRTD MWh/yr	22,251	1,688	143	24,082
PYRTD MW/yr	2.82	0.20	0.02	3.04
PYTD Incentives ($1000)	1,596.12	93.81	7.95	1,698

Table 76: EEP Program Participation and Reported Impacts for Penelec

Parameter	Residential (Non-LI)	Small C&I (Non-GNI)	GNI	Total
PYTD # Participants	282,819	22,522	1,908	307,249
PYRTD MWh/yr	24,932	1,951	165	27,048
PYRTD MW/yr	2.85	0.21	0.02	3.07
PYTD Incentives ($1000)	1,399.91	91.02	7.71	1,499

Table 77: EEP Program Participation and Reported Impacts for Penn Power

Parameter	Residential (Non-LI)	Small C&I (Non-GNI)	GNI	Total
PYTD # Participants	92,759	7,146	606	100,510
PYRTD MWh/yr	9,451	737	62	10,250
PYRTD MW/yr	1.15	0.09	0.01	1.24
PYTD Incentives ($1000)	486.22	28.97	2.45	518

Table 78: EEP Program Participation and Reported Impacts for WPP

Parameter	Residential (Non-LI)	Small C&I (Non-GNI)	GNI	Total
PYTD # Participants	293,819	21,812	1,848	317,479
PYRTD MWh/yr	25,045	1,850	157	27,051
PYRTD MW/yr	3.46	0.24	0.02	3.72
PYTD Incentives ($1000)	1,735.71	88.89	7.53	1,832

3.3.2 Gross Impact Evaluation

This program is disaggregated into four initiatives for evaluation. The impact evaluation of the Upstream Lighting initiative is described in detail in Appendix I. The impact evaluation of the Upstream Electronics initiative is described in detail in Appendix J. The impact evaluation of the Res HVAC initiative is described in detail in Appendix K. The impact evaluation of the Res Appliances initiative is described in detail in Appendix L. Table 79 summarizes program verified impacts and realization rates for each EDC.

Table 79: EEP Program Gross Impact Evaluation Summary for PY9

EDC	Sampling Initiative	Gross Verified MWh	Gross Verified MW	MWh Realization Rate	MW Realization Rate
Met-Ed	Upstream Lighting	28,376	3.66	128.6%	139.8%
Met-Ed	Upstream Electronics	494	0.05	102.8%	98.2%
Met-Ed	HVAC	1,107	0.38	129.2%	135.2%
Met-Ed	Appliances	800	0.09	117.2%	111.0%
Met-Ed Total		**30,778**	**4.19**	**128%**	**138%**
Penelec	Upstream Lighting	30,424	3.59	119.3%	133.5%
Penelec	Upstream Electronics	230	0.02	100.4%	96.0%
Penelec	HVAC	881	0.16	120.7%	60.9%
Penelec	Appliances	709	0.11	120.0%	112.9%
PenelecTotal		**32,243**	**3.88**	**119%**	**126%**
Penn Power	Upstream Lighting	12,439	1.58	129.2%	141.1%
Penn Power	Upstream Electronics	170	0.02	99.9%	95.0%
Penn Power	HVAC	326	0.09	114.9%	121.8%
Penn Power	Appliances	209	0.03	126.3%	114.2%
Penn PowerTotal		**13,145**	**1.72**	**128%**	**139%**
WPP	Upstream Lighting	29,605	4.03	122.4%	130.1%
WPP	Upstream Electronics	830	0.09	103.4%	98.1%
WPP	HVAC	1,554	0.44	118.3%	105.8%
WPP	Appliances	963	0.14	127.6%	121.4%
WPP Total		**32,952**	**4.69**	**122%**	**126%**

The gross realization rates for energy savings were driven primarily by the realization rates of the upstream lighting programs. The reported impacts for upstream lighting are somewhat conservative because reported impacts do not include additional savings contributions from cross sector sales.

3.3.3 Net Impact Evaluation

Tetra-Tech conducted a Net-to-Gross evaluation for this program in PY8. The net impact evaluation of the Upstream Lighting Initiative is described in Appendix I.2. The NTG from Phase II is used in PY9 for the Upstream Electronics Initiative as described in Appendix J.2. The net impact evaluation for the Res HVAC Initiative is described in Appendix K.2. The NTG evaluation for the Res Appliances Initiative is described in Appendix L.2. Table 80 summarizes program verified gross and net energy impacts and net-to-gross ratios for each EDC.

Table 80: EEP Program Net Impact Evaluation Summary for PY9

EDC	Sampling Initiative	Gross Verified MWh	NTG	Net Verified MWh
Met-Ed	Upstream Lighting	28,376	37.0%	10,513
Met-Ed	Upstream Electronics	494	49.5%	245
Met-Ed	HVAC	1,107	45.0%	498
Met-Ed	Appliances	800	52.0%	416
Met-Ed Total		**30,778**	**37.9%**	**11,672**
Penelec	Upstream Lighting	30,424	33.8%	10,291
Penelec	Upstream Electronics	230	49.5%	114
Penelec	HVAC	881	52.0%	458
Penelec	Appliances	709	48.0%	340
Penelec Total		**32,243**	**34.7%**	**11,203**
Penn Power	Upstream Lighting	12,439	38.8%	4,827
Penn Power	Upstream Electronics	170	49.5%	84
Penn Power	HVAC	326	56.0%	183
Penn Power	Appliances	209	47.0%	98
Penn Power Total		**13,145**	**39.5%**	**5,192**
WPP	Upstream Lighting	29,605	26.6%	7,863
WPP	Upstream Electronics	830	49.5%	411
WPP	HVAC	1,554	49.0%	762
WPP	Appliances	963	50.0%	482
WPP Total		**32,952**	**28.9%**	**9,517**

3.3.3.1 High-Impact Measure Research

The Upstream Lighting Initiative was identified as a High-Impact Measure and researched for net-to-gross in PY8. The net impact evaluation of the Upstream Lighting Initiative is described in Appendix I.2.

3.3.4 Verified Savings Estimates

In Table 81 the realization rates and net-to-gross ratios determined by the ADM and Tetra Tech team are applied to the reported energy and demand savings estimates to calculate the verified savings estimates for the Energy Efficient Products Program in PY9. These totals are added to the verified savings achieved in previous program years to calculate the P3TD program impacts.

Table 81: PYTD and P3TD Savings Summary

	Met-Ed		Penelec		Penn Power		WPP	
Savings Type	Energy (MWh/yr)	Demand (MW/yr)	Energy (MWh/yr)	Demand (MW/yr)	Energy (MWh/yr)	Demand (MW/yr)	Energy (MWh/yr)	Demand (MW/yr)
PYRTD	24,082	3.04	27,048	3.07	10,250	1.24	27,051	3.72
PYVTD Gross	30,778	4.19	32,243	3.88	13,145	1.72	32,952	4.69
PYVTD Net	11,672	1.60	11,203	1.36	5,192	0.69	9,517	1.40
RTD	49,542	6.22	60,549	6.68	16,452	1.98	58,400	7.86
VTD Gross	61,603	8.36	71,484	8.63	21,041	2.76	70,047	9.87
VTD Net	23,328	3.19	24,731	3.01	8,323	1.10	19,973	2.89

3.3.5 Process Evaluation

Process evaluation activities were conducted for three of four program components in PY8. An additional retailed survey for the Appliances component was conducted in PY9. Process evaluation samples are combined over all four EDCs. The participant survey sample design for process evaluation shown in Table 82. Note that the population sizes in the table cross program years (Retailers from PY9, others from PY8), and participant counts may not correspond to the gross impact evaluation tables listed above. Process and Net Impact evaluation is planned for the fourth program element – Upstream Electronics, in PY10.

Table 82: EEP Program Process Evaluation Sample Design

EDC	Measure	Population Size	Achieved Sample Size	Response Rate
Met-Ed	Appliances and HVAC	5,765	150	26%
Penelec	Appliances and HVAC	4,460	144	26%
Penn Power	Appliances and HVAC	1,696	117	26%
WPP	Appliances and HVAC	6,866	146	26%
Met-Ed	Lighting	294,513	176	5.9%
Penelec	Lighting	360,025	169	5.6%
Penn Power	Lighting	60,029	183	6.1%
WPP	Lighting	328,833	143	4.8%
Met-Ed	Retailers	282	20	34.5%
Penelec	Retailers	350	13	23.6%
Penn Power	Retailers	242	23	39.7%
WPP	Retailers	88	15	29.4%
Program Total		**1,063,149**	**1,299**	**16.0%**

Key findings and recommendations are listed in Section 3.3.7.

3.3.5.1 Appliances & HVAC

The appliances and HVAC sub-programs were combined for process evaluation since they are both downstream delivery that provide incentives directly to customers. The process evaluation

kicked off with interviews of FirstEnergy and ICSP program staff. The evaluation followed up with a participant customer survey, delivered by web and phone. Researchable issues focused on program awareness and marketing, interactions with contractors and retailers, satisfaction, and participation in the low-income appliance component. The survey sample was randomly selected for each EDC. In PY9, the evaluation team conducted additional activities to inform the process evaluation, including a survey of participating retailers. Related results and recommendations are included in Section 3.3.7.

3.3.5.2 Lighting

The lighting sub-program process evaluation began with interviews with FirstEnergy and ICSP program staff. Additionally, the evaluation included a web survey of FirstEnergy residential customers to gather information on their awareness, perception, and preference of different types of lighting, purchase behaviors, and awareness of the FirstEnergy program. Because the program provides a discount on the purchase price as opposed to a customer incentive, participants do not need to be aware of the program to participate. The survey reached customers who likely participated, as well as some who did not.

3.3.6 Cost-Effectiveness Reporting

A detailed breakdown of program finances and cost-effectiveness is presented in Table 84, Table 85, Table 86, and Table 87 for Met-Ed, Penelec, Penn Power, and WPP respectively. The last two columns of the tables show benefits as calculated with net verified impacts, along with net participant costs (if applicable). The third and fourth columns show results as calculated on a gross basis. PYTD costs and benefits are net present values (NPV) expressed in 2017 dollars. NPV costs and benefits for P3TD financials are expressed in the 2016 dollars.

The TRCs presented in this report are considered conservative, as they reflect a dual baseline protocol for residential lighting measures consistent with the current TRM. The TRM specifies that "calculations for bulbs expected to be installed or remain in use past 2020. For these bulbs, [post EISA 2007 baseline wattages] should be used for the savings calculations until 2020, followed by the [post 2020 baseline wattages] for the remainder of the measure life." The Companies note that since the TRM was adopted in 2015, there is growing uncertainty about the likelihood of DOE enforcement of EISA 2020 standard changes as well as the availability of pre-2020 baseline bulbs in the market. This has resulted in most states not adopting the prospective change in standards in cost effectiveness calculations, resulting in higher lifetime savings and benefits.

If TRCs were to not use the dual baselines, gross and net TRCs for the Energy Efficient Products program would increase by 32% to 39% depending on EDC. Gross and Net TRCs for the EE Products programs, with and without dual baseline treatment are presented in the following table:

Table 83 – Energy Efficient Products Program TRC with and without Dual Baseline Calculations

	Gross		Net	
EDC	Dual Baseline	Without Dual Baseline	Dual Baseline	Without Dual Baseline
Met-Ed	1.69	2.47	1.34	1.95
Penelec	2.06	3.03	1.52	2.21
Penn Power	2.17	3.22	1.77	2.60
WPP	1.41	2.25	0.93	1.43
Average	1.83	2.75	1.39	1.99

Table 84: Summary of Program Finances – Met-Ed

Row #	Cost Category	Gross PYTD ($1,000)		Gross P3TD ($1,000)		Net PYTD ($1,000)		Net P3TD ($1,000)	
1	EDC Incentives to Participants [1]	1,698		3,124		1,698		3,124	
2	EDC Incentives to Trade Allies	0		0		0		0	
3	Participant Costs (net of incentives/rebates paid by utilities)	5,427		10,090		1,244		2,335	
4	**Incremental Measure Costs (Sum of rows 1 through 3)**	**7,125**		**13,214**		**2,942**		**5,459**	
		EDC	CSP	EDC	CSP	EDC	CSP	EDC	CSP
5	Design & Development [2]	0	68	0	139	0	68	0	139
6	Administration, Management, and Technical Assistance [3]	3	135	32	275	3	135	32	275
7	Marketing [4]	8	51	14	183	8	51	14	183
8	Program Delivery [5]	0	474	0	962	0	474	0	962
9	EDC Evaluation Costs	110		179		110		179	
10	SWE Audit Costs	27		75		27		75	
11	**Program Overhead Costs (Sum of rows 5 through 10)**	**877**		**1,858**		**877**		**1,858**	
12	NPV of increases in costs of natural gas (or other fuels) for fuel switching programs	0		0		0		0	
13	**Total NPV TRC Costs [6] (Net present value of sum of rows 4, 11, and 12)**	**8,002**		**14,574**		**3,819**		**7,080**	
14	Total NPV Lifetime Electric Energy Benefits	7,473		14,471		2,855		5,519	
15	Total NPV Lifetime Electric Capacity Benefits	2,237		5,889		864		2,249	
16	Total NPV Lifetime Operation and Maintenance (O&M) Benefits	4,248		7,454		1,574		2,761	
17	Total NPV Lifetime Non-Electric Benefits (Fossil Fuel, Water)	-471		-1,519		-162		-551	
18	**Total NPV TRC Benefits [7] (Sum of rows 14 through 17)**	**13,487**		**26,295**		**5,131**		**9,978**	
19	**TRC Benefit-Cost Ratio [8]**	**1.69**		**1.80**		**1.34**		**1.41**	

[1] Includes direct install equipment costs and costs for EE&C kits.

[2] Includes direct costs attributable to plan and advance the programs. Note: The design of the HERs program should be included here, while the actual development and mailing of HERs would be attributable to Program Delivery.

[3] Includes rebate processing, tracking system, general administration, program management, general management and legal, and technical assistance. Any common portfolio costs that are allocated across programs should be shown in this row.

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

[5] Direct program implementation costs. Labor, fuel, and vehicle operation costs for appliance recycling and direct install programs. For behavioral programs, this includes the printing and postage of HERs.

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

[7] Total TRC Benefits equals the sum of Total Lifetime Electric and Non-Electric Benefits. 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. Savings carried over from Phase II are not included as a part of Total TRC Benefits for Phase III.

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

* Rows 1-11 are presented in nominal dollars

Table 85: Summary of Program Finances – Penelec

Row #	Cost Category	Gross PYTD ($1,000)		Gross P3TD ($1,000)		Net PYTD ($1,000)		Net P3TD ($1,000)	
1	EDC Incentives to Participants [1]	1,499		2,993		1,499		2,993	
2	EDC Incentives to Trade Allies	0		0		0		0	
3	Participant Costs (net of incentives/rebates paid by utilities)	3,900		7,887		596		1,138	
4	**Incremental Measure Costs (Sum of rows 1 through 3)**	**5,399**		**10,880**		**2,094**		**4,130**	
		EDC	CSP	EDC	CSP	EDC	CSP	EDC	CSP
5	Design & Development [2]	0	70	0	149	0	70	0	149
6	Administration, Management, and Technical Assistance [3]	2	138	42	296	2	138	42	296
7	Marketing [4]	8	34	13	170	8	34	13	170
8	Program Delivery [5]	0	483	0	1,036	0	483	0	1,036
9	EDC Evaluation Costs	108		172		108		172	
10	SWE Audit Costs	28		76		28		76	
11	**Program Overhead Costs (Sum of rows 5 through 10)**	**871**		**1,954**		**871**		**1,954**	
12	NPV of increases in costs of natural gas (or other fuels) for fuel switching programs	0		0		0		0	
13	**Total NPV TRC Costs [6] (Net present value of sum of rows 4, 11, and 12)**	**6,270**		**12,437**		**2,965**		**5,897**	
14	Total NPV Lifetime Electric Energy Benefits	7,396		16,381		2,603		5,727	
15	Total NPV Lifetime Electric Capacity Benefits	1,967		6,358		697		2,220	
16	Total NPV Lifetime Operation and Maintenance (O&M) Benefits	4,327		8,843		1,464		2,991	
17	Total NPV Lifetime Non-Electric Benefits (Fossil Fuel, Water)	-774		-2,568		-245		-853	
18	**Total NPV TRC Benefits [7] (Sum of rows 14 through 17)**	**12,917**		**29,013**		**4,518**		**10,085**	
19	**TRC Benefit-Cost Ratio [8]**	**2.06**		**2.33**		**1.52**		**1.71**	

[1] Includes direct install equipment costs and costs for EE&C kits.

[2] Includes direct costs attributable to plan and advance the programs. Note: The design of the HERs program should be included here, while the actual development and mailing of HERs would be attributable to Program Delivery.
[3] Includes rebate processing, tracking system, general administration, program management, general management and legal, and technical assistance. Any common portfolio costs that are allocated across programs should be shown in this row.
[4] Includes the marketing CSP and marketing costs by program CSPs.
[5] Direct program implementation costs. Labor, fuel, and vehicle operation costs for appliance recycling and direct install programs. For behavioral programs, this includes the printing and postage of HERs.
[6] Total TRC Costs includes Total EDC Costs and Participant Costs.
[7] Total TRC Benefits equals the sum of Total Lifetime Electric and Non-Electric Benefits. 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. Savings carried over from Phase II are not included as a part of Total TRC Benefits for Phase III.
[8] TRC Ratio equals Total NPV TRC Benefits divided by Total NPV TRC Costs.
* Rows 1-11 are presented in nominal dollars

Table 86: Summary of Program Finances – Penn Power

Row #	Cost Category	Gross PYTD ($1,000)		Gross P3TD ($1,000)		Net PYTD ($1,000)		Net P3TD ($1,000)	
1	EDC Incentives to Participants [1]	518		868		518		868	
2	EDC Incentives to Trade Allies	0		0		0		0	
3	Participant Costs (net of incentives/rebates paid by utilities)	1,632		2,860		413		773	
4	**Incremental Measure Costs (Sum of rows 1 through 3)**	**2,150**		**3,728**		**931**		**1,641**	
		EDC	CSP	EDC	CSP	EDC	CSP	EDC	CSP
5	Design & Development [2]	0	20	0	33	0	20	0	33
6	Administration, Management, and Technical Assistance [3]	-10	40	-19	65	-10	40	-19	65
7	Marketing [4]	2	8	4	27	2	8	4	27
8	Program Delivery [5]	0	139	0	227	0	139	0	227
9	EDC Evaluation Costs	23		37		23		37	
10	SWE Audit Costs	6		17		6		17	
11	**Program Overhead Costs (Sum of rows 5 through 10)**	**229**		**390**		**229**		**390**	
12	NPV of increases in costs of natural gas (or other fuels) for fuel switching programs	0		0		0		0	
13	**Total NPV TRC Costs [6] (Net present value of sum of rows 4, 11, and 12)**	**2,379**		**3,965**		**1,160**		**1,956**	
14	Total NPV Lifetime Electric Energy Benefits	3,019		4,842		1,200		1,926	
15	Total NPV Lifetime Electric Capacity Benefits	868		1,406		350		569	
16	Total NPV Lifetime Operation and Maintenance (O&M) Benefits	1,648		2,585		640		1,003	
17	Total NPV Lifetime Non-Electric Benefits (Fossil Fuel, Water)	-361		-559		-136		-213	
18	**Total NPV TRC Benefits [7] (Sum of rows 14 through 17)**	**5,175**		**8,274**		**2,054**		**3,286**	
19	**TRC Benefit-Cost Ratio [8]**	**2.17**		**2.09**		**1.77**		**1.68**	

[1] Includes direct install equipment costs and costs for EE&C kits.
[2] Includes direct costs attributable to plan and advance the programs. Note: The design of the HERs program should be included here, while the actual development and mailing of HERs would be attributable to Program Delivery.
[3] Includes rebate processing, tracking system, general administration, program management, general management and legal, and technical assistance. Any common portfolio costs that are allocated across programs should be shown in this row.
[4] Includes the marketing CSP and marketing costs by program CSPs.
[5] Direct program implementation costs. Labor, fuel, and vehicle operation costs for appliance recycling and direct install programs. For behavioral programs, this includes the printing and postage of HERs.
[6] Total TRC Costs includes Total EDC Costs and Participant Costs.
[7] Total TRC Benefits equals the sum of Total Lifetime Electric and Non-Electric Benefits. 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. Savings carried over from Phase II are not included as a part of Total TRC Benefits for Phase III.
[8] TRC Ratio equals Total NPV TRC Benefits divided by Total NPV TRC Costs.
* Rows 1-11 are presented in nominal dollars

Table 87: Summary of Program Finances – WPP

Row #	Cost Category	Gross PYTD ($1,000)		Gross P3TD ($1,000)		Net PYTD ($1,000)		Net P3TD ($1,000)	
1	EDC Incentives to Participants [1]	1,832		3,466		1,832		3,466	
2	EDC Incentives to Trade Allies	0		0		0		0	
3	Participant Costs (net of incentives/rebates paid by utilities)	5,674		10,588		918		1,596	
4	**Incremental Measure Costs (Sum of rows 1 through 3)**	**7,506**		**14,054**		**2,750**		**5,062**	
		EDC	CSP	EDC	CSP	EDC	CSP	EDC	CSP
5	Design & Development [2]	0	78	0	162	0	78	0	162
6	Administration, Management, and Technical Assistance [3]	24	155	118	321	24	155	118	321
7	Marketing [4]	8	132	14	313	8	132	14	313
8	Program Delivery [5]	0	542	0	1,124	0	542	0	1,124
9	EDC Evaluation Costs	121		186		121		186	
10	SWE Audit Costs	29		79		29		79	
11	**Program Overhead Costs (Sum of rows 5 through 10)**	**1,089**		**2,317**		**1,089**		**2,317**	
12	NPV of increases in costs of natural gas (or other fuels) for fuel switching programs	0		0		0		0	
13	**Total NPV TRC Costs [6] (Net present value of sum of rows 4, 11, and 12)**	**8,595**		**15,833**		**3,840**		**7,139**	
14	Total NPV Lifetime Electric Energy Benefits	6,370		14,424		1,925		4,228	
15	Total NPV Lifetime Electric Capacity Benefits	2,106		6,758		656		1,972	
16	Total NPV Lifetime Operation and Maintenance (O&M) Benefits	4,330		8,230		1,150		2,186	
17	Total NPV Lifetime Non-Electric Benefits (Fossil Fuel, Water)	-697		-2,736		-149		-692	
18	**Total NPV TRC Benefits [7] (Sum of rows 14 through 17)**	**12,110**		**26,675**		**3,582**		**7,692**	
19	**TRC Benefit-Cost Ratio [8]**	**1.41**		**1.68**		**0.93**		**1.08**	

[1] Includes direct install equipment costs and costs for EE&C kits.
[2] Includes direct costs attributable to plan and advance the programs. Note: The design of the HERs program should be included here, while the actual development and mailing of HERs would be attributable to Program Delivery.
[3] Includes rebate processing, tracking system, general administration, program management, general management and legal, and technical assistance. Any common portfolio costs that are allocated across programs should be shown in this row.
[4] Includes the marketing CSP and marketing costs by program CSPs.
[5] Direct program implementation costs. Labor, fuel, and vehicle operation costs for appliance recycling and direct install programs. For behavioral programs, this includes the printing and postage of HERs.
[6] Total TRC Costs includes Total EDC Costs and Participant Costs.
[7] Total TRC Benefits equals the sum of Total Lifetime Electric and Non-Electric Benefits. 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. Savings carried over from Phase II are not included as a part of Total TRC Benefits for Phase III.
[8] TRC Ratio equals Total NPV TRC Benefits divided by Total NPV TRC Costs.
* Rows 1-11 are presented in nominal dollars

3.3.7 Status of Recommendations

The impact and process evaluation activities in PY8 and PY9 led to the following findings and recommendations from Tetra Tech to the Companies along with a summary of how the Companies plan to address the recommendation in program delivery.

3.3.7.1 HVAC and Appliances

The following are findings and recommendations from the PY8 process evaluation effort from PY8.

Finding #1: Some customers feel rebates take too long to process. Approximately 10 percent of respondents recalled the rebate took longer than 90 days to process, which is the time frame communicated by the application. This led to lowered satisfaction with the program.

Recommendation #1: Work with the ICSP to monitor rebate payment times, and track applications that are taking longer than expected.

EDC Status Report #1: Recommendation accepted.

Finding #2: Some participants in the Appliance Rebate sub-program reported their income in a range that would qualify for the low-income Appliance Rebate sub-program.

Recommendation #2: Ensure that the low-income rebates are clearly communicated in marketing materials, particularly on the program application.

EDC Status Report #2: Recommendation accepted. Low-income rebate information continues to be clearly communicated on the website, in marketing materials and on the rebate application. Honeywell continues to inform retailers about program information and to answer any of their questions during regularly scheduled store visits.

Finding #3: While overall program satisfaction was high, Appliance participants rated their satisfaction with the amount of the rebate lower than other program aspects.

Recommendation #3: Review appliance rebate amounts in balance with other program metrics such as participation, budget, and satisfaction.

EDC Status Report #3: Recommendation accepted. Honeywell continues to work with retailers on providing information and to help educate customers on the importance of energy-saving benefits.

Finding #4: Contractors were by far the most common source of program information for HVAC participants. Satisfaction with HVAC contractors was particularly high, averaging 4.7 out of 5.

Recommendation #4: Continue to work with HVAC contractors to maintain their engagement with the program.

EDC Status Report #4: Recommendation accepted.

The following are findings and recommendations from the PY9 retailer survey.

Finding #1: Retailer satisfaction with the program is high (63 percent gave the overall program a rating of very or extremely satisfied). When asked what the EDC or Honeywell could do to improve the program, they mentioned that additional hand-outs with information about energy-saving benefits could help them promote program-eligible products to customers.

Recommendation #1: Provide more program materials, such as informational hand-outs, to the stores.

EDC Status Report #1: Recommendation under consideration.

Finding #2: Retailers were asked to rate their level of satisfaction with various program aspects. These included the appliances eligible for rebates, the rebate amounts, the materials they have received, and support from the EDC or Honeywell. The lowest satisfaction ratings given were for the support received from the EDC or from Honeywell (33 percent said they were somewhat satisfied[9] and 4 percent said they were not at all satisfied). The reasons provided were because they felt there was not enough personal interaction; stating either there has been no contact, or the materials were dropped off but there were no discussions.

Recommendation #2: Increase direct communication from Honeywell to provide program information, discuss the program with retailers, and answer questions.

EDC Status Report #2: Recommendation under consideration.

Finding #3: Based on their interaction with customers, retailers report that energy efficiency or ENERGY STAR® rating is the main factor when purchasing an appliance only 20 percent of the time (23 and 21 percent, respectively). Price was the biggest factor in customers' decision-making (65 percent), followed by size (35 percent), and aesthetics (25 percent).

Recommendation #3: Encourage Honeywell to work with the retailers to provide information and help educate customers on the importance of energy-saving benefits.

EDC Status Report #3: Recommendation under consideration.

Finding #4: Retailer awareness of the additional rebates available for income qualified customers is low (10 percent).

Recommendation #4: While it is not the role of the retailer to determine income eligibility, suggest additional education by the ICSP to help them understand the full range of program offerings and share with customers

[9] Response options were "not at all satisfied", "somewhat satisfied", "very satisfied", and "extremely satisfied."

EDC Status Report #1: Recommendation accepted. Honeywell continues to work with retailers to help them understand the full range of program offerings for them to share with customers.

3.3.7.2 Upstream Lighting

The process evaluation resulted in several noteworthy findings and recommendations. Not all findings and recommendations have a one-to-one correspondence, therefore the findings are disclosed first, followed by recommendations

Finding #1: Awareness of energy-efficient lighting products is high and has increased since Phase II. Almost all customers are at least "somewhat familiar" with CFLs and three-quarters report equal familiarity with LEDs. In contrast, only 55 percent of customers expressed this level of familiarity with LEDs in response to similar survey questions at Phase II. More than one-half understand that LEDs are more energy-efficient than CFLs.

Finding #2: Usage of energy efficient lighting products is high. Over 80 percent of customers have ever used CFLs in their homes and two-thirds have used LEDs.

Finding #3: Customers express a preference for, and greater satisfaction with, LEDs over CFLs. Among customers familiar with both CFLs and LEDs, more than 60 percent prefer LEDs. The quality of lighting from LEDs and greater energy efficiency are most often cited as the reasons for this preference. Two-thirds are "very satisfied" with LEDs, while less than 30 percent express similar satisfaction with CFLs.

Finding #4: Lighting purchases over the past 12 months are predominantly LEDs (57 percent). However, more than one-third of purchases still included incandescent bulbs. About two-thirds of purchases are made to replace an incandescent bulb, usually because the existing bulb is burned out.

Finding #5: Customers consider a wide range of factors when shopping for lighting products. Although price is most often the most important consideration, it is not the overwhelming deciding factor. Almost one in five cite the brightness of the bulb and 15 percent point to bulb life as most important.

Finding #6: Customers who have not used LEDs show declining reluctance to use these products since Phase II. Although 35 percent are “not at all” or “somewhat unlikely” to install and LED in the next 12 months, this is down from over one-half at Phase II. Almost one in five are “very” or “extremely likely” to install LED bulbs in the next year.

Finding #7: Using the Van Westendorp Price Sensitivity Meter, LED bulbs are a “bargain” at $2.00 to $2.76 (median, mean, respectively) and “starting to get expensive” at $4.00 and $5.04 (median, mean) for those who have not previously used LEDs. However, most customers are not aware of market prices: 60 percent of customers “don’t know” if the price of LEDs is higher, lower, or about the same as last year.

Finding #8: Awareness of program-sponsored price discounts is low. Only one in ten customers who purchased a program-eligible lighting product was aware that the price of the bulbs they purchased had been discounted.

Finding #9: Evidence from customer self-reports suggest that most will purchase energy-efficient lighting products regardless of the program-sponsored discount.

Finding #10: Regular interaction with the program implementer is relatively rare among the surveyed retailers. Those who have met with the representative are satisfied with the help they receive, but a request for more contact was among the most frequent suggestion for program improvements

Finding #11: Retailers are very satisfied with the program. Suggestions for ways it could be even more useful to their stores included more contact with program representatives, more and better signage (larger, bolder), and activities by the program representative that could reinforce the store's education efforts (e.g., displays, in-person interactions with customers)

Recommendation #1: Continue to market the program and conduct outreach efforts to increase awareness of the FirstEnergy programs and LED products.

EDC Status Report #1: Recommendation accepted.

Recommendation #2: Outreach efforts should continue to emphasize the energy and non-energy benefits of program-qualifying LED bulbs. While price is important to customers, it does not overwhelm other considerations and a large proportion of customers are unaware of the overall trend in LED bulb prices. Lighting quality and energy-efficiency are the most important consideration for a substantial proportion of customers.

EDC Status Report #2: Recommendation accepted. Honeywell continues to work with retailers providing information and to help educate customers on the importance of energy-saving benefits.

Recommendation #3: Work with the program implementer to establish greater consistency across participating retail locations in the level and nature of program support that is provided. Continue to incorporate feedback from participating retailers in program design and implementation and engage the retailers in marketing efforts.

EDC Status Report #3: Recommendation accepted.

3.4 LOW-INCOME ENERGY EFFICIENCY PROGRAM

The Low-Income Energy Efficiency Program (LIEEP) has six distinct components, each described below.

The *Low-Income Direct Install* (LI DI) component is administered by the Companies, and has three distinct components:

- *WARM Plus* low-income weatherization
- *WARM Extra Measures* low-income weatherization
- *WARM Multifamily*

These programs provide for direct installation of energy efficiency measures within customers' homes and tenants apartments. The WARM Plus and WARM Multifamily components provide for audits and direct installation of energy efficient equipment and envelope upgrades. WARM *Extra Measures* is similar to WARM Plus, except that it provides for additional measures that are Act-129 funded to be installed in homes that participate in the Companies' non-Act 129 Low-Income Usage Reduction Programs. The Companies' tracking and reporting system can cross reference account numbers with previous years to generate a list of unique, new participants for each program year. For sampling and reporting purposes, however, ADM selects to treat each incentive (typically corresponding to a unique account in the tracking data for the program year) as one participant.

The *Low-Income Appliance Turn-In* (LI ATI) component is administered by ARCA. The program is implemented in parallel with the main residential Appliance Turn-In program but provides targeted marketing and enhanced incentives to income qualified customers. Each rebate application (which corresponds to an appliance pick-up event and may involve multiple appliances) is treated as one participant.

The *Low-Income Kits* (LI Kit) component includes two subcomponents:

- Low-Income EE Kits administered by PowerDirect
- Low-Income School Education Program administered by AM Conservation Group (AMCG)

Each of these program components are similar to their corresponding non-Low-Income components in the Energy Efficient Homes Program, but they are targeted to low-income customers. Each kit is treated as a participant.

The *Low-Income Appliance Rebates* (LI Appliances) component is administered by Honeywell and provides for targeted marketing and enhanced downstream rebates on appliances.

The *Low-Income Home Energy Reports* (LI HER) component is like the HER component in the Energy Efficient Homes Program but is targeted to low-income qualified customers.

The *New Homes* component is like the New Homes component in the Energy Efficient Homes Program but is targeted to low-income customers.

3.4.1 Participation and Reported Savings by Customer Segment

Table 88 presents the participation counts, reported energy and demand savings, and incentive payments for the Appliance Turn-In Program in PY9 by customer segment and EDC. This program serves only the residential customer segment. The EE&C portfolios include separate Appliance Turn-In program components, also administered by ARCA, to serve the low-income residential and the nonresidential customer segments.

Table 88: LIEEP Participation and Reported Impacts

Parameter	Met-Ed LI Residential	Penelec LI Residential	Penn Power LI Residential	WPP LI Residential
PYTD # Participants	27,522	32,588	7,812	27,925
PYRTD MWh/yr	10,281	9,730	3,215	9,606
PYRTD MW/yr	1.20	1.15	0.41	1.25
PYTD Incentives ($1000)	133.41	86.26	50.63	98.80

3.4.2 Gross Impact Evaluation

The gross impact evaluation of this program is described in detail in Appendix D.1. Table 89 summarizes program verified impacts and realization rates for each EDC.

Table 89: LIEEP Gross Impact Evaluation Summary for PY9

EDC	Sampling Initiative	Gross Verified MWh	Gross Verified MW	MWh Realization Rate	MW Realization Rate
Met-Ed	Appliances	13	0.00	111.9%	106.8%
Met-Ed	Appliance Turn-In	575	0.09	83.8%	86.8%
Met-Ed	Direct Install	1,807	0.19	91.3%	94.8%
Met-Ed	Home Energy Reports	4,151	0.47	118.1%	107.7%
Met-Ed	Kits	4,773	0.55	120.6%	125.4%
Met-Ed	New Homes	98	0.02	74.2%	146.7%
Met-Ed Total		**11,417**	**1.33**	**111%**	**111%**
Penelec	Appliances	29	0.00	115.0%	100.7%
Penelec	Appliance Turn-In	831	0.11	92.8%	91.4%
Penelec	Direct Install	2,580	0.25	98.6%	97.8%
Penelec	Home Energy Reports	2,370	0.27	99.0%	68.7%
Penelec	Kits	4,748	0.47	125.2%	126.3%
Penelec	New Homes	4	0.00	70.2%	126.5%
PenelecTotal		**10,563**	**1.11**	**109%**	**97%**
Penn Power	Appliances	9	0.00	158.3%	145.7%
Penn Power	Appliance Turn-In	229	0.03	81.7%	75.5%
Penn Power	Direct Install	952	0.10	102.4%	99.9%
Penn Power	Home Energy Reports	782	0.09	104.5%	73.0%
Penn Power	Kits	1,442	0.17	123.1%	135.3%
Penn Power	New Homes	64	0.03	80.4%	130.0%
Penn PowerTotal		**3,478**	**0.42**	**108%**	**103%**
WPP	Appliances	25	0.00	134.7%	120.0%
WPP	Appliance Turn-In	751	0.10	93.7%	89.8%
WPP	Direct Install	1,968	0.21	102.4%	102.3%
WPP	Home Energy Reports	3,344	0.37	98.5%	72.8%
WPP	Kits	3,890	0.49	114.1%	120.8%
WPP	New Homes	48	0.02	77.5%	147.9%
WPP Total		**10,026**	**1.20**	**104%**	**96%**

The gross realization rates for energy savings were driven primarily by Appliance Turn-In part-use factors for refrigerators and freezers as determined through verification surveys, and by the unit energy consumptions for refrigerators and freezers, as determined through measure attributes recorded in the tracking and reporting system. Although verification rates determined through surveys were approximately 100%, the realization rates are generally lower than 100% because the part-use factors are lower than the TRM default values, and the calculated unit energy consumptions were lower than what would expect from application of default parameters in the TRM.

3.4.3 Net Impact Evaluation

Impact evaluation was not conducted for this program in PY8. The NTG for the Low-Income Energy Efficiency Program is estimated as 1.0 at this time for the purpose net cost effectiveness calculations.

3.4.4 Verified Savings Estimates

In Table 90 the realization rates and net-to-gross ratios determined by ADM are applied to the reported energy and demand savings estimates to calculate the verified savings estimates for The Low-Income Energy Efficiency Program in PY9. These totals are added to the verified savings achieved in previous program years to calculate the P3TD program impacts.

Table 90: PYTD and P3TD Savings Summary

	Met-Ed		Penelec		Penn Power		WPP	
Savings Type	Energy (MWh/yr)	Demand (MW/yr)	Energy (MWh/yr)	Demand (MW/yr)	Energy (MWh/yr)	Demand (MW/yr)	Energy (MWh/yr)	Demand (MW/yr)
PYRTD	10,281	1.20	9,730	1.15	3,215	0.41	9,606	1.25
PYVTD Gross	11,417	1.33	10,563	1.11	3,478	0.42	10,026	1.20
PYVTD Net	11,417	1.33	10,563	1.11	3,478	0.42	10,026	1.20
RTD	19,388	2.34	20,679	2.45	6,496	0.84	19,994	2.65
VTD Gross	21,523	2.48	22,921	2.44	6,558	0.77	20,941	2.46
VTD Net	21,523	2.48	22,921	2.44	6,558	0.77	20,941	2.46

3.4.5 Process Evaluation

Tetra Tech conducted a process evaluation for this program in PY8. The process evaluation for the Low-Income WARM and Multifamily components began with an interview of the program manager. These components do not rely on an ICSP for delivery. The evaluation centered on a phone survey of customers, and also involved interviews with contractors. The survey sample was randomly selected for each EDC.

Process evaluations for the Appliance Rebate, Behavioral, and Kits sub-programs were conducted with the similar Non-Low-Income programs in the Energy Efficient Products and Energy Efficient Homes programs, respectively. Findings and recommendations for those program components are reported in those sections. The sample design is shown in Table 91. Please note that the population counts in the table are from PY8, not PY9.

Table 91: LIP Program Process Evaluation Sample Design

EDC	Population Size	Achieved Sample Size	Response Rate
Met-Ed	1,551	80	30.0%
Penn Power	2,433	85	38.0%
Penelec	842	73	36.0%
WPP	1,954	101	35.0%

Key findings and recommendations are listed in Section 3.4.7.

3.4.6 Cost-Effectiveness Reporting

A detailed breakdown of program finances and cost-effectiveness is presented in Table 92, Table 93, Table 94, and Table 95 for Met-Ed, Penelec, Penn Power, and WPP respectively. The last two columns of the tables show benefits as calculated with net verified impacts, along with net participant costs (if applicable). The third and fourth columns show results as calculated on

a gross basis. PYTD costs and benefits are net present values (NPV) expressed in 2017 dollars. NPV costs and benefits for P3TD financials are expressed in the 2016 dollars.

Table 92: Summary of Program Finances – Met-Ed

Row #	Cost Category	Gross PYTD ($1,000)		Gross P3TD ($1,000)		Net PYTD ($1,000)		Net P3TD ($1,000)	
1	EDC Incentives to Participants [1]	133		192		133		192	
2	EDC Incentives to Trade Allies	0		0		0		0	
3	Participant Costs (net of incentives/rebates paid by utilities)	26		44		26		44	
4	**Incremental Measure Costs (Sum of rows 1 through 3)**	**159**		**235**		**159**		**235**	
		EDC	CSP	EDC	CSP	EDC	CSP	EDC	CSP
5	Design & Development [2]	0	94	0	199	0	94	0	199
6	Administration, Management, and Technical Assistance [3]	145	235	319	507	145	235	319	507
7	Marketing [4]	4	147	8	214	4	147	8	214
8	Program Delivery [5]	106	2,483	213	4,937	106	2,483	213	4,937
9	EDC Evaluation Costs	141		198		141		198	
10	SWE Audit Costs	53		147		53		147	
11	**Program Overhead Costs (Sum of rows 5 through 10)**	**3,409**		**6,742**		**3,409**		**6,742**	
12	NPV of increases in costs of natural gas (or other fuels) for fuel switching programs	0		0		0		0	
13	**Total NPV TRC Costs [6] (Net present value of sum of rows 4, 11, and 12)**	**3,568**		**6,756**		**3,568**		**6,756**	
14	Total NPV Lifetime Electric Energy Benefits	2,013		3,746		2,013		3,746	
15	Total NPV Lifetime Electric Capacity Benefits	505		1,178		505		1,178	
16	Total NPV Lifetime Operation and Maintenance (O&M) Benefits	7		7		7		7	
17	Total NPV Lifetime Non-Electric Benefits (Fossil Fuel, Water)	57		54		57		54	
18	**Total NPV TRC Benefits [7] (Sum of rows 14 through 17)**	**2,582**		**4,984**		**2,582**		**4,984**	
19	**TRC Benefit-Cost Ratio [8]**	**0.72**		**0.74**		**0.72**		**0.74**	

[1] Includes direct install equipment costs and costs for EE&C kits.
[2] Includes direct costs attributable to plan and advance the programs. Note: The design of the HERs program should be included here, while the actual development and mailing of HERs would be attributable to Program Delivery.
[3] Includes rebate processing, tracking system, general administration, program management, general management and legal, and technical assistance. Any common portfolio costs that are allocated across programs should be shown in this row.
[4] Includes the marketing CSP and marketing costs by program CSPs.
[5] Direct program implementation costs. Labor, fuel, and vehicle operation costs for appliance recycling and direct install programs. For behavioral programs, this includes the printing and postage of HERs.
[6] Total TRC Costs includes Total EDC Costs and Participant Costs.
[7] Total TRC Benefits equals the sum of Total Lifetime Electric and Non-Electric Benefits. 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. Savings carried over from Phase II are not included as a part of Total TRC Benefits for Phase III.
[8] TRC Ratio equals Total NPV TRC Benefits divided by Total NPV TRC Costs.
* Rows 1-11 are presented in nominal dollars

Table 93: Summary of Program Finances – Penelec

Row #	Cost Category	Gross PYTD ($1,000)		Gross P3TD ($1,000)		Net PYTD ($1,000)		Net P3TD ($1,000)	
1	EDC Incentives to Participants [1]	86		165		86		165	
2	EDC Incentives to Trade Allies	0		0		0		0	
3	Participant Costs (net of incentives/rebates paid by utilities)	15		22		15		22	
4	**Incremental Measure Costs (Sum of rows 1 through 3)**	**101**		**188**		**101**		**188**	
		EDC	CSP	EDC	CSP	EDC	CSP	EDC	CSP
5	Design & Development [2]	0	90	1	217	0	90	1	217
6	Administration, Management, and Technical Assistance [3]	160	234	358	568	160	234	358	568
7	Marketing [4]	4	121	7	187	4	121	7	187
8	Program Delivery [5]	138	2,376	285	4,757	138	2,376	285	4,757
9	EDC Evaluation Costs	160		223		160		223	
10	SWE Audit Costs	56		154		56		154	
11	**Program Overhead Costs (Sum of rows 5 through 10)**	**3,339**		**6,757**		**3,339**		**6,757**	
12	NPV of increases in costs of natural gas (or other fuels) for fuel switching programs	0		0		0		0	
13	**Total NPV TRC Costs [6] (Net present value of sum of rows 4, 11, and 12)**	**3,441**		**6,727**		**3,441**		**6,727**	
14	Total NPV Lifetime Electric Energy Benefits	2,012		4,136		2,012		4,136	
15	Total NPV Lifetime Electric Capacity Benefits	455		1,223		455		1,223	
16	Total NPV Lifetime Operation and Maintenance (O&M) Benefits	2		2		2		2	
17	Total NPV Lifetime Non-Electric Benefits (Fossil Fuel, Water)	90		84		90		84	
18	**Total NPV TRC Benefits [7] (Sum of rows 14 through 17)**	**2,559**		**5,445**		**2,559**		**5,445**	
19	**TRC Benefit-Cost Ratio [8]**	**0.74**		**0.81**		**0.74**		**0.81**	

[1] Includes direct install equipment costs and costs for EE&C kits.

[2] Includes direct costs attributable to plan and advance the programs. Note: The design of the HERs program should be included here, while the actual development and mailing of HERs would be attributable to Program Delivery.
[3] Includes rebate processing, tracking system, general administration, program management, general management and legal, and technical assistance. Any common portfolio costs that are allocated across programs should be shown in this row.
[4] Includes the marketing CSP and marketing costs by program CSPs.
[5] Direct program implementation costs. Labor, fuel, and vehicle operation costs for appliance recycling and direct install programs. For behavioral programs, this includes the printing and postage of HERs.
[6] Total TRC Costs includes Total EDC Costs and Participant Costs.
[7] Total TRC Benefits equals the sum of Total Lifetime Electric and Non-Electric Benefits. 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. Savings carried over from Phase II are not included as a part of Total TRC Benefits for Phase III.
[8] TRC Ratio equals Total NPV TRC Benefits divided by Total NPV TRC Costs.
* Rows 1-11 are presented in nominal dollars

Table 94: Summary of Program Finances – Penn Power

Row #	Cost Category	Gross PYTD ($1,000)		Gross P3TD ($1,000)		Net PYTD ($1,000)		Net P3TD ($1,000)	
1	EDC Incentives to Participants [1]	51		73		51		73	
2	EDC Incentives to Trade Allies	0		0		0		0	
3	Participant Costs (net of incentives/rebates paid by utilities)	44		46		44		46	
4	**Incremental Measure Costs (Sum of rows 1 through 3)**	**95**		**120**		**95**		**120**	
		EDC	CSP	EDC	CSP	EDC	CSP	EDC	CSP
5	Design & Development [2]	0	26	0	54	0	26	0	54
6	Administration, Management, and Technical Assistance [3]	49	64	107	134	49	64	107	134
7	Marketing [4]	1	42	2	62	1	42	2	62
8	Program Delivery [5]	60	860	115	1,529	60	860	115	1,529
9	EDC Evaluation Costs	52		71		52		71	
10	SWE Audit Costs	16		44		16		44	
11	**Program Overhead Costs (Sum of rows 5 through 10)**	**1,170**		**2,118**		**1,170**		**2,118**	
12	NPV of increases in costs of natural gas (or other fuels) for fuel switching programs	0		0		0		0	
13	**Total NPV TRC Costs [6] (Net present value of sum of rows 4, 11, and 12)**	**1,265**		**2,157**		**1,265**		**2,157**	
14	Total NPV Lifetime Electric Energy Benefits	684		1,273		684		1,273	
15	Total NPV Lifetime Electric Capacity Benefits	187		330		187		330	
16	Total NPV Lifetime Operation and Maintenance (O&M) Benefits	14		13		14		13	
17	Total NPV Lifetime Non-Electric Benefits (Fossil Fuel, Water)	-19		-17		-19		-17	
18	**Total NPV TRC Benefits [7] (Sum of rows 14 through 17)**	**865**		**1,598**		**865**		**1,598**	
19	**TRC Benefit-Cost Ratio [8]**	**0.68**		**0.74**		**0.68**		**0.74**	

[1] Includes direct install equipment costs and costs for EE&C kits.
[2] Includes direct costs attributable to plan and advance the programs. Note: The design of the HERs program should be included here, while the actual development and mailing of HERs would be attributable to Program Delivery.
[3] Includes rebate processing, tracking system, general administration, program management, general management and legal, and technical assistance. Any common portfolio costs that are allocated across programs should be shown in this row.
[4] Includes the marketing CSP and marketing costs by program CSPs.
[5] Direct program implementation costs. Labor, fuel, and vehicle operation costs for appliance recycling and direct install programs. For behavioral programs, this includes the printing and postage of HERs.
[6] Total TRC Costs includes Total EDC Costs and Participant Costs.
[7] Total TRC Benefits equals the sum of Total Lifetime Electric and Non-Electric Benefits. 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. Savings carried over from Phase II are not included as a part of Total TRC Benefits for Phase III.
[8] TRC Ratio equals Total NPV TRC Benefits divided by Total NPV TRC Costs.
* Rows 1-11 are presented in nominal dollars

Table 95: Summary of Program Finances – WPP

Row #	Cost Category	Gross PYTD ($1,000)		Gross P3TD ($1,000)		Net PYTD ($1,000)		Net P3TD ($1,000)	
1	EDC Incentives to Participants [1]	99		159		99		159	
2	EDC Incentives to Trade Allies	0		0		0		0	
3	Participant Costs (net of incentives/rebates paid by utilities)	24		32		24		32	
4	**Incremental Measure Costs (Sum of rows 1 through 3)**	**123**		**191**		**123**		**191**	
		EDC	CSP	EDC	CSP	EDC	CSP	EDC	CSP
5	Design & Development [2]	0	85	0	195	0	85	0	195
6	Administration, Management, and Technical Assistance [3]	146	206	314	487	146	206	314	487
7	Marketing [4]	3	147	7	249	3	147	7	249
8	Program Delivery [5]	119	2,131	229	4,720	119	2,131	229	4,720
9	EDC Evaluation Costs	154		214		154		214	
10	SWE Audit Costs	45		125		45		125	
11	**Program Overhead Costs (Sum of rows 5 through 10)**	**3,037**		**6,542**		**3,037**		**6,542**	
12	NPV of increases in costs of natural gas (or other fuels) for fuel switching programs	0		0		0		0	
13	**Total NPV TRC Costs [6] (Net present value of sum of rows 4, 11, and 12)**	**3,160**		**6,535**		**3,160**		**6,535**	
14	Total NPV Lifetime Electric Energy Benefits	1,719		3,664		1,719		3,664	
15	Total NPV Lifetime Electric Capacity Benefits	466		983		466		983	
16	Total NPV Lifetime Operation and Maintenance (O&M) Benefits	6		6		6		6	
17	Total NPV Lifetime Non-Electric Benefits (Fossil Fuel, Water)	75		70		75		70	
18	**Total NPV TRC Benefits [7] (Sum of rows 14 through 17)**	**2,266**		**4,723**		**2,266**		**4,723**	
19	**TRC Benefit-Cost Ratio [8]**	**0.72**		**0.72**		**0.72**		**0.72**	

[1] Includes direct install equipment costs and costs for EE&C kits.
[2] Includes direct costs attributable to plan and advance the programs. Note: The design of the HERs program should be included here, while the actual development and mailing of HERs would be attributable to Program Delivery.
[3] Includes rebate processing, tracking system, general administration, program management, general management and legal, and technical assistance. Any common portfolio costs that are allocated across programs should be shown in this row.
[4] Includes the marketing CSP and marketing costs by program CSPs.
[5] Direct program implementation costs. Labor, fuel, and vehicle operation costs for appliance recycling and direct install programs. For behavioral programs, this includes the printing and postage of HERs.
[6] Total TRC Costs includes Total EDC Costs and Participant Costs.
[7] Total TRC Benefits equals the sum of Total Lifetime Electric and Non-Electric Benefits. 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. Savings carried over from Phase II are not included as a part of Total TRC Benefits for Phase III.
[8] TRC Ratio equals Total NPV TRC Benefits divided by Total NPV TRC Costs.
* Rows 1-11 are presented in nominal dollars

3.4.7 Status of Recommendations

The impact and process evaluation activities in PY8 led to the following findings and recommendations from Tetra Tech to the Companies along with a summary of how the Companies plan to address the recommendation in program delivery.

Finding #1: Contractors are required to enter information in the FirstEnergy tracking system as well as a state-run website.

Recommendation #1: Include a web link to the state-run website within FirstEnergy's system for convenience to contractors.

EDC Status Report #1: The Companies periodically update the tracking and reporting system for the low-income programs, and this recommendation will be considered during the next round of coding updates.

Finding #2: While nearly all direct install measures are installed by the contractor, participants still report some are left behind for the homeowner to install. This may result in the measures never being installed and may impact the realization rate. This has improved since Phase II, but participants still report 4 percent of measures are left uninstalled.

Recommendation #2: Continue to work with contractors to ensure direct install measures are installed by the contractor, rather than left for the homeowner to be installed later.

EDC Status Report #2: Recommendation accepted, with regular reminders to contractors. Gross impact evaluation accounts for and accordingly reduces gross verified impacts for such instances, yet the gross realization rates are generally high.

3.5 C&I Energy Solutions for Business Program - Small

The C&I Solutions for Business Program – Small (referred to as ESB-Small Program) is offered to small commercial and industrial customers and is implemented jointly by Sodexo and ARCA. The Sodexo portion of the program includes downstream incentives for customers that install energy efficient equipment. Major program components include lighting (both new construction and retrofits), custom HVAC upgrades, compressed air projects, process improvements, and prescriptive HVAC, refrigeration, and food-service measures. The incentives for most downstream measures are proportional to the reported energy savings. The ARCA portion of the program included refrigerator, freezer, and room air conditioner recycling.

3.5.1 Participation and Reported Savings by Customer Segment

Table 96 and Table 97 present the participation counts, reported energy and demand savings, and incentive payments for the ESB-Small Program in PY9 by customer segment and EDC. This program serves the Small C&I and GNI customer segments. Each separate rebate application is counted as one participant.

Table 96: ESB-Small Program Participation and Reported Impacts for Met-Ed and Penelec

Parameter	Met-Ed Small C&I (Non-GNI)	Met-Ed GNI	Met-Ed Total	Penelec Small C&I (Non-GNI)	Penelec GNI	Penelec Total
PYTD # Participants	367	57	424	589	152	741
PYRTD MWh/yr	35,387	1,548	36,935	22,875	6,023	28,898
PYRTD MW/yr	5.20	0.23	5.43	3.17	0.93	4.11
PYTD Incentives ($1000)	1,385.14	86.42	1,471.55	1,222.30	334.54	1,556.85

Table 97: ESB-Small Program Participation and Reported Impacts for Penn Power and WPP

Parameter	Penn Power Small C&I (Non-GNI)	Penn Power GNI	Penn Power Total	WPP Small C&I (Non-GNI)	WPP GNI	WPP Total
PYTD # Participants	277	74	351	601	188	789
PYRTD MWh/yr	11,132	2,597	13,729	25,040	6,509	31,549
PYRTD MW/yr	1.53	0.41	1.93	3.40	1.03	4.43
PYTD Incentives ($1000)	570.14	165.83	735.97	1,313.35	351.46	1,664.80

3.5.2 Gross Impact Evaluation

The ESB-Small Program was disaggregated into four sampling initiatives for gross impact evaluation, as described in Appendix C. The Appliance Turn-In program component, administered by ARCA, was evaluated as a separate initiative. The gross impact evaluation for

the Appliance Turn-In initiative is described in detail in Appendix S. Lighting improvements were grouped into the C/I Lighting initiative and evaluated according to PA TRM protocols as described in detail in Appendix P. Prescriptive HVAC and appliance projects were grouped into the Prescriptive Initiative. The evaluation of Prescriptive projects is described in Appendix R. Custom projects include combinations of measures that serve multiple end-uses, as well as custom projects that involve combined heat and power, motors and drives, industrial process improvements, refrigeration, retro-commissioning, compressed air upgrades, data centers, and custom HVAC and chillers. The impact evaluation for the custom initiative is described in Appendix Q. The program also has a Direct Install Initiative. Evaluation activities for the Direct Install Initiative are described in Appendix T. For all EDCs, the Lighting initiative attributed for the majority of program savings, followed by the Custom initiative. The Prescriptive and Appliance Turn-In initiatives accounted for small fractions of overall program impacts. Table 98 summarizes program verified impacts and realization rates for each EDC.

Table 98: ESB-Small Program Gross Impact Evaluation Summary for PY9

EDC	Sampling Initiative	Gross Verified MWh	Gross Verified MW	MWh Realization Rate	MW Realization Rate
Met-Ed	Lighting	35,108	5.18	102%	101%
Met-Ed	Custom	2,048	0.20	100%	86%
Met-Ed	Prescriptive	184	0.04	86%	89%
Met-Ed	Appliance Turn-In	78	0.01	97%	63%
Met-Ed	Direct Install	6	0.00	95%	97%
Met-Ed Total		**37,424**	**5.42**	**101%**	**100%**
Penelec	Lighting	21,826	3.53	86%	95%
Penelec	Custom	2,647	0.27	94%	77%
Penelec	Prescriptive	611	0.03	101%	78%
Penelec	Appliance Turn-In	77	0.01	93%	78%
Penelec	Direct Install	8	0.00	94%	103%
PenelecTotal		**25,168**	**3.84**	**87%**	**94%**
Penn Power	Lighting	12,686	1.71	99%	97%
Penn Power	Custom	707	0.11	99%	79%
Penn Power	Prescriptive	313	0.03	197%	170%
Penn Power	Appliance Turn-In	16	0.00	77%	70%
Penn Power	Direct Install	0	0.00	100%	100%
Penn PowerTotal		13,722	1.86	100%	96%
WPP	Lighting	33,723	4.41	116%	108%
WPP	Custom	1,444	0.16	94%	73%
WPP	Prescriptive	550	0.07	66%	70%
WPP	Appliance Turn-In	72	0.01	84%	66%
WPP	Direct Install	0	0.00	100%	100%
WPP Total		**35,789**	**4.65**	**113%**	**105%**

The gross realization rates for energy savings were driven primarily by variances between assumed lighting hours of use in advance of rebate approval and hours of use that were determined through impact evaluation activities.

3.5.3 Net Impact Evaluation

Tetra-Tech conducted a Net-to-Gross evaluation for this program in PY8. The net impact evaluation of the Lighting Initiative is described in Appendix P.2. The net impact evaluation of the Custom Initiative is described in Appendix Q.2. The net impact evaluation of the Prescriptive Initiative is described in Appendix R.2. Net impact evaluation was not conducted for the Appliance Turn-In Initiative or the Direct Install Initiative. The NTG for the Appliance Turn-In Initiative is estimated to be the same as the NTG of the residential Appliance Turn-In Initiative, while the NTG of the Direct Install Initiative is estimated to be the same as for the Lighting Initiative, as all four rebated projects across the Companies were found to be lighting retrofits.

Table 99 summarizes program verified gross and net energy impacts and net-to-gross ratios for each EDC. Note that net-to-gross values are not identical to those reported in PY8 because the relative weights of gross impacts between strata vary from year to year. This is true among initiatives and within initiatives (e.g., large lighting projects may have different NTG than small lighting projects).

Table 99: ESB-Small Program Net Impact Evaluation Summary for PY9

EDC	Sampling Initiative	Gross Verified MWh	NTG	Net Verified MWh
Met-Ed	Lighting	35,108	63.1%	22,151
Met-Ed	Custom	2,048	38.8%	794
Met-Ed	Prescriptive	184	40.9%	75
Met-Ed	Appliance Turn-In	78	49.0%	38
Met-Ed	Direct Install	6	66.3%	4
Met-Ed Total		**37,424**	**61.6%**	**23,062**
Penelec	Lighting	21,826	83.7%	18,258
Penelec	Custom	2,647	51.6%	1,366
Penelec	Prescriptive	611	43.2%	264
Penelec	Appliance Turn-In	77	45.0%	34
Penelec	Direct Install	8	85.0%	7
Penelec Total		**25,168**	**79.2%**	**19,929**
Penn Power	Lighting	12,686	75.1%	9,522
Penn Power	Custom	707	46.1%	326
Penn Power	Prescriptive	313	37.7%	118
Penn Power	Appliance Turn-In	16	58.0%	9
Penn Power	Direct Install	0	75.2%	0
Penn Power Total		**13,722**	**72.7%**	**9,975**
WPP	Lighting	33,723	83.3%	28,098
WPP	Custom	1,444	47.2%	681
WPP	Prescriptive	550	100.2%	551
WPP	Appliance Turn-In	72	51.0%	37
WPP	Direct Install	0	82.9%	0
WPP Total		**35,789**	**82.1%**	**29,367**

3.5.3.1 High-Impact Measure Research

The Lighting and Custom Initiatives were identified as High-Impact Measures and researched for net-to-gross in PY8. The net impact evaluation of the Lighting Initiative is described in Appendix P.2. The net impact evaluation of the Custom Initiative is described in Appendix Q.2.

3.5.4 Verified Savings Estimates

In Table 100 the realization rates and net-to-gross ratios determined by Tetra Tech are applied to the reported energy and demand savings estimates to calculate the verified savings estimates for the ESB-Small Program in PY9 These totals are added to the verified savings achieved in previous program years to calculate the P3TD program impacts.

Table 100: PYTD and P3TD Savings Summary

	Met-Ed		Penelec		Penn Power		WPP	
Savings Type	Energy (MWh/yr)	Demand (MW/yr)	Energy (MWh/yr)	Demand (MW/yr)	Energy (MWh/yr)	Demand (MW/yr)	Energy (MWh/yr)	Demand (MW/yr)
PYRTD	36,935	5.43	28,898	4.11	13,729	1.93	31,549	4.43
PYVTD Gross	37,424	5.42	25,168	3.84	13,722	1.86	35,789	4.65
PYVTD Net	23,062	3.37	19,929	3.11	9,975	1.35	29,367	3.82
RTD	49,461	7.35	46,970	7.10	22,432	3.35	46,089	6.74
VTD Gross	48,893	7.44	42,043	6.78	21,873	3.33	50,312	6.87
VTD Net	30,503	4.68	33,818	5.54	15,854	2.41	41,286	5.65

3.5.5 Process Evaluation

Tetra Tech conducted a process evaluation for this program in PY8. The process evaluation kicked off with interviews with FirstEnergy and ICSP staff. These interviews led to identification of issues that were researched through a participant survey and contractor interviews. The participant survey was conducted over the phone. Researchable issues focused on satisfaction, customer awareness and marketing, incentive levels, program processes, and the transition to a new ICSP in Phase III.

Process evaluation activities were combined for the Large C&I, Small C&I, and Government and Institutional programs given the similarities in program delivery. Survey strata were based on the project type, and were defined as Custom, Lighting, or Other, with the Other category including prescriptive downstream measures (administered by Sodexo) but excluding Appliance Turn-In. The sample design, from the PY8 process evaluation effort, is shown in Table 101, and represents all C&I energy efficiency programs offered by each EDC.

Table 101: ESB-Small Program Process Evaluation Sample Design

Stratum	Population Size	Achieved Sample Size	Response Rate
Met-Ed Lighting	349	63	42%
Met-Ed Custom	40	17	57%
Met-Ed Other	27	2	29%
Penelec Lighting	792	103	44%
Penelec Custom	58	18	51%
Penelec Other	38	2	18%
Penn Power Lighting	416	45	38%
Penn Power Custom	20	7	47%
Penn Power Other	8	1	50%
WPP Lighting	639	70	41%
WPP Custom	47	14	48%
WPP Other	39	1	17%

Key findings and recommendations are listed in Section 3.5.7

3.5.6 Cost-Effectiveness Reporting

A detailed breakdown of program finances and cost-effectiveness is presented in Table 102, Table 103, Table 104, and Table 105 for Met-Ed, Penelec, Penn Power, and WPP respectively. The last two columns of the tables show benefits as calculated with net verified impacts, along with net participant costs (if applicable). The third and fourth columns show results as calculated on a gross basis. PYTD costs and benefits are net present values (NPV) expressed in 2017 dollars. NPV costs and benefits for P3TD financials are expressed in the 2016 dollars.

Table 102: Summary of Program Finances – Met-Ed

Row #	Cost Category	Gross PYTD ($1,000)		Gross P3TD ($1,000)		Net PYTD ($1,000)		Net P3TD ($1,000)	
1	EDC Incentives to Participants [1]	1,472		2,196		1,472		2,196	
2	EDC Incentives to Trade Allies	0		0		0		0	
3	Participant Costs (net of incentives/rebates paid by utilities)	4,850		7,359		2,297		3,654	
4	**Incremental Measure Costs (Sum of rows 1 through 3)**	**6,322**		**9,555**		**3,768**		**5,850**	
		EDC	CSP	EDC	CSP	EDC	CSP	EDC	CSP
5	Design & Development [2]	0	39	0	66	0	39	0	66
6	Administration, Management, and Technical Assistance [3]	42	411	97	676	42	411	97	676
7	Marketing [4]	0	163	0	286	0	163	0	286
8	Program Delivery [5]	59	334	136	563	59	334	136	563
9	EDC Evaluation Costs	176		241		176		241	
10	SWE Audit Costs	35		96		35		96	
11	**Program Overhead Costs (Sum of rows 5 through 10)**	**1,258**		**2,161**		**1,258**		**2,161**	
12	NPV of increases in costs of natural gas (or other fuels) for fuel switching programs	0		0		0		0	
13	**Total NPV TRC Costs [6] (Net present value of sum of rows 4, 11, and 12)**	**7,580**		**11,244**		**5,026**		**7,698**	
14	Total NPV Lifetime Electric Energy Benefits	14,996		18,653		9,255		11,660	
15	Total NPV Lifetime Electric Capacity Benefits	4,318		5,862		2,681		3,699	
16	Total NPV Lifetime Operation and Maintenance (O&M) Benefits	0		0		0		0	
17	Total NPV Lifetime Non-Electric Benefits (Fossil Fuel, Water)	-1,594		-2,024		-1,006		-1,294	
18	**Total NPV TRC Benefits [7] (Sum of rows 14 through 17)**	**17,721**		**22,490**		**10,931**		**14,065**	
19	**TRC Benefit-Cost Ratio [8]**	**2.34**		**2.00**		**2.17**		**1.83**	

[1] Includes direct install equipment costs and costs for EE&C kits.

[2] Includes direct costs attributable to plan and advance the programs. Note: The design of the HERs program should be included here, while the actual development and mailing of HERs would be attributable to Program Delivery.

[3] Includes rebate processing, tracking system, general administration, program management, general management and legal, and technical assistance. Any common portfolio costs that are allocated across programs should be shown in this row.

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

[5] Direct program implementation costs. Labor, fuel, and vehicle operation costs for appliance recycling and direct install programs. For behavioral programs, this includes the printing and postage of HERs.

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

[7] Total TRC Benefits equals the sum of Total Lifetime Electric and Non-Electric Benefits. 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. Savings carried over from Phase II are not included as a part of Total TRC Benefits for Phase III.

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

* Rows 1-11 are presented in nominal dollars

Table 103: Summary of Program Finances – Penelec

Row #	Cost Category	Gross PYTD ($1,000)		Gross P3TD ($1,000)		Net PYTD ($1,000)		Net P3TD ($1,000)	
1	EDC Incentives to Participants [1]	1,557		2,720		1,557		2,720	
2	EDC Incentives to Trade Allies	0		0		0		0	
3	Participant Costs (net of incentives/rebates paid by utilities)	8,198		12,266		6,308		9,382	
4	**Incremental Measure Costs (Sum of rows 1 through 3)**	**9,755**		**14,987**		**7,865**		**12,102**	
		EDC	CSP	EDC	CSP	EDC	CSP	EDC	CSP
5	Design & Development [2]	0	33	0	64	0	33	0	64
6	Administration, Management, and Technical Assistance [3]	48	340	125	667	48	340	125	667
7	Marketing [4]	0	157	0	275	0	157	0	275
8	Program Delivery [5]	72	282	169	554	72	282	169	554
9	EDC Evaluation Costs	183		254		183		254	
10	SWE Audit Costs	37		101		37		101	
11	**Program Overhead Costs (Sum of rows 5 through 10)**	**1,151**		**2,209**		**1,151**		**2,209**	
12	NPV of increases in costs of natural gas (or other fuels) for fuel switching programs	0		0		0		0	
13	**Total NPV TRC Costs [6] (Net present value of sum of rows 4, 11, and 12)**	**10,905**		**16,505**		**9,016**		**13,740**	
14	Total NPV Lifetime Electric Energy Benefits	9,502		15,272		7,564		12,351	
15	Total NPV Lifetime Electric Capacity Benefits	2,952		5,451		2,398		4,479	
16	Total NPV Lifetime Operation and Maintenance (O&M) Benefits	0		0		0		0	
17	Total NPV Lifetime Non-Electric Benefits (Fossil Fuel, Water)	-1,103		-1,644		-916		-1,377	
18	**Total NPV TRC Benefits [7] (Sum of rows 14 through 17)**	**11,350**		**19,080**		**9,046**		**15,453**	
19	**TRC Benefit-Cost Ratio [8]**	**1.04**		**1.16**		**1.00**		**1.12**	

[1] Includes direct install equipment costs and costs for EE&C kits.

[2] Includes direct costs attributable to plan and advance the programs. Note: The design of the HERs program should be included here, while the actual development and mailing of HERs would be attributable to Program Delivery.
[3] Includes rebate processing, tracking system, general administration, program management, general management and legal, and technical assistance. Any common portfolio costs that are allocated across programs should be shown in this row.
[4] Includes the marketing CSP and marketing costs by program CSPs.
[5] Direct program implementation costs. Labor, fuel, and vehicle operation costs for appliance recycling and direct install programs. For behavioral programs, this includes the printing and postage of HERs.
[6] Total TRC Costs includes Total EDC Costs and Participant Costs.
[7] Total TRC Benefits equals the sum of Total Lifetime Electric and Non-Electric Benefits. 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. Savings carried over from Phase II are not included as a part of Total TRC Benefits for Phase III.
[8] TRC Ratio equals Total NPV TRC Benefits divided by Total NPV TRC Costs.
* Rows 1-11 are presented in nominal dollars

Table 104: Summary of Program Finances – Penn Power

Row #	Cost Category	Gross PYTD ($1,000)		Gross P3TD ($1,000)		Net PYTD ($1,000)		Net P3TD ($1,000)	
1	EDC Incentives to Participants [1]	736		1,248		736		1,248	
2	EDC Incentives to Trade Allies	0		0		0		0	
3	Participant Costs (net of incentives/rebates paid by utilities)	3,723		4,680		2,471		2,943	
4	**Incremental Measure Costs (Sum of rows 1 through 3)**	**4,459**		**5,928**		**3,207**		**4,191**	
		EDC	CSP	EDC	CSP	EDC	CSP	EDC	CSP
5	Design & Development [2]	0	15	0	27	0	15	0	27
6	Administration, Management, and Technical Assistance [3]	18	158	27	283	18	158	27	283
7	Marketing [4]	0	32	0	55	0	32	0	55
8	Program Delivery [5]	20	122	41	222	20	122	41	222
9	EDC Evaluation Costs	44		61		44		61	
10	SWE Audit Costs	9		25		9		25	
11	**Program Overhead Costs (Sum of rows 5 through 10)**	**417**		**741**		**417**		**741**	
12	NPV of increases in costs of natural gas (or other fuels) for fuel switching programs	0		0		0		0	
13	**Total NPV TRC Costs [6] (Net present value of sum of rows 4, 11, and 12)**	**4,876**		**6,355**		**3,624**		**4,698**	
14	Total NPV Lifetime Electric Energy Benefits	5,229		8,024		3,825		5,838	
15	Total NPV Lifetime Electric Capacity Benefits	1,405		2,711		1,025		1,966	
16	Total NPV Lifetime Operation and Maintenance (O&M) Benefits	0		0		0		0	
17	Total NPV Lifetime Non-Electric Benefits (Fossil Fuel, Water)	-760		-1,030		-579		-782	
18	**Total NPV TRC Benefits [7] (Sum of rows 14 through 17)**	**5,873**		**9,705**		**4,271**		**7,022**	
19	**TRC Benefit-Cost Ratio [8]**	**1.20**		**1.53**		**1.18**		**1.49**	

[1] Includes direct install equipment costs and costs for EE&C kits.
[2] Includes direct costs attributable to plan and advance the programs. Note: The design of the HERs program should be included here, while the actual development and mailing of HERs would be attributable to Program Delivery.
[3] Includes rebate processing, tracking system, general administration, program management, general management and legal, and technical assistance. Any common portfolio costs that are allocated across programs should be shown in this row.
[4] Includes the marketing CSP and marketing costs by program CSPs.
[5] Direct program implementation costs. Labor, fuel, and vehicle operation costs for appliance recycling and direct install programs. For behavioral programs, this includes the printing and postage of HERs.
[6] Total TRC Costs includes Total EDC Costs and Participant Costs.
[7] Total TRC Benefits equals the sum of Total Lifetime Electric and Non-Electric Benefits. 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. Savings carried over from Phase II are not included as a part of Total TRC Benefits for Phase III.
[8] TRC Ratio equals Total NPV TRC Benefits divided by Total NPV TRC Costs.
* Rows 1-11 are presented in nominal dollars

Table 105: Summary of Program Finances – WPP

Row #	Cost Category	Gross PYTD ($1,000)		Gross P3TD ($1,000)		Net PYTD ($1,000)		Net P3TD ($1,000)	
1	EDC Incentives to Participants [1]	1,665		2,542		1,665		2,542	
2	EDC Incentives to Trade Allies	0		0		0		0	
3	Participant Costs (net of incentives/rebates paid by utilities)	13,007		17,251		10,436		13,783	
4	**Incremental Measure Costs (Sum of rows 1 through 3)**	**14,672**		**19,793**		**12,101**		**16,325**	
		EDC	CSP	EDC	CSP	EDC	CSP	EDC	CSP
5	Design & Development [2]	0	39	0	69	0	39	0	69
6	Administration, Management, and Technical Assistance [3]	50	406	124	719	50	406	124	719
7	Marketing [4]	0	229	0	401	0	229	0	401
8	Program Delivery [5]	60	329	140	587	60	329	140	587
9	EDC Evaluation Costs	191		257		191		257	
10	SWE Audit Costs	34		95		34		95	
11	**Program Overhead Costs (Sum of rows 5 through 10)**	**1,338**		**2,391**		**1,338**		**2,391**	
12	NPV of increases in costs of natural gas (or other fuels) for fuel switching programs	0		0		0		0	
13	**Total NPV TRC Costs [6] (Net present value of sum of rows 4, 11, and 12)**	**16,010**		**21,181**		**13,439**		**17,874**	
14	Total NPV Lifetime Electric Energy Benefits	13,702		18,327		11,242		15,056	
15	Total NPV Lifetime Electric Capacity Benefits	3,664		5,497		3,016		4,528	
16	Total NPV Lifetime Operation and Maintenance (O&M) Benefits	0		0		0		0	
17	Total NPV Lifetime Non-Electric Benefits (Fossil Fuel, Water)	-1,870		-2,324		-1,570		-1,945	
18	**Total NPV TRC Benefits [7] (Sum of rows 14 through 17)**	**15,496**		**21,500**		**12,689**		**17,640**	
19	**TRC Benefit-Cost Ratio [8]**	**0.97**		**1.02**		**0.94**		**0.99**	

[1] Includes direct install equipment costs and costs for EE&C kits.
[2] Includes direct costs attributable to plan and advance the programs. Note: The design of the HERs program should be included here, while the actual development and mailing of HERs would be attributable to Program Delivery.
[3] Includes rebate processing, tracking system, general administration, program management, general management and legal, and technical assistance. Any common portfolio costs that are allocated across programs should be shown in this row.
[4] Includes the marketing CSP and marketing costs by program CSPs.
[5] Direct program implementation costs. Labor, fuel, and vehicle operation costs for appliance recycling and direct install programs. For behavioral programs, this includes the printing and postage of HERs.
[6] Total TRC Costs includes Total EDC Costs and Participant Costs.
[7] Total TRC Benefits equals the sum of Total Lifetime Electric and Non-Electric Benefits. 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. Savings carried over from Phase II are not included as a part of Total TRC Benefits for Phase III.
[8] TRC Ratio equals Total NPV TRC Benefits divided by Total NPV TRC Costs.
* Rows 1-11 are presented in nominal dollars

3.5.7 Status of Recommendations

The impact and process evaluation activities in PY8 led to the following findings and recommendations from Tetra Tech to the Companies along with a summary of how the Companies plan to address the recommendation in program delivery.

Finding #1: Participating customer and trade ally satisfaction remains high. Average customer and trade ally satisfaction ratings across all aspects of the program met or exceeded 4.0 on a 1 to 5 scale with 1 being "not at all satisfied" and 5 being "very satisfied". Nearly two-thirds of participant customer respondents (64 percent) reported that they have recommended FirstEnergy's business programs to others and 84 percent said they are "very likely" to participate in FirstEnergy's programs again in the future, suggesting a strong pipeline for future participation.

Recommendation #1: Continue current processes to maintain high customer and trade ally satisfaction and monitor impacts of program design changes on satisfaction levels.

EDC Status Report #1: Recommendation accepted.

Finding #2: Trade allies continue to be the primary driver of customer awareness and participation in Phase III. While the program has been successful in generating repeat participants through the trade ally relationships, views on the level of general customer awareness of FirstEnergy's business programs is mixed. Participants report preferring to receive information about FirstEnergy's programs through email or electronic newsletters, direct mail, and utility bill inserts.

Recommendation #2: Continue to leverage trade ally relationships to help drive participation in the program. Consider additional email and/or direct mailing campaigns to customers.

EDC Status Report #2: Recommendation accepted.

Finding #3: Impressions of the transition to a new ICSP are largely positive; though feedback suggests there may be opportunities to further support to trade allies. Most trade allies interviewed felt well supported by the program and report being in regular communication with their ICSP representative. At the same time, some trade allies noted the loss of some established working relationships and longer response times to requests or questions than observed under the previous ICSP.

Recommendation #3: Continue providing individual support to trade allies and work to ensure inquiries are responded to promptly.

EDC Status Report #3: Recommendation accepted.

Finding #4: While recent efforts to provide additional application support have been recognized, further streamlining the application process remains among the most common recommendations provided by customers and trade allies. Participating trade allies and customers often described the application process as time-consuming and/or cumbersome.

Additionally, several trade allies mentioned not pursuing program incentives for certain projects due to the perceived administrative burden or combination of the required paperwork not being worth the incentives available through the program.

Recommendation #5: Continue to review the application process on an ongoing basis for any additional efficiencies that may be achieved without compromising program implementation or evaluation efforts. In addition, continue to provide application training and support to trade allies and customers.

EDC Status Report #5: Recommendation accepted. The Companies note that applications – particularly for lighting upgrades – will continue to require significant levels of detail to conform with Act 129 measurement and verification requirements.

3.6 C&I Energy Solutions for Business Program - Large

The C&I Solutions for Business Program – Large (referred to as ESB-Large Program) is offered to large commercial and industrial customers and is implemented by Sodexo. The program includes downstream incentives for customers that install energy efficient equipment. Major program components include lighting (both new construction and retrofits), custom HVAC upgrades, compressed air projects, process improvements, and prescriptive HVAC, refrigeration, and food-service measures. The incentives for most downstream measures are proportional to the reported energy savings.

3.6.1 Participation and Reported Savings by Customer Segment

Table 106 and Table 107 present the participation counts, reported energy and demand savings, and incentive payments for the ESB-Small Program in PY9 by customer segment and EDC. This program serves the Large C&I and GNI customer segments. Each separate rebate application is counted as one participant.

Table 106: ESB-Large Program Participation and Reported Impacts for Met-Ed and Penelec

Parameter	Met-Ed Large C&I (Non-GNI)	Met-Ed GNI	Met-Ed Total	Penelec Large C&I (Non-GNI)	Penelec GNI	Penelec Total
PYTD # Participants	141	66	207	125	51	176
PYRTD MWh/yr	25,810	5,524	31,334	41,228	3,864	45,092
PYRTD MW/yr	3.65	1.04	4.69	5.29	0.49	5.78
PYTD Incentives ($1000)	1,226.23	270.89	1,497.12	2,012.45	185.47	2,197.93

Table 107: ESB-Large Program Participation and Reported Impacts for Penn Power and WPP

Parameter	Penn Power Large C&I (Non-GNI)	Penn Power GNI	Penn Power Total	WPP Large C&I (Non-GNI)	WPP GNI	WPP Total
PYTD # Participants	43	6	49	96	30	126
PYRTD MWh/yr	11,183	266	11,449	22,360	19,431	41,790
PYRTD MW/yr	1.33	0.01	1.34	3.18	1.77	4.95
PYTD Incentives ($1000)	492.27	17.43	509.70	1,104.21	683.28	1,787.49

3.6.2 Gross Impact Evaluation

The ESB-Large Program was disaggregated into three sampling initiatives for gross impact evaluation, as described in Appendix C. Lighting improvements were grouped into the C/I Lighting initiative and evaluated according to PA TRM protocols as described in detail in

Appendix P. Prescriptive HVAC and appliance projects were grouped into the Prescriptive Initiative. The evaluation of Prescriptive projects is described in Appendix R. Custom projects include combinations of measures that serve multiple end-uses, as well as custom projects that involve combined heat and power, motors and drives, industrial process improvements, refrigeration, retro-commissioning, compressed air upgrades, data centers, and custom HVAC and chillers. The impact evaluation for the Custom Initiative is described in Appendix Q. For all EDCs, the Lighting Initiative attributed for the majority of program savings, followed by the Custom initiative. The Prescriptive and Appliance Turn-In initiatives accounted for small fractions of overall program impacts. Table 108 summarizes program verified impacts and realization rates for each EDC.

Table 108: ESB-Large Program Gross Impact Evaluation Summary for PY9

EDC	Sampling Initiative	Gross Verified MWh	Gross Verified MW	MWh Realization Rate	MW Realization Rate
Met-Ed	Lighting	22,323	3.12	102%	101%
Met-Ed	Custom	9,284	1.36	100%	86%
Met-Ed	Prescriptive	27	0.01	86%	89%
Met-Ed Total		**31,633**	**4.49**	**101.0%**	**95.8%**
Penelec	Lighting	32,607	4.64	86%	95%
Penelec	Custom	6,726	0.70	94%	77%
Penelec	Prescriptive	16	0.00	101%	78%
PenelecTotal		**39,348**	**5.34**	**87.3%**	**92.5%**
Penn Power	Lighting	8,104	0.92	99%	97%
Penn Power	Custom	3,206	0.31	99%	79%
Penn Power	Prescriptive	7	0.00	197%	170%
Penn PowerTotal		**11,317**	**1.22**	**98.9%**	**91.6%**
WPP	Lighting	19,515	2.99	116%	108%
WPP	Custom	23,492	1.58	94%	73%
WPP	Prescriptive	14	0.01	66%	70%
WPP Total		**43,021**	**4.58**	**102.9%**	**92.5%**

The gross realization rates for energy savings were driven primarily by variances between assumed operational characteristics in advance of rebate approval and operational characteristics that were determined through impact evaluation activities. Key operational characteristics include lighting hours of use and equivalent full load hours for chillers, air compressors, and motors.

3.6.3 Net Impact Evaluation

Tetra-Tech conducted a Net-to-Gross evaluation for this program in PY8. The net impact evaluation of the Lighting Initiative is described in Appendix P.2. The net impact evaluation of the Custom Initiative is described in Appendix Q.2. The net impact evaluation of the Prescriptive Initiative is described in Appendix R.2. Table 109 summarizes program verified gross and net energy impacts and net-to-gross ratios for each EDC. Note that net-to-gross values are not identical to those reported in PY8 because the relative weights of gross impacts

between strata vary from year to year. This is true among initiatives and also within initiatives (e.g., large lighting projects may have different NTG than small lighting projects).

Table 109: ESB-Large Program Net Impact Evaluation Summary for PY8

EDC	Sampling Initiative	Gross Verified MWh	NTG	Net Verified MWh
Met-Ed	Lighting	22,323	63.1%	14,084
Met-Ed	Custom	9,284	38.8%	3,598
Met-Ed	Prescriptive	27	40.9%	11
Met-Ed Total		31,633	55.9%	17,693
Penelec	Lighting	32,607	83.7%	27,276
Penelec	Custom	6,726	51.6%	3,470
Penelec	Prescriptive	16	43.2%	7
Penelec Total		39,348	78.2%	30,753
Penn Power	Lighting	8,104	75.1%	6,083
Penn Power	Custom	3,206	46.1%	1,479
Penn Power	Prescriptive	7	37.7%	3
Penn Power Total		11,317	66.8%	7,564
WPP	Lighting	19,515	83.3%	16,259
WPP	Custom	23,492	47.2%	11,085
WPP	Prescriptive	14	100.2%	14
WPP Total		43,021	63.6%	27,359

3.6.3.1 High-Impact Measure Research

The Lighting and Custom Initiatives were identified as High-Impact Measures in PY8. The net impact evaluation of the Lighting Initiative is described in Appendix P.2. The net impact evaluation of the Custom Initiative is described in Appendix Q.2.

3.6.4 Verified Savings Estimates

In Table 110 the realization rates and net-to-gross ratios determined by Tetra Tech are applied to the reported energy and demand savings estimates to calculate the verified savings estimates for ESB-Large Program in PY8. These totals are added to the verified savings achieved in previous program years to calculate the P3TD program impacts.

Table 110: PYTD and P3TD Savings Summary

	Met-Ed		Penelec		Penn Power		WPP	
Savings Type	Energy (MWh/yr)	Demand (MW/yr)	Energy (MWh/yr)	Demand (MW/yr)	Energy (MWh/yr)	Demand (MW/yr)	Energy (MWh/yr)	Demand (MW/yr)
PYRTD	31,334	4.69	45,092	5.78	11,449	1.34	41,790	4.95
PYVTD Gross	31,633	4.49	39,348	5.34	11,317	1.22	43,021	4.58
PYVTD Net	17,693	2.50	30,753	4.24	7,564	0.83	27,359	3.24
RTD	62,253	8.79	60,902	7.64	14,495	1.63	52,268	6.47
VTD Gross	61,276	8.76	54,015	7.00	14,085	1.55	53,435	6.05
VTD Net	33,881	4.77	41,859	5.57	9,225	1.03	35,032	4.28

3.6.5 Process Evaluation

The process evaluation effort for all three C&I Programs is described in Sections 3.5.5 and 3.5.7. Most practical aspects of the programs are managed as one general effort rather than three distinct programs, but applications are placed in one of three programs according to their associated rate classes.

3.6.6 Cost-Effectiveness Reporting

A detailed breakdown of program finances and cost-effectiveness is presented in Table 111, Table 112, Table 113, and Table 114 for Met-Ed, Penelec, Penn Power, and WPP respectively. The last two columns of the tables show benefits as calculated with net verified impacts, along with net participant costs (if applicable). The third and fourth columns show results as calculated on a gross basis. PYTD costs and benefits are net present values (NPV) expressed in 2017 dollars. NPV costs and benefits for P3TD financials are expressed in the 2016 dollars.

Table 111: Summary of Program Finances – Met-Ed

Row #	Cost Category	Gross PYTD ($1,000)		Gross P3TD ($1,000)		Net PYTD ($1,000)		Net P3TD ($1,000)	
1	EDC Incentives to Participants [1]	1,497		3,039		1,497		3,039	
2	EDC Incentives to Trade Allies	0		0		0		0	
3	Participant Costs (net of incentives/rebates paid by utilities)	5,755		13,784		2,151		5,603	
4	**Incremental Measure Costs (Sum of rows 1 through 3)**	**7,253**		**16,822**		**3,648**		**8,642**	
		EDC	CSP	EDC	CSP	EDC	CSP	EDC	CSP
5	Design & Development [2]	0	34	0	81	0	34	0	81
6	Administration, Management, and Technical Assistance [3]	26	268	69	636	26	268	69	636
7	Marketing [4]	0	106	0	185	0	106	0	185
8	Program Delivery [5]	27	369	63	875	27	369	63	875
9	EDC Evaluation Costs	195		276		195		276	
10	SWE Audit Costs	27		74		27		74	
11	**Program Overhead Costs (Sum of rows 5 through 10)**	**1,052**		**2,259**		**1,052**		**2,259**	
12	NPV of increases in costs of natural gas (or other fuels) for fuel switching programs	0		0		0		0	
13	**Total NPV TRC Costs [6] (Net present value of sum of rows 4, 11, and 12)**	**8,304**		**18,566**		**4,699**		**10,609**	
14	Total NPV Lifetime Electric Energy Benefits	12,482		23,695		7,024		13,121	
15	Total NPV Lifetime Electric Capacity Benefits	3,524		7,237		1,972		3,925	
16	Total NPV Lifetime Operation and Maintenance (O&M) Benefits	0		0		0		0	
17	Total NPV Lifetime Non-Electric Benefits (Fossil Fuel, Water)	-1,015		-1,813		-640		-1,172	
18	**Total NPV TRC Benefits [7] (Sum of rows 14 through 17)**	**14,990**		**29,118**		**8,356**		**15,874**	
19	**TRC Benefit-Cost Ratio [8]**	**1.81**		**1.57**		**1.78**		**1.50**	

[1] Includes direct install equipment costs and costs for EE&C kits.

[2] Includes direct costs attributable to plan and advance the programs. Note: The design of the HERs program should be included here, while the actual development and mailing of HERs would be attributable to Program Delivery.

[3] Includes rebate processing, tracking system, general administration, program management, general management and legal, and technical assistance. Any common portfolio costs that are allocated across programs should be shown in this row.

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

[5] Direct program implementation costs. Labor, fuel, and vehicle operation costs for appliance recycling and direct install programs. For behavioral programs, this includes the printing and postage of HERs.

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

[7] Total TRC Benefits equals the sum of Total Lifetime Electric and Non-Electric Benefits. 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. Savings carried over from Phase II are not included as a part of Total TRC Benefits for Phase III.

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

* Rows 1-11 are presented in nominal dollars

Table 112: Summary of Program Finances – Penelec

Row #	Cost Category	Gross PYTD ($1,000)		Gross P3TD ($1,000)		Net PYTD ($1,000)		Net P3TD ($1,000)	
1	EDC Incentives to Participants [1]	2,198		2,942		2,198		2,942	
2	EDC Incentives to Trade Allies	0		0		0		0	
3	Participant Costs (net of incentives/rebates paid by utilities)	12,971		17,970		9,873		13,199	
4	**Incremental Measure Costs (Sum of rows 1 through 3)**	**15,169**		**20,912**		**12,071**		**16,141**	
		EDC	CSP	EDC	CSP	EDC	CSP	EDC	CSP
5	Design & Development [2]	0	48	0	77	0	48	0	77
6	Administration, Management, and Technical Assistance [3]	51	377	99	606	51	377	99	606
7	Marketing [4]	0	71	0	124	0	71	0	124
8	Program Delivery [5]	28	518	66	833	28	518	66	833
9	EDC Evaluation Costs	170		246		170		246	
10	SWE Audit Costs	24		66		24		66	
11	**Program Overhead Costs (Sum of rows 5 through 10)**	**1,287**		**2,115**		**1,287**		**2,115**	
12	NPV of increases in costs of natural gas (or other fuels) for fuel switching programs	0		0		0		0	
13	**Total NPV TRC Costs [6] (Net present value of sum of rows 4, 11, and 12)**	**16,456**		**21,984**		**13,359**		**17,409**	
14	Total NPV Lifetime Electric Energy Benefits	14,827		19,277		11,652		15,035	
15	Total NPV Lifetime Electric Capacity Benefits	4,091		5,319		3,261		4,252	
16	Total NPV Lifetime Operation and Maintenance (O&M) Benefits	0		0		0		0	
17	Total NPV Lifetime Non-Electric Benefits (Fossil Fuel, Water)	-1,674		-1,960		-1,384		-1,629	
18	**Total NPV TRC Benefits [7] (Sum of rows 14 through 17)**	**17,244**		**22,636**		**13,530**		**17,658**	
19	**TRC Benefit-Cost Ratio [8]**	**1.05**		**1.03**		**1.01**		**1.01**	

[1] Includes direct install equipment costs and costs for EE&C kits.

[2] Includes direct costs attributable to plan and advance the programs. Note: The design of the HERs program should be included here, while the actual development and mailing of HERs would be attributable to Program Delivery.
[3] Includes rebate processing, tracking system, general administration, program management, general management and legal, and technical assistance. Any common portfolio costs that are allocated across programs should be shown in this row.
[4] Includes the marketing CSP and marketing costs by program CSPs.
[5] Direct program implementation costs. Labor, fuel, and vehicle operation costs for appliance recycling and direct install programs. For behavioral programs, this includes the printing and postage of HERs.
[6] Total TRC Costs includes Total EDC Costs and Participant Costs.
[7] Total TRC Benefits equals the sum of Total Lifetime Electric and Non-Electric Benefits. 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. Savings carried over from Phase II are not included as a part of Total TRC Benefits for Phase III.
[8] TRC Ratio equals Total NPV TRC Benefits divided by Total NPV TRC Costs.
* Rows 1-11 are presented in nominal dollars

Table 113: Summary of Program Finances – Penn Power

Row #	Cost Category	Gross PYTD ($1,000)		Gross P3TD ($1,000)		Net PYTD ($1,000)		Net P3TD ($1,000)	
1	EDC Incentives to Participants [1]	510		677		510		677	
2	EDC Incentives to Trade Allies	0		0		0		0	
3	Participant Costs (net of incentives/rebates paid by utilities)	3,085		3,805		1,894		2,198	
4	**Incremental Measure Costs (Sum of rows 1 through 3)**	**3,595**		**4,483**		**2,403**		**2,876**	
		EDC	CSP	EDC	CSP	EDC	CSP	EDC	CSP
5	Design & Development [2]	0	11	0	18	0	11	0	18
6	Administration, Management, and Technical Assistance [3]	17	91	30	140	17	91	30	140
7	Marketing [4]	0	9	0	15	0	9	0	15
8	Program Delivery [5]	8	125	16	193	8	125	16	193
9	EDC Evaluation Costs	37		53		37		53	
10	SWE Audit Costs	5		15		5		15	
11	**Program Overhead Costs (Sum of rows 5 through 10)**	**303**		**481**		**303**		**481**	
12	NPV of increases in costs of natural gas (or other fuels) for fuel switching programs	0		0		0		0	
13	**Total NPV TRC Costs [6] (Net present value of sum of rows 4, 11, and 12)**	**3,898**		**4,712**		**2,707**		**3,182**	
14	Total NPV Lifetime Electric Energy Benefits	4,249		5,040		2,866		3,321	
15	Total NPV Lifetime Electric Capacity Benefits	918		1,166		626		777	
16	Total NPV Lifetime Operation and Maintenance (O&M) Benefits	0		0		0		0	
17	Total NPV Lifetime Non-Electric Benefits (Fossil Fuel, Water)	-379		-410		-321		-341	
18	**Total NPV TRC Benefits [7] (Sum of rows 14 through 17)**	**4,788**		**5,796**		**3,172**		**3,756**	
19	**TRC Benefit-Cost Ratio [8]**	**1.23**		**1.23**		**1.17**		**1.18**	

[1] Includes direct install equipment costs and costs for EE&C kits.
[2] Includes direct costs attributable to plan and advance the programs. Note: The design of the HERs program should be included here, while the actual development and mailing of HERs would be attributable to Program Delivery.
[3] Includes rebate processing, tracking system, general administration, program management, general management and legal, and technical assistance. Any common portfolio costs that are allocated across programs should be shown in this row.
[4] Includes the marketing CSP and marketing costs by program CSPs.
[5] Direct program implementation costs. Labor, fuel, and vehicle operation costs for appliance recycling and direct install programs. For behavioral programs, this includes the printing and postage of HERs.
[6] Total TRC Costs includes Total EDC Costs and Participant Costs.
[7] Total TRC Benefits equals the sum of Total Lifetime Electric and Non-Electric Benefits. 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. Savings carried over from Phase II are not included as a part of Total TRC Benefits for Phase III.
[8] TRC Ratio equals Total NPV TRC Benefits divided by Total NPV TRC Costs.
* Rows 1-11 are presented in nominal dollars

Table 114: Summary of Program Finances – WPP

Row #	Cost Category	Gross PYTD ($1,000)		Gross P3TD ($1,000)		Net PYTD ($1,000)		Net P3TD ($1,000)	
1	EDC Incentives to Participants [1]	1,787		2,309		1,787		2,309	
2	EDC Incentives to Trade Allies	0		0		0		0	
3	Participant Costs (net of incentives/rebates paid by utilities)	13,374		16,335		8,306		10,402	
4	**Incremental Measure Costs (Sum of rows 1 through 3)**	**15,162**		**18,644**		**10,094**		**12,711**	
		EDC	CSP	EDC	CSP	EDC	CSP	EDC	CSP
5	Design & Development [2]	0	48	0	71	0	48	0	71
6	Administration, Management, and Technical Assistance [3]	26	376	69	558	26	376	69	558
7	Marketing [4]	0	83	0	146	0	83	0	146
8	Program Delivery [5]	20	517	48	767	20	517	48	767
9	EDC Evaluation Costs	157		223		157		223	
10	SWE Audit Costs	20		55		20		55	
11	**Program Overhead Costs (Sum of rows 5 through 10)**	**1,247**		**1,938**		**1,247**		**1,938**	
12	NPV of increases in costs of natural gas (or other fuels) for fuel switching programs	233		218		110		103	
13	**Total NPV TRC Costs [6] (Net present value of sum of rows 4, 11, and 12)**	**16,641**		**19,772**		**11,450**		**14,041**	
14	Total NPV Lifetime Electric Energy Benefits	16,593		19,227		10,535		12,647	
15	Total NPV Lifetime Electric Capacity Benefits	3,607		4,595		2,558		3,287	
16	Total NPV Lifetime Operation and Maintenance (O&M) Benefits	0		0		0		0	
17	Total NPV Lifetime Non-Electric Benefits (Fossil Fuel, Water)	-572		-841		-668		-879	
18	**Total NPV TRC Benefits [7] (Sum of rows 14 through 17)**	**19,629**		**22,981**		**12,425**		**15,055**	
19	**TRC Benefit-Cost Ratio [8]**	**1.18**		**1.16**		**1.09**		**1.07**	

[1] Includes direct install equipment costs and costs for EE&C kits.
[2] Includes direct costs attributable to plan and advance the programs. Note: The design of the HERs program should be included here, while the actual development and mailing of HERs would be attributable to Program Delivery.
[3] Includes rebate processing, tracking system, general administration, program management, general management and legal, and technical assistance. Any common portfolio costs that are allocated across programs should be shown in this row.
[4] Includes the marketing CSP and marketing costs by program CSPs.
[5] Direct program implementation costs. Labor, fuel, and vehicle operation costs for appliance recycling and direct install programs. For behavioral programs, this includes the printing and postage of HERs.
[6] Total TRC Costs includes Total EDC Costs and Participant Costs.
[7] Total TRC Benefits equals the sum of Total Lifetime Electric and Non-Electric Benefits. 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. Savings carried over from Phase II are not included as a part of Total TRC Benefits for Phase III.
[8] TRC Ratio equals Total NPV TRC Benefits divided by Total NPV TRC Costs.
* Rows 1-11 are presented in nominal dollars

3.6.7 Status of Recommendations

Recommendations for the nonresidential programs are listed in Section 3.5.7.

3.7 GOVERNMENT AND INSTITUTIONAL TARIFF PROGRAM

The Government and Institutional Tariff Program (referred to as the GAIT Program) is offered to customers with specific rate tariffs such as schools, municipalities, and volunteer fire departments. The impacts from this program are counted toward the Companies' GNI compliance targets, although most of the GNI participation is through the ESB-Small and ESB-Large programs. The program is implemented jointly by Sodexo and ARCA. The Sodexo portion of the program includes downstream incentives for customers that install energy efficient equipment. All measures included in the other C&I EE Programs are offered in the GAIT Program. However, Lighting continues to account for the vast majority of impacts. The incentives for most downstream measures are proportional to the reported energy savings. The ARCA portion of the program included refrigerator, freezer, and room air conditioner recycling.

3.7.1 Participation and Reported Savings by Customer Segment

Table 115 presents the participation counts, reported energy and demand savings, and incentive payments for the GAIT Program in PY9 by EDC. This program serves only the GNI customer segment. Each separate rebate application is counted as one participant.

Table 115: GAIT Program Participation and Reported Impacts

Parameter	Met-Ed GNI	Penelec GNI	Penn Power GNI	WPP GNI
PYTD # Participants	57	307	81	301
PYRTD MWh/yr	619	1,152	605	9,426
PYRTD MW/yr	0.00	0.02	0.00	0.02
PYTD Incentives ($1000)	31.65	57.07	37.16	481.52

3.7.2 Gross Impact Evaluation

The GAIT Program was disaggregated into four sampling initiatives for gross impact evaluation, as described in Appendix C. The Appliance Turn-In program component, administered by ARCA, was evaluated as a separate initiative. The gross impact evaluation for the Appliance Turn-In initiative is described in detail in Appendix S. Lighting improvements were grouped into the C/I Lighting initiative and evaluated according to PA TRM protocols as described in detail in Appendix P. Prescriptive HVAC and appliance projects were grouped into the Prescriptive Initiative. The evaluation of Prescriptive projects is described in Appendix R. Custom projects include combinations of measures that serve multiple end-uses, as well as custom projects that involve combined heat and power, motors and drives, industrial process improvements, refrigeration, retro-commissioning, compressed air upgrades, data centers, and custom HVAC and chillers. The impact evaluation for the custom initiative is described in Appendix Q, however there were no custom projects in the GAIT programs this year. For all EDCs, the Lighting initiative attributed for almost the entirety of program savings. Table 116 summarizes program verified impacts and realization rates for each EDC.

Table 116: GAIT Program Gross Impact Evaluation Summary for PY9

EDC	Sampling Initiative	Gross Verified MWh	Gross Verified MW	MWh Realization Rate	MW Realization Rate
Met-Ed	Lighting	627	0.00	102%	101%
Met-Ed	Prescriptive	0	0.00	86%	89%
Met-Ed	Appliance Turn-In	1	0.00	97%	63%
Met-Ed Total		**628**	**0.00**	**101.5%**	**99.9%**
Penelec	Lighting	988	0.02	86%	95%
Penelec	Prescriptive	0	0.00	101%	78%
Penelec	Appliance Turn-In	2	0.00	93%	78%
PenelecTotal		**990**	**0.02**	**86.0%**	**95.1%**
Penn Power	Lighting	598	0.00	99%	97%
Penn Power	Prescriptive	0	0.00	197%	170%
Penn Power	Appliance Turn-In	0	0.00	77%	70%
Penn PowerTotal		**598**	**0.00**	**98.8%**	**100.0%**
WPP	Lighting	10,925	0.02	116%	108%
WPP	Prescriptive	0	0.00	66%	70%
WPP	Appliance Turn-In	1	0.00	84%	66%
WPP Total		**10,925**	**0.02**	**115.9%**	**107.3%**

The gross realization rates for energy savings were driven primarily by variances between assumed operational characteristics in advance of rebate approval and operational characteristics that were determined through impact evaluation activities. Key operational characteristics include lighting hours of use and equivalent full load hours for chillers, air compressors, and motors.

3.7.3 Net Impact Evaluation

Tetra-Tech conducted a Net-to-Gross evaluation for this program in PY8. The net impact evaluation of the Lighting Initiative is described in Appendix P.2. The net impact evaluation of the Custom Initiative is described in Appendix Q.2. The net impact evaluation of the Prescriptive Initiative is described in Appendix R.2. Net impact evaluation was not conducted for the Appliance Turn-In Initiative or the Direct Install Initiative. The NTG for the Appliance Turn-In Initiative is estimated to be the same as the NTG of the residential Appliance Turn-In Initiative. Table 117 summarizes program verified gross and net energy impacts and net-to-gross ratios for each EDC. Note that net-to-gross values are not identical to those reported in PY8 because the relative weights of gross impacts between strata vary from year to year. This is true among initiatives and also within initiatives (e.g., large lighting projects may have different NTG than small lighting projects).

Table 117: GAIT Program Net Impact Evaluation Summary for PY9

EDC	Sampling Initiative	Gross Verified MWh	NTG	Net Verified MWh
Met-Ed	Lighting	627	63.1%	396
Met-Ed	Prescriptive	0	40.9%	0
Met-Ed	Appliance Turn-In	1	49.0%	0
Met-Ed Total		628	63.1%	396
Penelec	Lighting	988	83.7%	827
Penelec	Prescriptive	0	43.2%	0
Penelec	Appliance Turn-In	2	45.0%	1
Penelec		990	83.6%	827
Penn Power	Lighting	598	75.1%	449
Penn Power	Prescriptive	0	37.7%	0
Penn Power	Appliance Turn-In	0	58.0%	0
Penn Power		598	75.1%	449
WPP	Lighting	10,925	83.3%	9,102
WPP	Prescriptive	0	100.2%	0
WPP	Appliance Turn-In	1	51.0%	0
WPP		10,925	83.3%	9,103

3.7.3.1 High-Impact Measure Research

The Lighting and Custom Initiatives were identified as High-Impact Measures in PY8. The net impact evaluation of the Lighting Initiative is described in Appendix P.2. The net impact evaluation of the Custom Initiative is described in Appendix Q.2.

3.7.4 Verified Savings Estimates

In Table 118 the realization rates and net-to-gross ratios determined by Tetra Tech are applied to the reported energy and demand savings estimates to calculate the verified savings estimates for the GAIT Program in PY9. These totals are added to the verified savings achieved in previous program years to calculate the P3TD program impacts.

Table 118: PYTD and P3TD Savings Summary

	Met-Ed		Penelec		Penn Power		WPP	
Savings Type	Energy (MWh/yr)	Demand (MW/yr)	Energy (MWh/yr)	Demand (MW/yr)	Energy (MWh/yr)	Demand (MW/yr)	Energy (MWh/yr)	Demand (MW/yr)
PYRTD	619	0.00	1,152	0.02	605	0.00	9,426	0.02
PYVTD Gross	628	0.00	990	0.02	598	0.00	10,925	0.02
PYVTD Net	396	0.00	827	0.02	449	0.00	9,103	0.02
RTD	892	0.01	2,004	0.04	2,030	0.06	14,915	0.18
VTD Gross	878	0.01	1,786	0.03	1,943	0.07	16,453	0.18
VTD Net	562	0.01	1,501	0.03	1,461	0.05	13,683	0.15

3.7.5 Process Evaluation

The process evaluation effort for all three C&I Programs is described in Section 3.5.7. Most practical aspects of the programs are managed as one general effort rather than three distinct

programs, but applications are placed in one of three programs according to their associated rate classes.

3.7.6 Cost-Effectiveness Reporting

A detailed breakdown of program finances and cost-effectiveness is presented in Table 119, Table 120, Table 121, and Table 122 for Met-Ed, Penelec, Penn Power, and WPP respectively. The last two columns of the tables show benefits as calculated with net verified impacts, along with net participant costs (if applicable). The third and fourth columns show results as calculated on a gross basis. PYTD costs and benefits are net present values (NPV) expressed in 2017 dollars. NPV costs and benefits for P3TD financials are expressed in the 2016 dollars.

Table 119: Summary of Program Finances – Met-Ed

Row #	Cost Category	Gross PYTD ($1,000)		Gross P3TD ($1,000)		Net PYTD ($1,000)		Net P3TD ($1,000)	
1	EDC Incentives to Participants [1]	32		45		32		45	
2	EDC Incentives to Trade Allies	0		0		0		0	
3	Participant Costs (net of incentives/rebates paid by utilities)	65		120		29		61	
4	**Incremental Measure Costs (Sum of rows 1 through 3)**	**97**		**166**		**61**		**107**	
		EDC	CSP	EDC	CSP	EDC	CSP	EDC	CSP
5	Design & Development [2]	0	1	0	2	0	1	0	2
6	Administration, Management, and Technical Assistance [3]	5	22	-5	40	5	22	-5	40
7	Marketing [4]	0	12	0	21	0	12	0	21
8	Program Delivery [5]	2	6	5	13	2	6	5	13
9	EDC Evaluation Costs	17		30		17		30	
10	SWE Audit Costs	2		6		2		6	
11	**Program Overhead Costs (Sum of rows 5 through 10)**	**66**		**112**		**66**		**112**	
12	NPV of increases in costs of natural gas (or other fuels) for fuel switching programs	0		0		0		0	
13	**Total NPV TRC Costs [6] (Net present value of sum of rows 4, 11, and 12)**	**163**		**267**		**127**		**210**	
14	Total NPV Lifetime Electric Energy Benefits	253		337		159		216	
15	Total NPV Lifetime Electric Capacity Benefits	4		12		2		8	
16	Total NPV Lifetime Operation and Maintenance (O&M) Benefits	0		0		0		0	
17	Total NPV Lifetime Non-Electric Benefits (Fossil Fuel, Water)	-29		-39		-18		-25	
18	**Total NPV TRC Benefits [7] (Sum of rows 14 through 17)**	**228**		**310**		**144**		**199**	
19	**TRC Benefit-Cost Ratio [8]**	**1.40**		**1.16**		**1.13**		**0.94**	

[1] Includes direct install equipment costs and costs for EE&C kits.

[2] Includes direct costs attributable to plan and advance the programs. Note: The design of the HERs program should be included here, while the actual development and mailing of HERs would be attributable to Program Delivery.

[3] Includes rebate processing, tracking system, general administration, program management, general management and legal, and technical assistance. Any common portfolio costs that are allocated across programs should be shown in this row.

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

[5] Direct program implementation costs. Labor, fuel, and vehicle operation costs for appliance recycling and direct install programs. For behavioral programs, this includes the printing and postage of HERs.

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

[7] Total TRC Benefits equals the sum of Total Lifetime Electric and Non-Electric Benefits. 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. Savings carried over from Phase II are not included as a part of Total TRC Benefits for Phase III.

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

* Rows 1-11 are presented in nominal dollars

Table 120: Summary of Program Finances – Penelec

Row #	Cost Category	Gross PYTD ($1,000)		Gross P3TD ($1,000)		Net PYTD ($1,000)		Net P3TD ($1,000)	
1	EDC Incentives to Participants [1]	57		100		57		100	
2	EDC Incentives to Trade Allies	0		0		0		0	
3	Participant Costs (net of incentives/rebates paid by utilities)	344		534		279		433	
4	**Incremental Measure Costs (Sum of rows 1 through 3)**	**401**		**634**		**336**		**533**	
		EDC	CSP	EDC	CSP	EDC	CSP	EDC	CSP
5	Design & Development [2]	0	2	0	4	0	2	0	4
6	Administration, Management, and Technical Assistance [3]	8	45	10	86	8	45	10	86
7	Marketing [4]	0	15	0	27	0	15	0	27
8	Program Delivery [5]	3	15	8	30	3	15	8	30
9	EDC Evaluation Costs	24		46		24		46	
10	SWE Audit Costs	3		8		3		8	
11	**Program Overhead Costs (Sum of rows 5 through 10)**	**115**		**219**		**115**		**219**	
12	NPV of increases in costs of natural gas (or other fuels) for fuel switching programs	0		0		0		0	
13	**Total NPV TRC Costs [6] (Net present value of sum of rows 4, 11, and 12)**	**517**		**820**		**451**		**723**	
14	Total NPV Lifetime Electric Energy Benefits	379		658		317		553	
15	Total NPV Lifetime Electric Capacity Benefits	18		27		15		23	
16	Total NPV Lifetime Operation and Maintenance (O&M) Benefits	0		0		0		0	
17	Total NPV Lifetime Non-Electric Benefits (Fossil Fuel, Water)	-49		-77		-41		-65	
18	**Total NPV TRC Benefits [7] (Sum of rows 14 through 17)**	**348**		**608**		**291**		**511**	
19	**TRC Benefit-Cost Ratio [8]**	**0.67**		**0.74**		**0.64**		**0.71**	

[1] Includes direct install equipment costs and costs for EE&C kits.

[2] Includes direct costs attributable to plan and advance the programs. Note: The design of the HERs program should be included here, while the actual development and mailing of HERs would be attributable to Program Delivery.
[3] Includes rebate processing, tracking system, general administration, program management, general management and legal, and technical assistance. Any common portfolio costs that are allocated across programs should be shown in this row.
[4] Includes the marketing CSP and marketing costs by program CSPs.
[5] Direct program implementation costs. Labor, fuel, and vehicle operation costs for appliance recycling and direct install programs. For behavioral programs, this includes the printing and postage of HERs.
[6] Total TRC Costs includes Total EDC Costs and Participant Costs.
[7] Total TRC Benefits equals the sum of Total Lifetime Electric and Non-Electric Benefits. 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. Savings carried over from Phase II are not included as a part of Total TRC Benefits for Phase III.
[8] TRC Ratio equals Total NPV TRC Benefits divided by Total NPV TRC Costs.
* Rows 1-11 are presented in nominal dollars

Table 121: Summary of Program Finances – Penn Power

Row #	Cost Category	Gross PYTD ($1,000)		Gross P3TD ($1,000)		Net PYTD ($1,000)		Net P3TD ($1,000)	
1	EDC Incentives to Participants [1]	37		110		37		110	
2	EDC Incentives to Trade Allies	0		0		0		0	
3	Participant Costs (net of incentives/rebates paid by utilities)	153		274		106		178	
4	**Incremental Measure Costs (Sum of rows 1 through 3)**	**190**		**383**		**143**		**288**	
		EDC	CSP	EDC	CSP	EDC	CSP	EDC	CSP
5	Design & Development [2]	0	0	0	1	0	0	0	1
6	Administration, Management, and Technical Assistance [3]	0	19	0	59	0	19	0	59
7	Marketing [4]	0	4	0	6	0	4	0	6
8	Program Delivery [5]	1	3	2	7	1	3	2	7
9	EDC Evaluation Costs	6		10		6		10	
10	SWE Audit Costs	1		2		1		2	
11	**Program Overhead Costs (Sum of rows 5 through 10)**	**33**		**87**		**33**		**87**	
12	NPV of increases in costs of natural gas (or other fuels) for fuel switching programs	0		0		0		0	
13	**Total NPV TRC Costs [6] (Net present value of sum of rows 4, 11, and 12)**	**223**		**456**		**176**		**364**	
14	Total NPV Lifetime Electric Energy Benefits	231		733		174		551	
15	Total NPV Lifetime Electric Capacity Benefits	0		63		0		47	
16	Total NPV Lifetime Operation and Maintenance (O&M) Benefits	0		0		0		0	
17	Total NPV Lifetime Non-Electric Benefits (Fossil Fuel, Water)	-37		-94		-28		-71	
18	**Total NPV TRC Benefits [7] (Sum of rows 14 through 17)**	**194**		**702**		**146**		**528**	
19	**TRC Benefit-Cost Ratio [8]**	**0.87**		**1.54**		**0.83**		**1.45**	

[1] Includes direct install equipment costs and costs for EE&C kits.
[2] Includes direct costs attributable to plan and advance the programs. Note: The design of the HERs program should be included here, while the actual development and mailing of HERs would be attributable to Program Delivery.
[3] Includes rebate processing, tracking system, general administration, program management, general management and legal, and technical assistance. Any common portfolio costs that are allocated across programs should be shown in this row.
[4] Includes the marketing CSP and marketing costs by program CSPs.
[5] Direct program implementation costs. Labor, fuel, and vehicle operation costs for appliance recycling and direct install programs. For behavioral programs, this includes the printing and postage of HERs.
[6] Total TRC Costs includes Total EDC Costs and Participant Costs.
[7] Total TRC Benefits equals the sum of Total Lifetime Electric and Non-Electric Benefits. 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. Savings carried over from Phase II are not included as a part of Total TRC Benefits for Phase III.
[8] TRC Ratio equals Total NPV TRC Benefits divided by Total NPV TRC Costs.
* Rows 1-11 are presented in nominal dollars

Table 122: Summary of Program Finances – WPP

Row #	Cost Category	Gross PYTD ($1,000)		Gross P3TD ($1,000)		Net PYTD ($1,000)		Net P3TD ($1,000)	
1	EDC Incentives to Participants [1]	482		756		482		756	
2	EDC Incentives to Trade Allies	0		0		0		0	
3	Participant Costs (net of incentives/rebates paid by utilities)	4,068		5,775		3,309		4,677	
4	**Incremental Measure Costs (Sum of rows 1 through 3)**	**4,550**		**6,531**		**3,791**		**5,433**	
		EDC	CSP	EDC	CSP	EDC	CSP	EDC	CSP
5	Design & Development [2]	0	1	0	3	0	1	0	3
6	Administration, Management, and Technical Assistance [3]	4	246	5	393	4	246	5	393
7	Marketing [4]	0	12	0	21	0	12	0	21
8	Program Delivery [5]	2	10	6	23	2	10	6	23
9	EDC Evaluation Costs	21		38		21		38	
10	SWE Audit Costs	2		7		2		7	
11	**Program Overhead Costs (Sum of rows 5 through 10)**	**299**		**496**		**299**		**496**	
12	NPV of increases in costs of natural gas (or other fuels) for fuel switching programs	0		0		0		0	
13	**Total NPV TRC Costs [6] (Net present value of sum of rows 4, 11, and 12)**	**4,849**		**6,723**		**4,090**		**5,672**	
14	Total NPV Lifetime Electric Energy Benefits	4,187		6,042		3,488		5,024	
15	Total NPV Lifetime Electric Capacity Benefits	15		166		12		137	
16	Total NPV Lifetime Operation and Maintenance (O&M) Benefits	0		0		0		0	
17	Total NPV Lifetime Non-Electric Benefits (Fossil Fuel, Water)	-616		-812		-514		-676	
18	**Total NPV TRC Benefits [7] (Sum of rows 14 through 17)**	**3,585**		**5,396**		**2,987**		**4,486**	
19	**TRC Benefit-Cost Ratio [8]**	**0.74**		**0.80**		**0.73**		**0.79**	

[1] Includes direct install equipment costs and costs for EE&C kits.
[2] Includes direct costs attributable to plan and advance the programs. Note: The design of the HERs program should be included here, while the actual development and mailing of HERs would be attributable to Program Delivery.
[3] Includes rebate processing, tracking system, general administration, program management, general management and legal, and technical assistance. Any common portfolio costs that are allocated across programs should be shown in this row.
[4] Includes the marketing CSP and marketing costs by program CSPs.
[5] Direct program implementation costs. Labor, fuel, and vehicle operation costs for appliance recycling and direct install programs. For behavioral programs, this includes the printing and postage of HERs.
[6] Total TRC Costs includes Total EDC Costs and Participant Costs.
[7] Total TRC Benefits equals the sum of Total Lifetime Electric and Non-Electric Benefits. 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. Savings carried over from Phase II are not included as a part of Total TRC Benefits for Phase III.
[8] TRC Ratio equals Total NPV TRC Benefits divided by Total NPV TRC Costs.
* Rows 1-11 are presented in nominal dollars

3.7.7 Status of Recommendations

Recommendations for the nonresidential programs are listed in Section 3.5.7.

3.8 Behavioral Demand Response Program

The Behavioral Demand Response (BDR) Program is a component of the Energy Efficient Homes Program. This section lists impacts and cost effectiveness information for this program component. The impact values presented in this section are independent of the results reported in Section 3.2, but the cost effectiveness tables presented in section 3.8.5 are also included in the overall program cost effectiveness tables in Section 3.2.6.
The BDR program is administered by Oracle and is marketed as the Peak Day Alert Program. In PY9, only Penn Power had a BDR program, as the other EDCs were still in the midst of smart meter rollouts. Met-Ed and WPP have commenced BDR programs in PY10. Oracle established the program as a randomized control trial to facilitate measurement and verification. Approximately 30,000 Penn Power customers received postcards in May 2017, educating them about conserving energy during peak days. Customers were then provided Peak Day Alert notifications by telephone or email, in advance of Act 129 events.

Compliance targets for demand response programs were established at the system level, which means the load reductions measured at the customer meter must be escalated to reflect transmission and distribution losses. The peak demand impacts presented in this section have been adjusted for line losses.

3.8.1 Participation and Reported Savings by Customer Segment

Table 123 presents the participation counts, reported energy and demand savings, and incentive payments for the BDR Program in PY8 by EDC. This program serves only the Residential customer segment. Each separate household is counted as one participant.

Table 123: BDR Program Participation and Reported Impacts

Parameter	Met-Ed Residential (Non-LI)	Penn Power Residential (Non-LI)	WPP Residential (Non-LI)
PYTD # Participants	0	30,047	0
PYVTD MW/yr	0.00	2.16	0.00
PYTD Incentives ($1000)	0.00	0.00	0.00
Evaluation Approach	Interval Meter Analysis with Randomized Control Trial		

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3.8.2 Gross Impact Evaluation

The gross impact evaluation for the BDR initiative is described in detail in Appendix U. The evaluation approach is similar to that of the Home Energy Reports program component, but with hourly data. Table 124 summarizes program verified impacts and realization rates for each EDC.

Table 124: Behavioral Demand Response Program Gross Impact Evaluation Summary for PY9

Event Date	Verified MW and Relative Precision @ 90% C.L.		
	Met-Ed	Penn Power	WPP
13-Jun	0 ± 0	1.95 ± 0.49	0 ± 0
20-Jul	0 ± 0	2.52 ± 0.48	0 ± 0
21-Jul	0 ± 0	2.01 ± 0.5	0 ± 0
Total	0 ± 0	2.16 ± 0.28	0 ± 0

As with the other demand response programs offered by the Companies, ex ante impacts are not reported. Oracle did provide ex ante estimates however, which were quite similar to the verified impacts shown above.

3.8.3 Net Impact Evaluation

Net impact evaluation is not conducted for this program because the randomized control trial approach described above measures net program impacts.

3.8.4 Process Evaluation

Tetra Tech is presently conducting a process evaluation of this program. The process evaluation results and recommendations will be included in the PY10 report.

3.8.5 Cost-Effectiveness Reporting

A detailed breakdown of program finances and cost-effectiveness is presented in Table 125, Table 126, and Table 127 for Met-Ed, Penelec, and Penn Power respectively. TRC benefits were calculated using gross verified impacts. PYTD financials are expressed in 2017 dollars and P3TD financials are expressed in the 2016 dollars. Additional discussion of TRC inputs and alternative TRC values for Demand Response programs are provided in Section 3.10.4

Table 125: Summary of Finances for the Behavioral Demand Response Program – Met-Ed

Row #	Cost Category	Gross PYTD ($1,000)		Gross P3TD ($1,000)		Net PYTD ($1,000)		Net P3TD ($1,000)	
1	EDC Incentives to Participants [1]	0		0		0		0	
2	EDC Incentives to Trade Allies	0		0		0		0	
3	Participant Costs (net of incentives/rebates paid by utilities)	0		0		0		0	
4	**Incremental Measure Costs (Sum of rows 1 through 3)**	**0**		**0**		**0**		**0**	
		EDC	CSP	EDC	CSP	EDC	CSP	EDC	CSP
5	Design & Development [2]	0	9	0	9	0	9	0	9
6	Administration, Management, and Technical Assistance [3]	0	19	0	19	0	19	0	19
7	Marketing [4]	0	0	0	0	0	0	0	0
8	Program Delivery [5]	0	65	0	65	0	65	0	65
9	EDC Evaluation Costs	-2		0		-2		0	
10	SWE Audit Costs	0		0		0		0	
11	**Program Overhead Costs (Sum of rows 5 through 10)**	**91**		**93**		**91**		**93**	
12	NPV of increases in costs of natural gas (or other fuels) for fuel switching programs	0		0		0		0	
13	**Total NPV TRC Costs [6] (Net present value of sum of rows 4, 11, and 12)**	**91**		**1,982**		**91**		**1,982**	
14	Total NPV Lifetime Electric Energy Benefits	0		0		0		0	
15	Total NPV Lifetime Electric Capacity Benefits	0		0		0		0	
16	Total NPV Lifetime Operation and Maintenance (O&M) Benefits	0		0		0		0	
17	Total NPV Lifetime Non-Electric Benefits (Fossil Fuel, Water)	0		0		0		0	
18	**Total NPV TRC Benefits [7] (Sum of rows 14 through 17)**	**0**		**0**		**0**		**0**	
19	**TRC Benefit-Cost Ratio [8]**	**0.00**		**0.00**		**0.00**		**0.00**	

[1] Includes direct install equipment costs and costs for EE&C kits.
[2] Includes direct costs attributable to plan and advance the programs. Note: The design of the HERs program should be included here, while the actual development and mailing of HERs would be attributable to Program Delivery.
[3] Includes rebate processing, tracking system, general administration, program management, general management and legal, and technical assistance. Any common portfolio costs that are allocated across programs should be shown in this row.
[4] Includes the marketing CSP and marketing costs by program CSPs.
[5] Direct program implementation costs. Labor, fuel, and vehicle operation costs for appliance recycling and direct install programs. For behavioral programs, this includes the printing and postage of HERs.
[6] Total TRC Costs includes Total EDC Costs and Participant Costs.
[7] Total TRC Benefits equals the sum of Total Lifetime Electric and Non-Electric Benefits. 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. Savings carried over from Phase II are not included as a part of Total TRC Benefits for Phase III.
[8] TRC Ratio equals Total NPV TRC Benefits divided by Total NPV TRC Costs.
* Rows 1-11 are presented in nominal dollars

Table 126: Summary of Finances for the Behavioral Demand Response Program – Penn Power

Row #	Cost Category	Gross PYTD ($1,000)		Gross P3TD ($1,000)		Net PYTD ($1,000)		Net P3TD ($1,000)	
1	EDC Incentives to Participants [1]	0		0		0		0	
2	EDC Incentives to Trade Allies	0		0		0		0	
3	Participant Costs (net of incentives/rebates paid by utilities)	0		0		0		0	
4	**Incremental Measure Costs (Sum of rows 1 through 3)**	**0**		**0**		**0**		**0**	
		EDC	CSP	EDC	CSP	EDC	CSP	EDC	CSP
5	Design & Development [2]	0	25	0	25	0	25	0	25
6	Administration, Management, and Technical Assistance [3]	8	50	20	50	8	50	20	50
7	Marketing [4]	0	0	0	0	0	0	0	0
8	Program Delivery [5]	0	174	0	174	0	174	0	174
9	EDC Evaluation Costs	59		60		59		60	
10	SWE Audit Costs	2		6		2		6	
11	**Program Overhead Costs (Sum of rows 5 through 10)**	**318**		**335**		**318**		**335**	
12	NPV of increases in costs of natural gas (or other fuels) for fuel switching programs	0		0		0		0	
13	**Total NPV TRC Costs [6] (Net present value of sum of rows 4, 11, and 12)**	**318**		**17,285**		**318**		**17,285**	
14	Total NPV Lifetime Electric Energy Benefits	0		0		0		0	
15	Total NPV Lifetime Electric Capacity Benefits	183		172		183		172	
16	Total NPV Lifetime Operation and Maintenance (O&M) Benefits	0		0		0		0	
17	Total NPV Lifetime Non-Electric Benefits (Fossil Fuel, Water)	0		0		0		0	
18	**Total NPV TRC Benefits [7] (Sum of rows 14 through 17)**	**183**		**172**		**183**		**172**	
19	**TRC Benefit-Cost Ratio [8]**	**0.58**		**0.01**		**0.58**		**0.01**	

[1] Includes direct install equipment costs and costs for EE&C kits.
[2] Includes direct costs attributable to plan and advance the programs. Note: The design of the HERs program should be included here, while the actual development and mailing of HERs would be attributable to Program Delivery.
[3] Includes rebate processing, tracking system, general administration, program management, general management and legal, and technical assistance. Any common portfolio costs that are allocated across programs should be shown in this row.
[4] Includes the marketing CSP and marketing costs by program CSPs.
[5] Direct program implementation costs. Labor, fuel, and vehicle operation costs for appliance recycling and direct install programs. For behavioral programs, this includes the printing and postage of HERs.
[6] Total TRC Costs includes Total EDC Costs and Participant Costs.
[7] Total TRC Benefits equals the sum of Total Lifetime Electric and Non-Electric Benefits. 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. Savings carried over from Phase II are not included as a part of Total TRC Benefits for Phase III.
[8] TRC Ratio equals Total NPV TRC Benefits divided by Total NPV TRC Costs.
* Rows 1-11 are presented in nominal dollars

Table 127: Summary of Finances for the Behavioral Demand Response Program – WPP

Row #	Cost Category	Gross PYTD ($1,000)		Gross P3TD ($1,000)		Net PYTD ($1,000)		Net P3TD ($1,000)	
1	EDC Incentives to Participants [1]	0		0		0		0	
2	EDC Incentives to Trade Allies	0		0		0		0	
3	Participant Costs (net of incentives/rebates paid by utilities)	0		0		0		0	
4	**Incremental Measure Costs (Sum of rows 1 through 3)**	**0**		**0**		**0**		**0**	
		EDC	CSP	EDC	CSP	EDC	CSP	EDC	CSP
5	Design & Development [2]	0	4	0	4	0	4	0	4
6	Administration, Management, and Technical Assistance [3]	0	8	0	8	0	8	0	8
7	Marketing [4]	0	0	0	0	0	0	0	0
8	Program Delivery [5]	0	28	0	28	0	28	0	28
9	EDC Evaluation Costs	-2		0		-2		0	
10	SWE Audit Costs	0		0		0		0	
11	**Program Overhead Costs (Sum of rows 5 through 10)**	**39**		**41**		**39**		**41**	
12	NPV of increases in costs of natural gas (or other fuels) for fuel switching programs	0		0		0		0	
13	**Total NPV TRC Costs [6] (Net present value of sum of rows 4, 11, and 12)**	**39**		**2,066**		**39**		**2,066**	
14	Total NPV Lifetime Electric Energy Benefits	0		0		0		0	
15	Total NPV Lifetime Electric Capacity Benefits	0		0		0		0	
16	Total NPV Lifetime Operation and Maintenance (O&M) Benefits	0		0		0		0	
17	Total NPV Lifetime Non-Electric Benefits (Fossil Fuel, Water)	0		0		0		0	
18	**Total NPV TRC Benefits [7] (Sum of rows 14 through 17)**	**0**		**0**		**0**		**0**	
19	**TRC Benefit-Cost Ratio [8]**	**0.00**		**0.00**		**0.00**		**0.00**	

[1] Includes direct install equipment costs and costs for EE&C kits.
[2] Includes direct costs attributable to plan and advance the programs. Note: The design of the HERs program should be included here, while the actual development and mailing of HERs would be attributable to Program Delivery.
[3] Includes rebate processing, tracking system, general administration, program management, general management and legal, and technical assistance. Any common portfolio costs that are allocated across programs should be shown in this row.
[4] Includes the marketing CSP and marketing costs by program CSPs.
[5] Direct program implementation costs. Labor, fuel, and vehicle operation costs for appliance recycling and direct install programs. For behavioral programs, this includes the printing and postage of HERs.
[6] Total TRC Costs includes Total EDC Costs and Participant Costs.
[7] Total TRC Benefits equals the sum of Total Lifetime Electric and Non-Electric Benefits. 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. Savings carried over from Phase II are not included as a part of Total TRC Benefits for Phase III.
[8] TRC Ratio equals Total NPV TRC Benefits divided by Total NPV TRC Costs.
* Rows 1-11 are presented in nominal dollars

3.8.6 Status of Recommendations

Findings and recommendations that result from the ongoing process evaluation will be presented in the PY10 annual report.

3.9 C&I Demand Response Program - Small

The C&I Demand Response Program – Small (SDR Program) is a load curtailment program that is available to all small C&I customers. The program, for both the Large and Small C&I sectors is effectively managed as one program by the Companies, and is implemented by Enernoc in Penn Power, and by both Enernoc and CPower in Met-Ed and WPP. The program offers incentives for load reductions during event hours. Most customers reduce loads by rescheduling industrial processes to off-event hours or by changing operations for the duration of the event.

Compliance targets for demand response programs were established at the system level, which means the load reductions measured at the customer meter must be escalated to reflect transmission and distribution losses. The peak demand impacts presented in this section have been adjusted for line losses.

3.9.1 Participation and Reported Savings by Customer Segment

Table 128 presents the participation counts, reported energy and demand savings, and incentive payments for the SDR Program in PY9 by EDC. Each separate facility is counted as one participant.

Table 128: C&I Demand Response Program – Small, Program Participation and Impacts

Parameter	Met-Ed Small C&I (Non-GNI)	Met-Ed GNI	Met-Ed Total	Penn Power Small C&I (Non-GNI)	Penn Power GNI	Penn Power Total	WPP Small C&I (Non-GNI)	WPP GNI	WPP Total
PYTD # Participants	19	18	37	1	2	3	19	0	19
PYVTD MW/yr	1.89	0.77	2.66	0.04	0.15	0.19	2.69	0.00	2.69
PYTD Incentives ($1000)	832.48	339.77	1,172.25	0.00	0.00	0.00	2,265.14	0.00	2,265.14
Evaluation Approach	Apply weighted average of three lowest-RRMSE CBL algorithms, selected from 12 candidates.								

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3.9.2 Gross Impact Evaluation

3.9.2.1 Methodology

The Demand Response Programs in both the Large and Small C&I sectors are effectively managed as one program by the Companies. Tetra Tech conducted a process evaluation of the combined program in PY9. The process evaluation is discussed in Section 3.10.2.

3.9.2.2 Results

Table 129 shows verified impacts by event and EDC, as well as overall PY9 impacts with 90% confidence intervals.

Table 129: C&I Demand Response Program – Small, Verified PY9 Impacts

Event Date	Verified MW and Precision @ 90% C.L.		
	Met-Ed	Penn Power	WPP
13-Jun	3.0 ± 0.3	0.1 ± 0.1	3.3 ± 1.4
20-Jul	3.0 ± 0.4	0.2 ± 0.2	2.4 ± 1.6
21-Jul	1.9 ± 0.3	0.2 ± 0.3	2.3 ± 2.4
Total	**2.7 +/- 0.2**	**0.2 +/- 0.1**	**2.7 +/- 1.0**

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3.9.3 Process Evaluation

The Demand Response Programs in both the Large and Small C&I sectors are effectively managed as one program by the Companies. Tetra Tech conducted a process evaluation of the combined program in PY9. The process evaluation is discussed in Section 3.10.3.

3.9.4 Cost-Effectiveness Reporting

A detailed breakdown of program finances and cost-effectiveness is presented in Table 130, Table 131, and Table 132 for Met-Ed, Penelec, and Penn Power respectively. TRC benefits were calculated using gross verified impacts. PYTD financials are expressed in 2017 dollars and P3TD financials are expressed in the 2016 dollars. Additional discussion of TRC inputs and alternative TRC values for the C&I Demand Response programs are provided in Section 3.10.4.

Table 130: Summary of Finances for C&I Demand Response Program – Small – Met-Ed

Row #	Cost Category	Gross PYTD ($1,000)		Gross P3TD ($1,000)		Net PYTD ($1,000)		Net P3TD ($1,000)	
1	EDC Incentives to Participants [1]	1		1		1		1	
2	EDC Incentives to Trade Allies	0		0		0		0	
3	Participant Costs (net of incentives/rebates paid by utilities)	0		0		0		0	
4	**Incremental Measure Costs (Sum of rows 1 through 3)**	**1**		**1**		**1**		**1**	
		EDC	CSP	EDC	CSP	EDC	CSP	EDC	CSP
5	Design & Development [2]	0	3	0	4	0	3	0	4
6	Administration, Management, and Technical Assistance [3]	14	13	29	16	14	13	29	16
7	Marketing [4]	0	20	0	24	0	20	0	24
8	Program Delivery [5]	1	29	1	36	1	29	1	36
9	EDC Evaluation Costs	8		12		8		12	
10	SWE Audit Costs	3		7		3		7	
11	**Program Overhead Costs (Sum of rows 5 through 10)**	**91**		**131**		**91**		**131**	
12	NPV of increases in costs of natural gas (or other fuels) for fuel switching programs	0		0		0		0	
13	**Total NPV TRC Costs [6] (Net present value of sum of rows 4, 11, and 12)**	**91**		**126**		**91**		**126**	
14	Total NPV Lifetime Electric Energy Benefits	0		0		0		0	
15	Total NPV Lifetime Electric Capacity Benefits	226		212		226		212	
16	Total NPV Lifetime Operation and Maintenance (O&M) Benefits	0		0		0		0	
17	Total NPV Lifetime Non-Electric Benefits (Fossil Fuel, Water)	0		0		0		0	
18	**Total NPV TRC Benefits [7] (Sum of rows 14 through 17)**	**226**		**212**		**226**		**212**	
19	**TRC Benefit-Cost Ratio [8]**	**2.47**		**1.68**		**2.47**		**1.68**	

[1] Includes direct install equipment costs and costs for EE&C kits.
[2] Includes direct costs attributable to plan and advance the programs. Note: The design of the HERs program should be included here, while the actual development and mailing of HERs would be attributable to Program Delivery.
[3] Includes rebate processing, tracking system, general administration, program management, general management and legal, and technical assistance. Any common portfolio costs that are allocated across programs should be shown in this row.
[4] Includes the marketing CSP and marketing costs by program CSPs.
[5] Direct program implementation costs. Labor, fuel, and vehicle operation costs for appliance recycling and direct install programs. For behavioral programs, this includes the printing and postage of HERs.
[6] Total TRC Costs includes Total EDC Costs and Participant Costs.
[7] Total TRC Benefits equals the sum of Total Lifetime Electric and Non-Electric Benefits. 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. Savings carried over from Phase II are not included as a part of Total TRC Benefits for Phase III.
[8] TRC Ratio equals Total NPV TRC Benefits divided by Total NPV TRC Costs.
* Rows 1-11 are presented in nominal dollars

Table 131: Summary of Finances for C&I Demand Response Program – Small – Penn Power

Row #	Cost Category	Gross PYTD ($1,000)		Gross P3TD ($1,000)		Net PYTD ($1,000)		Net P3TD ($1,000)	
1	EDC Incentives to Participants [1]	0		0		0		0	
2	EDC Incentives to Trade Allies	0		0		0		0	
3	Participant Costs (net of incentives/rebates paid by utilities)	0		0		0		0	
4	**Incremental Measure Costs (Sum of rows 1 through 3)**	**0**		**0**		**0**		**0**	
		EDC	CSP	EDC	CSP	EDC	CSP	EDC	CSP
5	Design & Development [2]	0	0	0	0	0	0	0	0
6	Administration, Management, and Technical Assistance [3]	6	0	12	1	6	0	12	1
7	Marketing [4]	0	0	0	1	0	0	0	1
8	Program Delivery [5]	0	0	1	2	0	0	1	2
9	EDC Evaluation Costs	3		4		3		4	
10	SWE Audit Costs	1		3		1		3	
11	**Program Overhead Costs (Sum of rows 5 through 10)**	**10**		**22**		**10**		**22**	
12	NPV of increases in costs of natural gas (or other fuels) for fuel switching programs	0		0		0		0	
13	**Total NPV TRC Costs [6] (Net present value of sum of rows 4, 11, and 12)**	**10**		**22**		**10**		**22**	
14	Total NPV Lifetime Electric Energy Benefits	0		0		0		0	
15	Total NPV Lifetime Electric Capacity Benefits	16		15		16		15	
16	Total NPV Lifetime Operation and Maintenance (O&M) Benefits	0		0		0		0	
17	Total NPV Lifetime Non-Electric Benefits (Fossil Fuel, Water)	0		0		0		0	
18	**Total NPV TRC Benefits [7] (Sum of rows 14 through 17)**	**16**		**15**		**16**		**15**	
19	**TRC Benefit-Cost Ratio [8]**	**1.59**		**0.69**		**1.59**		**0.69**	

[1] Includes direct install equipment costs and costs for EE&C kits.
[2] Includes direct costs attributable to plan and advance the programs. Note: The design of the HERs program should be included here, while the actual development and mailing of HERs would be attributable to Program Delivery.
[3] Includes rebate processing, tracking system, general administration, program management, general management and legal, and technical assistance. Any common portfolio costs that are allocated across programs should be shown in this row.
[4] Includes the marketing CSP and marketing costs by program CSPs.
[5] Direct program implementation costs. Labor, fuel, and vehicle operation costs for appliance recycling and direct install programs. For behavioral programs, this includes the printing and postage of HERs.
[6] Total TRC Costs includes Total EDC Costs and Participant Costs.
[7] Total TRC Benefits equals the sum of Total Lifetime Electric and Non-Electric Benefits. 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. Savings carried over from Phase II are not included as a part of Total TRC Benefits for Phase III.
[8] TRC Ratio equals Total NPV TRC Benefits divided by Total NPV TRC Costs.
* Rows 1-11 are presented in nominal dollars

Table 132: Summary of Finances for C&I Demand Response Program – Small – WPP

Row #	Cost Category	Gross PYTD ($1,000)		Gross P3TD ($1,000)		Net PYTD ($1,000)		Net P3TD ($1,000)	
1	EDC Incentives to Participants [1]	2		2		2		2	
2	EDC Incentives to Trade Allies	0		0		0		0	
3	Participant Costs (net of incentives/rebates paid by utilities)	-1		-1		-1		-1	
4	**Incremental Measure Costs (Sum of rows 1 through 3)**	**2**		**2**		**2**		**2**	
		EDC	CSP	EDC	CSP	EDC	CSP	EDC	CSP
5	Design & Development [2]	0	1	0	2	0	1	0	2
6	Administration, Management, and Technical Assistance [3]	17	4	36	9	17	4	36	9
7	Marketing [4]	0	6	0	14	0	6	0	14
8	Program Delivery [5]	1	9	2	20	1	9	2	20
9	EDC Evaluation Costs	10		15		10		15	
10	SWE Audit Costs	3		8		3		8	
11	**Program Overhead Costs (Sum of rows 5 through 10)**	**50**		**106**		**50**		**106**	
12	NPV of increases in costs of natural gas (or other fuels) for fuel switching programs	0		0		0		0	
13	**Total NPV TRC Costs [6] (Net present value of sum of rows 4, 11, and 12)**	**51**		**104**		**51**		**104**	
14	Total NPV Lifetime Electric Energy Benefits	0		0		0		0	
15	Total NPV Lifetime Electric Capacity Benefits	229		214		229		214	
16	Total NPV Lifetime Operation and Maintenance (O&M) Benefits	0		0		0		0	
17	Total NPV Lifetime Non-Electric Benefits (Fossil Fuel, Water)	0		0		0		0	
18	**Total NPV TRC Benefits [7] (Sum of rows 14 through 17)**	**229**		**214**		**229**		**214**	
19	**TRC Benefit-Cost Ratio [8]**	**4.44**		**2.06**		**4.44**		**2.06**	

[1] Includes direct install equipment costs and costs for EE&C kits.
[2] Includes direct costs attributable to plan and advance the programs. Note: The design of the HERs program should be included here, while the actual development and mailing of HERs would be attributable to Program Delivery.
[3] Includes rebate processing, tracking system, general administration, program management, general management and legal, and technical assistance. Any common portfolio costs that are allocated across programs should be shown in this row.
[4] Includes the marketing CSP and marketing costs by program CSPs.
[5] Direct program implementation costs. Labor, fuel, and vehicle operation costs for appliance recycling and direct install programs. For behavioral programs, this includes the printing and postage of HERs.
[6] Total TRC Costs includes Total EDC Costs and Participant Costs.
[7] Total TRC Benefits equals the sum of Total Lifetime Electric and Non-Electric Benefits. 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. Savings carried over from Phase II are not included as a part of Total TRC Benefits for Phase III.
[8] TRC Ratio equals Total NPV TRC Benefits divided by Total NPV TRC Costs.
* Rows 1-11 are presented in nominal dollars

3.9.5 Status of Recommendations

The Demand Response Programs in both the Large and Small C&I sectors are effectively managed as one program by the Companies. Findings and recommendations for both programs are discussed in Section 3.10.5.

3.10 C&I Demand Response Program - Large

The C&I Demand Response Program – Large (LDR Program) is a load curtailment program that is available to all large C&I customers. The program for both the Large and Small C&I sectors is effectively managed as one program by the companies, and is implemented by Enernoc in Penn Power, and by both Enernoc and CPower in Met-Ed and WPP. The program offers incentives for load reductions during event hours. Most customers reduce loads by rescheduling industrial processes to off-event hours or by changing operations for the duration of the event.

Compliance targets for demand response programs were established at the system level, which means the load reductions measured at the customer meter must be escalated to reflect transmission and distribution losses. The peak demand impacts presented in this section have been adjusted for line losses.

3.10.1 Participation and Reported Savings by Customer Segment

Table 133 presents the participation counts, reported energy and demand savings, and incentive payments for the LDR Program in PY9 by EDC. Each separate facility is counted as one participant.

Table 133: C&I Demand Response Program – Large, Program Participation and Impacts

Parameter	Met-Ed Small C&I (Non-GNI)	Met-Ed GNI	Met-Ed Total	Penn Power Small C&I (Non-GNI)	Penn Power GNI	Penn Power Total	WPP Small C&I (Non-GNI)	WPP GNI	WPP Total
PYTD # Participants	52	15	67	6	0	6	12	0	12
PYVTD MW/yr	39.22	4.08	43.29	31.11	0.00	31.11	79.21	0.00	79.21
PYTD Incentives ($1000)	26,041.65	2,706.60	28,748.25	231,282.24	0.00	231,282.24	573,903.60	0.00	573,903.60
Evaluation Approach	Apply weighted average of three lowest-RRMSE CBL algorithms, selected from 12 candidates.								

3.10.2 Gross Impact Evaluation

3.10.2.1 Methodology

Gross impact evaluation consisted of establishing various customer baseline loads (CBLs) for each program participant. The CBL algorithms were ranked in order of relative root mean square error (RRMSE) and the three CBLs with lowest RRMSEs were selected for each participant. A weighted average of the top three CBLs was used in creating the actual CBL for each participant, with the inverse squares of the RMSEs used as weights. The CBLs are described below.

Ten of Ten CBL

This CBL is the average hourly whole-facility demand profile from the last ten weekdays that are (i) not holidays, (ii) not pre-specified customer-specific shutdown days, (iii) not weekends[10], (iv) not Act 129 event-days, (v) not customer-specific PJM event-participation days.

Ten of Ten Individual CBL

This CBL is the average hourly whole-facility demand profile from the last ten weekdays of the matching type (e.g. Mondays, Tuesdays, etc.) that are (i) not holidays, (ii) not pre-specified customer-specific shutdown days, (iii) not weekends, (iv) not Act 129 event-days, (v) not customer-specific PJM event-participation days (vi) not customer – specific peak load shaving event days.

Six of Seven CBL

This CBL is the average hourly whole-facility demand profile from the highest load (as defined during event-hours) six of last seven weekdays that are (i) not holidays, (ii) not pre-specified customer-specific shutdown days, (iii) not weekends, (iv) not Act 129 event-days, (v) not customer-specific PJM event-participation days (vi) not customer – specific peak load shaving event days.

To be eligible for this CBL, customers must provide forward-looking weekly production schedules.

Six of Seven Individual CBL

This CBL is the average hourly whole-facility demand profile from the highest load (as defined during event-hours) six of the last seven weekdays of the matching type (e.g. Mondays, Tuesdays, etc.) that are (i) not holidays, (ii) not pre-specified customer-specific shutdown days, (iii) not weekends, (iv) not Act 129 event-days, (v) not customer-specific PJM event-participation days (vi) not customer – specific peak load shaving event days.

To be eligible for this CBL, customers must provide forward-looking weekly production schedules.

PJM Three Day Type CBL

This CBL is similar to the six of seven CBL listed above, but the basis day exclusion rules are to first select the five most recent qualifying weekdays, then, if any of the five are 75% lower than the average of the five, to replace them with the next available reference weekday, going back at most 45 days. Once there are five suitable reference weekdays, the highest four are selected to develop the CBL.

PJM Seven Day Type CBL

This CBL is similar to the Three-Day Type CBL described above, but also requires matching of individual day types.

[10] This rule anticipates that all events will be called on non-holiday weekdays.

Twenty of Twenty CBL

This CBL is similar to the Ten of Ten CBL described above but adds first ten weekdays following the event that are (i) not holidays, (ii) not pre-specified customer-specific shutdown days, (iii) not weekends, (iv) not Act 129 event-days, (v) not customer-specific PJM event-participation days.

Twenty of Twenty Individual CBL

This CBL is similar to the Twenty of Twenty CBL described above but uses weekdays of the matching type.

Weather Sensitive Adjustment

For each of the CBLs above, a weather-sensitive variant was constructed with the addition of a "Weather Sensitive Adjustment", which is a linear correction term with facility demand as the dependent variable and the dry-bulb temperature as the independent variable. The regressions were run for hours ending 15-18, using weekdays with average event-window temperatures above 75 °F, that were not holidays, event days, or facility shutdown days.

Measurement Precision and Confidence Intervals

Confidence intervals were calculated with the RRMSEs of the top three CBLs, with cross terms to account for correlations between the CBLs. Systematic uncertainty with respect to overall CBL selection methodology was estimated by comparing results with results from an alternate scenario where only the top CBL was selected for each participant.

3.10.2.2 Results

Table 134Table 129 shows verified impacts by event and EDC, as well as overall PY9 impacts with 90% confidence intervals.

Table 134: C&I Demand Response Program – Large, Verified PY9 Impacts

Event Date	Verified MW and Relative Precision @ 90% C.L.		
	Met-Ed	Penn Power	WPP
13-Jun	45.0 ± 5.2	48.7 ± 24.2	119.9 ± 48.5
20-Jul	44.1 ± 5.7	26.4 ± 24.3	72.3 ± 46.7
21-Jul	40.8 ± 6.2	18.1 ± 24.1	45.4 ± 47.0
Total	**43.3 +/- 3.6**	**31.1 +/- 18.1**	**79.2 +/- 29.9**

3.10.3 Process Evaluation

Tetra Tech conducted a process evaluation of the Commercial and Industrial Demand Response Programs in PY9. This process evaluation examined researchable questions related to program design, marketing, program operations, and participant satisfaction.

The evaluation consisted of the following activities:

- Program documentation and tracking data review, including review and preliminary analysis of actual 2017 event data;
- Interviews with Company staff (completed in December 2017) and ICSP program providers;
- Participation in a CPower webinar targeted towards potential new customers, entitled "Maximize Revenues with the Commercial and Industrial Demand Response Program from FirstEnergy's Pennsylvania Utilities";
- Surveys with participating customers (n=25 completes).

Process evaluation activities were combined for the Large C&I, Small C&I programs given the similarities in program delivery. The Tetra Tech team used the program and implementation staff interviews to understand how the program targeted, enrolled, and communicated with program participants.

As a precursor to surveying customers, Tetra Tech identified the number unique program participants, as several participants had multiple facilities enrolled in the program. There were 60 unique participants in PY9, and all were contacted for the survey. The stratification design and response rates are shown in Table 135, and represents all C&I energy efficiency programs offered by each EDC.

Table 135: C&I Demand Response Program Process Evaluation Sample Design

Stratum (ICSP)	Population Size (Unique Participants)	Achieved Sample Size	Response Rate
All	60	25	42%

Key findings and recommendations are listed in Section 3.10.5.

3.10.4 Cost-Effectiveness Reporting

A detailed breakdown of program finances and cost-effectiveness is presented in Table 136, Table 137, and Table 138 for Met-Ed, Penelec, and Penn Power respectively. TRC benefits were calculated using gross verified impacts. PYTD financials are expressed in 2017 dollars and P3TD financials are expressed in the 2016 dollars. Customer costs are estimated considering 75% of ICSP pricing consistent with the TRC order.

Note that the TRC Order specifies, for Demand Response, the that *"All peak demand reduction values would be multiplied by the avoided cost of generation capacity ($/kW-year for the Annual Product Type) for the delivery year as set by PJM's Base Residual Auction."* For 2017, Base Residual Auction (BRA) Annual Product Type clearing prices were the same and are used in the tables below.

The TRC values for the C&I Demand Response Programs appear to be anomalously high for PY9. There are several reasons for the apparent high TRC values. There were only three events causing program incremental costs, which scale with the number of events, to be lower than planned. In PY10, we expect higher costs per MW of load reduction because there were six events.

Furthermore, the Companies present reasonable, alternative cost-effectiveness calculations that yield much lower TRC ratios. Other considerations raise potential issues with the TRC values presented. Use of the Annual Resource Type overstates the avoided cost for Summer Only DR program. For 2017, PJM clearing prices are available for: a) Limited (Summer-Only) Resources; b) Extended Summer Resources; and c) Annual Resources. The Limited value is $106.02/MW-day rather than the value for Annual Resources of $120/MW-day. Use of the Limited value would reduce the average TRC for Demand Response programs from 4.06 to 3.81.

Another consideration is that the three DR events in PY9 occurred on three of five critical peak days, as defined by PJM. It is reasonable to prorate DR program benefits by a factor of 3/5, given that the DR program had no impact on two of five PJM critical peak days. This would reduce the average TRC from 4.06 to 2.43

Avoided Transmission and Distribution (T&D) prices comprise 48% of total avoided costs associated with demand response in PY9. The Companies have previously recommended exclusion of avoided T&D from cost effectiveness tests for demand response. If T&D benefits were to be excluded, the average TRC for all C&I DR programs offered by the three Companies in PY9 would decrease by 48%, from 4.06 to 2.09.

The combination of the three scenarios would reduce TRC from 4.06 to 1.11.

Table 136: Summary of Finances for C&I Demand Response Program – Large – Met-Ed

Row #	Cost Category	Gross PYTD ($1,000)		Gross P3TD ($1,000)		Net PYTD ($1,000)		Net P3TD ($1,000)	
1	EDC Incentives to Participants [1]	29		29		29		29	
2	EDC Incentives to Trade Allies	0		0		0		0	
3	Participant Costs (net of incentives/rebates paid by utilities)	210		210		210		210	
4	**Incremental Measure Costs (Sum of rows 1 through 3)**	**238**		**238**		**238**		**238**	
		EDC	CSP	EDC	CSP	EDC	CSP	EDC	CSP
5	Design & Development [2]	0	37	0	45	0	37	0	45
6	Administration, Management, and Technical Assistance [3]	127	146	264	174	127	146	264	174
7	Marketing [4]	0	219	0	260	0	219	0	260
8	Program Delivery [5]	6	328	12	391	6	328	12	391
9	EDC Evaluation Costs	68		104		68		104	
10	SWE Audit Costs	23		64		23		64	
11	**Program Overhead Costs (Sum of rows 5 through 10)**	**954**		**1,314**		**954**		**1,314**	
12	NPV of increases in costs of natural gas (or other fuels) for fuel switching programs	0		0		0		0	
13	**Total NPV TRC Costs [6] (Net present value of sum of rows 4, 11, and 12)**	**1,192**		**1,478**		**1,192**		**1,478**	
14	Total NPV Lifetime Electric Energy Benefits	0		0		0		0	
15	Total NPV Lifetime Electric Capacity Benefits	3,675		3,447		3,675		3,447	
16	Total NPV Lifetime Operation and Maintenance (O&M) Benefits	0		0		0		0	
17	Total NPV Lifetime Non-Electric Benefits (Fossil Fuel, Water)	0		0		0		0	
18	**Total NPV TRC Benefits [7] (Sum of rows 14 through 17)**	**3,675**		**3,447**		**3,675**		**3,447**	
19	**TRC Benefit-Cost Ratio [8]**	**3.08**		**2.33**		**3.08**		**2.33**	

[1] Includes direct install equipment costs and costs for EE&C kits.
[2] Includes direct costs attributable to plan and advance the programs. Note: The design of the HERs program should be included here, while the actual development and mailing of HERs would be attributable to Program Delivery.
[3] Includes rebate processing, tracking system, general administration, program management, general management and legal, and technical assistance. Any common portfolio costs that are allocated across programs should be shown in this row.
[4] Includes the marketing CSP and marketing costs by program CSPs.
[5] Direct program implementation costs. Labor, fuel, and vehicle operation costs for appliance recycling and direct install programs. For behavioral programs, this includes the printing and postage of HERs.
[6] Total TRC Costs includes Total EDC Costs and Participant Costs.
[7] Total TRC Benefits equals the sum of Total Lifetime Electric and Non-Electric Benefits. 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. Savings carried over from Phase II are not included as a part of Total TRC Benefits for Phase III.
[8] TRC Ratio equals Total NPV TRC Benefits divided by Total NPV TRC Costs.
* Rows 1-11 are presented in nominal dollars

Table 137: Summary of Finances for C&I Demand Response Program – Large – Penn Power

Row #	Cost Category	Gross PYTD ($1,000)		Gross P3TD ($1,000)		Net PYTD ($1,000)		Net P3TD ($1,000)	
1	EDC Incentives to Participants [1]	231		231		231		231	
2	EDC Incentives to Trade Allies	0		0		0		0	
3	Participant Costs (net of incentives/rebates paid by utilities)	-58		-58		-58		-58	
4	**Incremental Measure Costs (Sum of rows 1 through 3)**	**173**		**173**		**173**		**173**	
		EDC	CSP	EDC	CSP	EDC	CSP	EDC	CSP
5	Design & Development [2]	0	12	0	13	0	12	0	13
6	Administration, Management, and Technical Assistance [3]	55	46	107	52	55	46	107	52
7	Marketing [4]	0	69	0	78	0	69	0	78
8	Program Delivery [5]	3	103	5	117	3	103	5	117
9	EDC Evaluation Costs	23		35		23		35	
10	SWE Audit Costs	8		23		8		23	
11	**Program Overhead Costs (Sum of rows 5 through 10)**	**320**		**431**		**320**		**431**	
12	NPV of increases in costs of natural gas (or other fuels) for fuel switching programs	0		0		0		0	
13	**Total NPV TRC Costs [6] (Net present value of sum of rows 4, 11, and 12)**	**493**		**572**		**493**		**572**	
14	Total NPV Lifetime Electric Energy Benefits	0		0		0		0	
15	Total NPV Lifetime Electric Capacity Benefits	2,641		2,470		2,641		2,470	
16	Total NPV Lifetime Operation and Maintenance (O&M) Benefits	0		0		0		0	
17	Total NPV Lifetime Non-Electric Benefits (Fossil Fuel, Water)	0		0		0		0	
18	**Total NPV TRC Benefits [7] (Sum of rows 14 through 17)**	**2,641**		**2,470**		**2,641**		**2,470**	
19	**TRC Benefit-Cost Ratio [8]**	**5.35**		**4.32**		**5.35**		**4.32**	

[1] Includes direct install equipment costs and costs for EE&C kits.
[2] Includes direct costs attributable to plan and advance the programs. Note: The design of the HERs program should be included here, while the actual development and mailing of HERs would be attributable to Program Delivery.
[3] Includes rebate processing, tracking system, general administration, program management, general management and legal, and technical assistance. Any common portfolio costs that are allocated across programs should be shown in this row.
[4] Includes the marketing CSP and marketing costs by program CSPs.
[5] Direct program implementation costs. Labor, fuel, and vehicle operation costs for appliance recycling and direct install programs. For behavioral programs, this includes the printing and postage of HERs.
[6] Total TRC Costs includes Total EDC Costs and Participant Costs.
[7] Total TRC Benefits equals the sum of Total Lifetime Electric and Non-Electric Benefits. 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. Savings carried over from Phase II are not included as a part of Total TRC Benefits for Phase III.
[8] TRC Ratio equals Total NPV TRC Benefits divided by Total NPV TRC Costs.
* Rows 1-11 are presented in nominal dollars

Table 138: Summary of Finances for C&I Demand Response Program – Large – WPP

Row #	Cost Category	Gross PYTD ($1,000)		Gross P3TD ($1,000)		Net PYTD ($1,000)		Net P3TD ($1,000)	
1	EDC Incentives to Participants [1]	574		574		574		574	
2	EDC Incentives to Trade Allies	0		0		0		0	
3	Participant Costs (net of incentives/rebates paid by utilities)	-143		-143		-143		-143	
4	**Incremental Measure Costs (Sum of rows 1 through 3)**	**430**		**430**		**430**		**430**	
		EDC	CSP	EDC	CSP	EDC	CSP	EDC	CSP
5	Design & Development [2]	0	40	0	53	0	40	0	53
6	Administration, Management, and Technical Assistance [3]	154	157	322	204	154	157	322	204
7	Marketing [4]	0	236	0	306	0	236	0	306
8	Program Delivery [5]	7	353	15	459	7	353	15	459
9	EDC Evaluation Costs	86		130		86		130	
10	SWE Audit Costs	27		74		27		74	
11	**Program Overhead Costs (Sum of rows 5 through 10)**	**1,060**		**1,562**		**1,060**		**1,562**	
12	NPV of increases in costs of natural gas (or other fuels) for fuel switching programs	0		0		0		0	
13	**Total NPV TRC Costs [6] (Net present value of sum of rows 4, 11, and 12)**	**1,491**		**1,899**		**1,491**		**1,899**	
14	Total NPV Lifetime Electric Energy Benefits	0		0		0		0	
15	Total NPV Lifetime Electric Capacity Benefits	6,724		6,303		6,724		6,303	
16	Total NPV Lifetime Operation and Maintenance (O&M) Benefits	0		0		0		0	
17	Total NPV Lifetime Non-Electric Benefits (Fossil Fuel, Water)	0		0		0		0	
18	**Total NPV TRC Benefits [7] (Sum of rows 14 through 17)**	**6,724**		**6,303**		**6,724**		**6,303**	
19	**TRC Benefit-Cost Ratio [8]**	**4.51**		**3.32**		**4.51**		**3.32**	

[1] Includes direct install equipment costs and costs for EE&C kits.
[2] Includes direct costs attributable to plan and advance the programs. Note: The design of the HERs program should be included here, while the actual development and mailing of HERs would be attributable to Program Delivery.
[3] Includes rebate processing, tracking system, general administration, program management, general management and legal, and technical assistance. Any common portfolio costs that are allocated across programs should be shown in this row.
[4] Includes the marketing CSP and marketing costs by program CSPs.
[5] Direct program implementation costs. Labor, fuel, and vehicle operation costs for appliance recycling and direct install programs. For behavioral programs, this includes the printing and postage of HERs.
[6] Total TRC Costs includes Total EDC Costs and Participant Costs.
[7] Total TRC Benefits equals the sum of Total Lifetime Electric and Non-Electric Benefits. 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. Savings carried over from Phase II are not included as a part of Total TRC Benefits for Phase III.
[8] TRC Ratio equals Total NPV TRC Benefits divided by Total NPV TRC Costs.
* Rows 1-11 are presented in nominal dollars

3.10.5 Status of Recommendations

The impact and process evaluation activities in PY9 led to the following findings and recommendations from Tetra Tech to the Companies along with a summary of how the Companies plan to address the recommendation in program delivery. The list below details that

while the programs are generally running well, there are a few items that may warrant review as the programs evolve.

Finding #1: **Event performance for each EDC and ICSP in 2017 relied heavily on a few major customers causing unpredictable performance relative to expectations.** For Met Ed, one major customer subscribed to the program with 6 MW but did not participate in any events citing production needs were a priority over demand response. West Penn Power had a major customer who contributed negatively to event results. Conversely, two large Penn Power customers were responsible for the EDC exceeding its program goals throughout 2017; if these two customers do not regularly participate in events or reduce energy demands only modestly, then the EDC is likely to fall short of its targets. The ICSPs reported during our interviews that they have heard feedback from customers that production requirements have been a larger priority and are one of the challenges for the programs to meet targets. This should be a topic of further exploration among participants in the PY10 evaluation.

Recommendation #1: ICSPs should consider taking steps in subsequent program years to reduce the risk from reliance on a small number of major customers where possible. The ICSPs should enroll more customers to diversify risk and increase MW over-subscription if available resources and budgets to mitigate performance uncertainty. Customer confusion should be addressed in operating procedures to facilitate optimal event performance by enrolled customers.

EDC Status Report #1: Recommendation accepted. The Companies will also add that the Behavioral Demand Response Program also adds to diversification and risk mitigation at the portfolio level. On PY10, Met-Ed and West Penn Power will have active Behavioral Demand Response Programs.

Finding #2: **Despite some performance uncertainty on the program side, customers did not report change in perception of the Companies through the participant survey.** Customers maintained a high opinion of the Companies after their participation in the program, and a few indicated their views had improved. No customers reported negative opinions of the Companies as a result of the program

Recommendation #2: ICSPs to continue or enhance current customer-side processes to maintain customer satisfaction and positive opinions about the Companies and monitor impacts of any Act 129 or PJM ELRP program changes on customer satisfaction levels.

EDC Status Report #2: Recommendation accepted.

Finding 3: The most common source of program confusion for respondents centered around their incentive agreement with the ICSPs. While customers generally reported they knew incentives were available for program participation, four of 25 customers rated their incentive agreement “somewhat difficult” to understand.

Recommendation #3: Because customer agreements are not shared with the Companies, consider advising the ICSPs to review those agreements and incentive structure with customers regularly to ensure participation expectations, incentive structure or other contract details are clearly understood.

EDC Status Report #3: Recommendation accepted and discussed with ICSP.

The next two findings do not reflect problems necessitating immediate attention, however, they relate to areas where we suggest the Companies be aware of the potential for negative reactions if they persist or become more widespread.

Finding 4: Some customers recall participating in more Act 129 C&I DR events than were initiated. Nine of 25 customers recalled more than three events occurring over the course of the summer when just three Act 129 events occurred. There could be several reasons for the mistaken recall – including PJM DR program events or test events being confused for Act 129 events -- however this misperception could decrease a customer's willingness to participate in future events.

Recommendation 4: **Monitor customer awareness of Act 129 events**. Especially if the events coincide with PJM DR events, and work with ICSPs to ensure that communication about Act 129 DR events is accurate and clear.

EDC Status Report #4: Recommendation accepted.

Finding 5: Disruptions that customers experience through event response can be significantly longer than the 4 hours of the actual event. One customer reported it takes 6 or 7 hours to return operations after participation in an Act 129 event. It is likely that disruptions longer than the 4-hour event period are incurred by many industrial and manufacturing customers, which make up the highest proportion of program participants surveyed.

Recommendation #5: Work with ICSPs to ensure that their recruitment of, and communications with customers are sensitive to this issue. Continue to monitor the impact of Act 129 C&I DR events on customer downtime and production to mitigate potential negative effects on customer satisfaction or willingness to participate in future events. The Companies and ICSPs should consider working together to assess customer impacts and curtailment costs to consider alternative curtailment load reduction options. The program should also consider modifying program messaging that specifically highlights that most participants we surveyed do not find participation difficult. The evaluation team also recommends that non-participant interviews in upcoming evaluation cycles may be useful in helping to identify whether production concerns or operational downtime are a more widespread customer concern and/or participation barrier.

EDC Status Report #5: Recommendation accepted.

4 Cost Recovery

Act 129 allows Pennsylvania EDCs to recover EE&C plan costs through a cost-recovery mechanism. Each EDCs cost-recovery charges are organized separately by five customer sectors to ensure that the electric rate classes that finance the programs are the rate classes that receive the direct energy and conservation benefits. Cost-recovery is governed by tariffed rate class, so it is necessarily tied to the way customers are metered and charged for electric service. Readers should be mindful of the differences between the tables below and Section 2.4. For example, the low-income customer segments are subsets of the residential tariff(s) and therefore not listed separately. Table 139, Table 140, Table 141, and Table 142.

Table 139: Met-Ed EE&C Expenditures by Cost-Recovery Category[11] ($1,000)

Cost Recovery Sector	Rate Classes Included	PYTD $ Spending ($1,000)[1]	P3TD $ Spending ($1,000)[1]
Residential (incl Low Income)	Rate RS	$12,682	$25,512
Small C&I	Rate GS-Small, Rate GS-Medium, and Outdoor Lighting Service	$2,802	$4,389
Large C&I	Rate GS-Large, Rate GP and Rate TP	$3,538	$6,639
Street Lighting	Street Lighting Service, LED Street Lighting Service and Ornamental Street Lighting Service	$48	$72
Government & Non-Profit Tariff	Rate GS - Volunteer Fire Company, and Non-Profit Ambulance Service, Rescue Squad and Senior Center Service Rate and Rate MS	$50	$85
Portfolio Total		$19,121	$36,696

[11] Includes SWE costs

Table 140: Penelec EE&C Expenditures by Cost-Recovery Category[12] ($1,000)

Cost Recovery Sector	Rate Classes Included	PYTD $ Spending ($1,000)[1]	P3TD $ Spending ($1,000)[1]
Residential (incl Low Income)	Rate RS	$11,265	$24,164
Small C&I	Rate GS-Small, Rate GS-Medium, and Outdoor Lighting Service	$2,712	$4,833
Large C&I	Rate GS-Large, Rate GP, and Rate LP	$3,490	$5,057
Street Lighting	Street Lighting Service, LED Street Lighting Service, and Ornamental Street Lighting Service	$80	$141
Government & Non-Profit Tariff	Rate GS – Volunteer Fire Company, and Non-Profit Ambulance Service, Rescue Squad and Senior Center Service Rate and Rate H	$93	$177
Portfolio Total		$17,640	$34,372

Table 141: Penn Power EE&C Expenditures by Cost-Recovery Category[13] ($1,000)

Cost Recovery Sector	Rate Classes Included	PYTD $ Spending ($1,000)[1]	P3TD $ Spending ($1,000)[1]
Residential (incl Low Income)	Rate RS	$4,249	$7,730
Small C&I	Rate GS, GS Special Rider GSDS, Rate GM, Rate GS-Large and POL	$1,150	$1,982
Large C&I	Rate GP, and Rate GT	$1,366	$1,820
Street Lighting	Rate Schedules SV, SVD, SM and LED	$53	$162
Government & Non-Profit Tariff	Rate GS – Volunteer Fire Company, and Non-Profit Ambulance Service, Rescue Squad and Senior Center Service Rate and Rate PNP	$18	$35
Portfolio Total		$6,834	$11,728

[12] Includes SWE costs
[13] Includes SWE costs

Table 142: WPP EE&C Expenditures by Cost-Recovery Category[14] ($1,000)

Cost Recovery Sector	Rate Classes Included	PYTD $ Spending ($1,000)[1]	P3TD $ Spending ($1,000)[1]
Residential (incl Low Income)	Rate 10	$12,746	$25,731
Small C&I	Rate GS 20, Rate GS 30	$3,051	$4,947
Large C&I	Rate GS 35, 40, 44, 46, and Tariff No. 38	$4,675	$6,381
Street Lighting	Rate Schedules 51 through 58, 71, 72	$710	$1,110
Government & Non-Profit Tariff	Rate GS 20 – Volunteer Fire Company, and Non-Profit Ambulance Service, Rescue Squad and Senior Center Service Rate	$71	$142
Portfolio Total		$21,253	$38,311

[14] Includes SWE costs

Appendix A Upstream Lighting Cross Sector Sales

The upstream lighting programs promote and discount efficient screw-based light bulbs at participating retail stores within the Companies' service territories. Historical M&V activities have established that a small percentage of the discounted lamps are installed in non-residential settings. This has several implications for evaluation, reporting, and program management:

1. The hours of use and coincidence factors used to calculate verified impacts must be adjusted to account for various installation settings.
2. The impacts for lamps installed in GNI facilities can be counted toward the Companies' GNI energy reduction compliance targets.
3. Program funds need to be moved between the residential and commercial sectors to ensure that there was no subsidization of commercial energy savings by the residential class.

The general approach to evaluating the impacts from cross sector sales is to conduct a random digit dial survey to determine the percentages of program lamps that are installed in various facility types. The PA TRM impact evaluation algorithms and parameters for nonresidential lighting are used to evaluate impacts for the percentage of lamps that are reported to be installed in nonresidential settings. This process is discussed in detail in Appendix I.

Note that the Companies EE&C plans also include distribution of efficient screw-based lamps through conservation kits in their residential and nonresidential sector programs. Based on historical customer surveys, a portion of lighting products distributed to small commercial customers are subsequently redistributed to employees, members, or parishioners for use in their homes. In such cases, the TRM residential lighting protocols are used to evaluate the energy and demand impacts associated with these "reverse-crossover" lamps. The Companies did not have active conservation kit programs in the commercial sector in PY9, therefore adjustments of this kind are not needed for PY9.

The Companies' EE&C plans and tracking and reporting systems attribute all costs and impacts of the upstream lighting initiative to the residential sector, specifically to the *Energy Efficient Products Program*. However, post-hoc adjustments to funding are made after M&V activities establish the cross-sector rate. Data in the tracking and reporting systems are not adjusted to account for cross-sector sales. Adjustments to overall impacts are conveyed by the program realization rate (this is one of the reasons for the high realization rate for this initiative). See Appendix M for impact evaluation details.

Survey results indicate that practically all of the efficient lamps that are installed in the nonresidential sector are installed in the small commercial and industrial class. Therefore, the funds transfer needed to avoid cross-subsidization is a net transfer from the ESB-Small Program to the EEP Program. Table 143 shows the overall incentive funding for the Upstream Lighting initiative and allocates incentives according to the fraction of sales attributed to residential and non-residential sectors. The funding amounts in the last column are transferred from ESB-Small Program to the EEP Program.

Table 143: Upstream Lighting funding allocation between programs.

EDC	Total Upstream Lighting Incentives	Residential EEP Program (91.7%)	SFB-Small Program (8.3%)
Met-Ed	$ 1,226,042	$ 1,124,281	$ 101,760.48
Penelec	$ 1,189,573	$ 1,090,839	$ 98,733.62
Penn Power	$ 378,621	$ 347,196	$ 31,425.24
West Penn	$ 1,161,770	$ 1,065,344	$ 96,425.97

Appendix B Site Inspection Summary

Table 144: PY9 Site Visit Summary

EDC	Program	Inspection Firm	Number of Inspections Conducted	Number of Sites with Discrepancies from Reported Values	Summary of Common Discrepancies
Met-Ed	Energy Efficient Products Program - HVAC Rebates	Honeywell	124	0	n/a
Penelec		Honeywell	92	0	n/a
Penn Power		Honeywell	40	0	n/a
WPP		Honeywell	188	0	n/a
Met-Ed	Energy Efficient Products Program - New Construction	PSD	6	Discrepancies do not necessarily constitute a lack of verification for this program. Please refer to the gross realization rates as a measure of consistency between reported and verified values.	The most common are due to using REM/Rate defaults for furnace fan energy usage rating rather than looking them up by model #, and estimating the % of lamps that are efficient.
Met-Ed		ADM	16		
Penelec		PSD	5		
Penelec		ADM	2		
Penn Power		PSD	7		
Penn Power		ADM	19		
WPP		PSD	12		
WPP		ADM	11		
Met-Ed	Low-Income Direct Install Programs	PSD, Action Housing, Pure Energy LLC	65	3	Measure count discrepancies involve aerators, furnace whistles, lamps, showerheads, and smart power strips.
Penelec			46	2	
Penn Power			51	1	
WPP			46	3	
Met-Ed	C/I Programs	ADM	74	Discrepancies do not necessarily constitute a lack of verification. Please refer to the gross realization rates as a measure of consistency between reported and verified values.	The main discrepancy is lamp fixture counts/types. Other measures are verified essentially 100% of the time.
Penelec	C/I Programs	ADM	73		
Penn Power	C/I Programs	ADM	59		
WPP	C/I Programs	ADM	73		
TOTAL			**1010**	**n/a**	

Appendix C Assignments of Measures to Gross Impact Initiatives

C.1 NONRESIDENTIAL EE PROGRAMS

Sampling for the nonresidential programs is performed on a project by project level. Each project can have multiple measures. If a project is sampled, all (or in rare cases where sampling may be involved, most) measures are sampled. As a first step, projects in the tracking and reporting system are assigned an evaluation initiative. Each entry in FirstEnergy's tracking and reporting system is assigned to one of seven initiatives: Appliance Recycling, Prescriptive, Lighting, Custom, Direct Install, Conservation Kits, Behavioral, or Null. The Null Initiative is defined solely to strip away items that are not associated with energy savings. These are generally line items to track special promotional bonus incentives and may include Energy Audits that are not associated with energy savings (if measures are installed as a result of the audit, they appear as separate entries in the tracking system). In PY9, there were no measures associated with the Behavioral, or Conservation Kits Initiatives. These program components are a part of the Companies' EE&C plans but were not implemented in PY9.
It is possible for projects to include multiple measures, and therefore a project may theoretically map to multiple initiatives. In practice, since rebate applications include equipment and measures that map to a single initiative as defined below, this did not occur in PY9. Measures assigned to the custom evaluation protocol are those that may potentially require custom treatment, but TRM algorithms may be applicable.

Table 145: Assignment of measures to initiatives for Nonresidential Programs

Measure	TRM Section	Initiative
Freezer Recycling - SCI	2.4.3	CI_Appliance_Recycling
Refrigerator Recycling - SCI	2.4.3	CI_Appliance_Recycling
Room Air Conditioner Recycling - SCI	2.2.5	CI_Appliance_Recycling
Dehumidifiers Recycling - Govt	IMP	CI_Appliance_Recycling
Freezer Recycling - Govt	2.4.3	CI_Appliance_Recycling
Refrigerator Recycling - Govt	2.4.3	CI_Appliance_Recycling
Room Air Conditioner Recycling - Govt	2.2.5	CI_Appliance_Recycling
Automatic Milker Takeoffs	4.1.1	CI_Prescriptive
Dairy Scroll Compressors	4.1.2	CI_Prescriptive
High Efficiency Ventilation Fans	4.1.3	CI_Prescriptive
High Volume LowSpeed Fans	4.1.5	CI_Prescriptive
Livestock Waterer	4.1.6	CI_Prescriptive
Heat Reclaimers	4.1.4	CI_Prescriptive
Low Pressure Irrigation System	4.1.8a	CI_Prescriptive
VFD on Dairy Vacuum Pumps	4.1.7	CI_Prescriptive
LED - Traffic Signals - Round - 12 Green	3.1.4	CI_Lighting
LED - Traffic Signals - Round - 8 Green	3.1.4	CI_Lighting
LED - Traffic Signals - Round - 12 Red	3.1.4	CI_Lighting
LED - Traffic Signals - Round - 8 Red	3.1.4	CI_Lighting
LED - Traffic Signals - Round - 12 Yellow	3.1.4	CI_Lighting
LED - Traffic Signals - Turn Signals - 12 Green	3.1.4	CI_Lighting
LED - Traffic Signals - Turn Signals - 8 Green	3.1.4	CI_Lighting
LED - Traffic Signals - Turn Signals - 12 Red	3.1.4	CI_Lighting

Measure	TRM Section	Initiative
LED - Traffic Signals - Turn Signals - 8 Red	3.1.4	CI_Lighting
LED - Traffic Signals - Turn Signals - 12 Yellow	3.1.4	CI_Lighting
LED - Traffic Signals - Turn Signals - 8 Yellow	3.1.4	CI_Lighting
LED - Traffic Signals - 12 Countdown Only	3.1.4	CI_Lighting
LED - Traffic Signals - 12 Hand Only	3.1.4	CI_Lighting
LED - Traffic Signals - 12 Pedestrian and Hand Overlay	3.1.4	CI_Lighting
LED - Traffic Signals - 12 Pedestrian Only	3.1.4	CI_Lighting
LED - Traffic Signals - 16 Hand with Countdown Side by Side	3.1.4	CI_Lighting
LED - Traffic Signals - 16 Pedestrian and Hand Overlay	3.1.4	CI_Lighting
LED - Traffic Signals - 16 Pedestrian and Hand Side by Side	3.1.4	CI_Lighting
LED - Traffic Signals - 16 Pedestrian and Hand with Countdown Overlay	3.1.4	CI_Lighting
LED - Traffic Signals - 9 Hand Only	3.1.4	CI_Lighting
LED - Traffic Signals - 9 Pedestrian Only	3.1.4	CI_Lighting
LED - Traffic Signals - Round - 8 Yellow	3.1.4	CI_Lighting
Street & Area Lighting (Tariff / Customer Owned)	3.1.1	CI_Lighting
Street & Area Lighting (Tariff / Utility Owned)	3.1.1	CI_Lighting
Anti Sweat Heater Controls	3.5.6	CI_Prescriptive
Ice Machines GT 1000 lbs/day	3.7.1	CI_Prescriptive
Ice Machines 501 to 1000 lbs/day	3.7.1	CI_Prescriptive
Ice Machine LT 500lbs/day	3.7.1	CI_Prescriptive
Combination Oven	IMP	CI_Prescriptive
Convection Ovens	IMP	CI_Prescriptive
Fryer	IMP	CI_Prescriptive
Griddles	IMP	CI_Prescriptive
Hot Food Holding Cabinet - Half Size	IMP	CI_Prescriptive
Hot Food Holding Cabinet - Three-Quarter Size	IMP	CI_Prescriptive
Hot Food Holding Cabinets - Full size	IMP	CI_Prescriptive
Commercial Reach In Refrigerators	3.5.1	CI_Prescriptive
Commercial Reach In Freezers	3.5.1	CI_Prescriptive
Refrigerated Case Covers	3.5.10	CI_Prescriptive
Steam cookers - 3 Pan	3.7.4	CI_Prescriptive
Steam cookers - 4 Pan	3.7.4	CI_Prescriptive
Steam cookers - 5 Pan	3.7.4	CI_Prescriptive
Steam cookers - 6 Pan	3.7.4	CI_Prescriptive
Strip Curtains	3.5.9	CI_Prescriptive
Vending Machine Controls	3.7.2	CI_Prescriptive
Vending Machines	3.7.5	CI_Prescriptive
Pre Rinse Spray Nozzles	3.4.2	CI_Prescriptive
Water Heater - Heat Pump	3.4.1	CI_Prescriptive
Water Heater - Solar	2.3.2	CI_Prescriptive
Clothes Dryer	2.4.5	CI_Prescriptive
Clothes Washers - Tier I	3.6.1	CI_Prescriptive
Clothes Washers - Tier II	3.6.1	CI_Prescriptive
Clothes Washers - Tier III	3.6.1	CI_Prescriptive
Room Air Conditioners	3.2.7	CI_Prescriptive
Freezers	2.4.2	CI_Prescriptive
Refrigerators - Tier I	2.4.1	CI_Prescriptive
Refrigerators - Tier II	2.4.1	CI_Prescriptive

Measure	TRM Section	Initiative
Refrigerators - Tier III	2.4.1	CI_Prescriptive
Computers	3.9.1a	CI_Prescriptive
Uninterruptable Power Supplies	IMP	CI_Prescriptive
Computer Monitors	3.9.1f	CI_Prescriptive
Heat Pump Clothes Dryer	IMP	CI_Prescriptive
Copiers	3.9.1c	CI_Prescriptive
Fax Machine	3.9.1b	CI_Prescriptive
Multifunction Devices	3.9.1e	CI_Prescriptive
Printers	3.9.1d	CI_Prescriptive
Direct Install - Non Lighting	Various TRM Sections	CI_Direct_Install
Direct Install - Lighting	Various TRM Sections	CI_Direct_Install
Post Audit - Lighting	Various TRM Sections	CI_Direct_Install
Post Audit - Non Lighting	Various TRM Sections	CI_Direct_Install
Combined Heat and Power	n/a	CI_Custom
Custom - Building Improvements	n/a	CI_Custom
Custom - Retrocommissioning - Large	n/a	CI_Custom
Custom - Process Improvement	n/a	CI_Custom
Custom - Compressed Air	n/a	CI_Custom
Custom - Data Centers	n/a	CI_Custom
Custom - HVAC & Chillers	n/a	CI_Custom
Custom - Motors - Three Phase	n/a	CI_Custom
Custom - Retrocommissioning Small	n/a	CI_Custom
Custom - Refrigeration	n/a	CI_Custom
Custom - VFDs < 10HP	n/a	CI_Custom
Custom - VFDs > 10 HP	n/a	CI_Custom
Facility Audits	Various TRM Sections	CI_Direct_Install
Electric Chillers - Air Cooled > 150 tons	3.2.2a	CI_Prescriptive
Electric Chillers - Air Cooled < 150 tons	3.2.2a	CI_Prescriptive
Electric Chillers - Water Cooled - Centrifugal < 150 tons	3.2.2b	CI_Prescriptive
Electric Chillers - Water Cooled - Centrifugal >= 600 tons	3.2.2b	CI_Prescriptive
Electric Chillers - Water Cooled - Centrifugal >= 150 tons and < 300 tons	3.2.2b	CI_Prescriptive
Electric Chillers - Water Cooled - Centrifugal >= 300 tons and < 600 tons	3.2.2b	CI_Prescriptive
Electric Chillers - Water Cooled - Reciprocating/Positive Disp >= 150 < 300 tons	3.2.2b	CI_Prescriptive
Electric Chillers - Water Cooled - Reciprocating/Positive Disp >= 300 ton	3.2.2b	CI_Prescriptive
Electric Chillers - Water Cooled - Reciprocating/Positive Displ >= 75 < 150 tons	3.2.2b	CI_Prescriptive
Electric Chillers - Water Cooled - Reciprocating/Positive Displacement < 75 tons	3.2.2b	CI_Prescriptive
Heat Pumps - Air Source < 65,000 Btu/h (5.4 tons) 16 SEER 9.0 HSPF	3.2.1d	CI_Prescriptive
Heat Pumps - Air Source < 65,000 Btu/h (5.4 tons) 18 SEER 10.0 HSPF	3.2.1d	CI_Prescriptive

Measure	TRM Section	Initiative
Heat Pumps - Air Source >= 135,000 (11.25 tons) and < 240,000 Btu/h (20 tons)	3.2.1d	CI_Prescriptive
Heat Pumps - Air Source >= 240,000 Btu/h (20 tons)	3.2.1d	CI_Prescriptive
Heat Pumps - Air Source >= 65,000 (5.4 tons) and < 135,000 Btu/h (11.25 tons)	3.2.1d	CI_Prescriptive
Heat Pumps - Ground Source < 135,000 Btu/h (11.25 tons)	3.2.3c	CI_Prescriptive
Heat Pumps - Ground Water Source < 135,000 Btu/h (11.25 tons)	3.2.3b	CI_Prescriptive
Heat Pumps - Single Zone Ductless Mini-Split	3.2.4b	CI_Prescriptive
Heat Pumps - Multi Zone Ductless Mini-Split	3.2.4b	CI_Prescriptive
Heat Pumps - Water Source < 17,000 Btu/h (1.42 tons)	3.2.3a	CI_Prescriptive
Heat Pumps - Water Source GTE 17,000 Btu/h (1.42 tons)	3.2.3a	CI_Prescriptive
Packaged Terminal Air Conditioner	3.2.1e	CI_Prescriptive
Packaged Terminal Heat Pump	3.2.1g	CI_Prescriptive
Packaged/Split AC - Air Cooled >= 135,000 (11.25) and < 240,000 Btu/h (20 tons)	3.2.1a	CI_Prescriptive
Packaged/Split AC - Air Cooled >= 240,000 (20) and < 760,000 Btu/h (63.33 tons)	3.2.1a	CI_Prescriptive
Packaged/Split AC - Air Cooled >= 65,000 (5.4) and < 135,000 Btu/h (11.25 tons)	3.2.1a	CI_Prescriptive
Packaged/Split AC - Air Cooled >= 760,000 Btu/h (63.33 tons)	3.2.1a	CI_Prescriptive
Packaged/Split AC - Evap Cooled GE 135,000 (11.25) and LT 240,000 Btu/h (20 tons)	3.2.1c	CI_Prescriptive
Packaged/Split AC - Evap Cooled GE 240,000 (20) and LT 760,000 Btu/h (63.33 tons)	3.2.1c	CI_Prescriptive
Packaged/Split AC - Evap Cooled GE 65,000 (5.4) and LT 125,000 Btuh (11.25 tons)	3.2.1c	CI_Prescriptive
Packaged/Split AC - Evaporatively Cooled LT 65,000 Btu/h (5.4 tons) 16 SEER	3.2.1c	CI_Prescriptive
Packaged/Split AC - Evaporatively Cooled LT 65,000 Btu/h (5.4 tons) 18 SEER	3.2.1c	CI_Prescriptive
Packaged/Split AC - Water Cooled GE 135,000 (11.25) and < 240,00 Btu/h (20 tons)	3.2.1b	CI_Prescriptive
Packaged/Split AC - Water Cooled GE 760,000 Btu/h (63.33 tons)	3.2.1b	CI_Prescriptive
Packaged/Split AC -Water Cooled >= 240,000 (20) and < 760,000 Btu/h (63.33 tons)	3.2.1b	CI_Prescriptive
Packaged/Split AC -Water Cooled >= 65,000 (5.4) and < 135,000 Btu/h (11.25 tons)	3.2.1b	CI_Prescriptive
Packaged/Split AC Units - Air Cooled LT 65,000 Btu/h (5.4 tons) 16 SEER	3.2.1a	CI_Prescriptive
Packaged/Split AC Units - Air Cooled LT 65,000 Btu/h (5.4 tons) 18 SEER	3.2.1a	CI_Prescriptive
Packaged/Split AC Units - Evaporatively Cooled GE 760,000 Btu/h (63.33 tons)	3.2.1c	CI_Prescriptive
Packaged/Split AC Units - Water Cooled < 65,000 Btu/h (5.4 tons) 16 SEER	3.2.1b	CI_Prescriptive
Packaged/Split AC Units - Water Cooled < 65,000	3.2.1b	CI_Prescriptive

Measure	TRM Section	Initiative
Btu/h (5.4 tons) 18 SEER		
CFL Fixtures	3.1.1	CI_Lighting
Lighting - Other	3.1.1	CI_Lighting
Lighting Controls	3.1.3	CI_Lighting
CFL Lamps Specialty	3.1.1	CI_Lighting
CFL Lamps	3.1.1	CI_Lighting
Linear Fluorescent T5	3.1.1	CI_Lighting
Linear Fluorescent T8	3.1.1	CI_Lighting
LED Channel Signage	3.1.6	CI_Lighting
Exit Sign	3.1.5	CI_Lighting
LED Fixtures External	3.1.1	CI_Lighting
LED Fixtures Internal	3.1.1	CI_Lighting
LED Lamps	3.1.1	CI_Lighting
LED Lamps (Post 2020)	3.1.1	CI_Lighting
LED Linear	3.1.1	CI_Lighting
LED Reach in Refrigerator / Freezer Lights	3.1.7	CI_Lighting
Street & Area Lighting (Customer Owned)	3.1.1	CI_Lighting
CFL Lamps (Post 2020)	3.1.1	CI_Lighting
LED 6-8W Standard Bulb	3.1.1	CI_Direct_Install
LED 9-13W Standard Bulb	3.1.1	CI_Direct_Install
LED Nightlights	3.1.1	CI_Direct_Install
Tier 1, Smart Power Strip 5 Outlets, one installed	2.5.3	CI_Direct_Install
Tier 2, Smart Power Strip	2.5.3	CI_Direct_Install
CFL 9-13 Watt	3.1.1	CI_Direct_Install

C.2 Residential Programs

For the gross impact evaluation effort, sampling initiatives were confined to distinct programs with the exception of the New Homes component of the Low-Income Energy Efficiency Program, which was evaluated in the general residential New Homes Initiative. The table below lists (non-low-income) residential measures in the Companies' tracking and reporting system and assigns them to their respective evaluation initiatives. Note that some of the measures are denoted as disabled in the tracking system because they are not currently offered. We retain these measures for completeness – if the measures will again be offered in Act 129, they will fall in their corresponding sampling initiatives in the table. Note that the Home Energy Report measure is not listed in the table below, but the measure constitutes its own initiative.

Table 146: Assignment of measures to initiatives for Residential Programs

Measure	TRM Section	Initiative
100W equivalent CFL	2.1.1	Upstream Lighting
100W equivalent LED	2.1.1	Upstream Lighting
100W equivalent LED Specialty	2.1.1	Upstream Lighting
100W equivalent LEDee	2.1.1	Upstream Lighting
150W equivalent CFL	2.1.1	Upstream Lighting
150W equivalent LED	2.1.1	Upstream Lighting
150W equivalent LED Specialty	2.1.1	Upstream Lighting
150W equivalent LEDee	2.1.1	Upstream Lighting

Measure	TRM Section	Initiative
25-30W equivalent CFL	2.1.1	Upstream Lighting
25-30W equivalent LED	2.1.1	Upstream Lighting
25-30W equivalent LED Specialty	2.1.1	Upstream Lighting
25-30W equivalent LEDee	2.1.1	Upstream Lighting
40-45W equivalent CFL	2.1.1	Upstream Lighting
40-45W equivalent LED	2.1.1	Upstream Lighting
40-45W equivalent LED Specialty	2.1.1	Upstream Lighting
40-45W equivalent LEDee	2.1.1	Upstream Lighting
50-60W equivalent CFL	2.1.1	Upstream Lighting
50-60W equivalent LED	2.1.1	Upstream Lighting
50-60W equivalent LED Specialty	2.1.1	Upstream Lighting
50-60W equivalent LEDee	2.1.1	Upstream Lighting
65W equivalent CFL	2.1.1	Upstream Lighting
65W equivalent LED	2.1.1	Upstream Lighting
65W equivalent LED Specialty	2.1.1	Upstream Lighting
65W equivalent LEDee	2.1.1	Upstream Lighting
72-75W equivalent CFL	2.1.1	Upstream Lighting
72-75W equivalent LED	2.1.1	Upstream Lighting
72-75W equivalent LED Specialty	2.1.1	Upstream Lighting
New Construction - Multi Family Low Rise	2.6.3	New Homes
New Construction - Single Family Detached	2.6.3	New Homes
New Construction - Two-on-Two Condos	2.6.3	New Homes
New Construction -Townhouse and Duplexs	2.6.3	New Homes
New Manufactured Housing	2.6.3	New Homes
LI New Construction	2.6.3	New Homes
Dehumidifier Recycling	IMP	Res ATI
Freezer Recycling	2.4.3	Res ATI
Refrigerator Recycling	2.4.3	Res ATI
Room Air Conditioner Recycling	2.2.55	Res ATI
Low Flow Swivel Aerator	Various TRM Sections	Res EE Kits
Furnace Whistle	Various TRM Sections	Res EE Kits
LED 12w	Various TRM Sections	Res EE Kits
XXX Disabled LED 6.5w	Various TRM Sections	Res EE Kits
LED 9w	Various TRM Sections	Res EE Kits
LED nightlight	Various TRM Sections	Res EE Kits
XXX Disabled Smart Strip	Various TRM Sections	Res EE Kits
XXXDisabled	Various TRM Sections	Res EE Kits
Low Flow Shower Head 1.6 GPM	Various TRM Sections	Res EE Kits
13/20/25 - 3 way CFL	Various TRM Sections	Res EE Kits
XXX Disabled 9w Globe	Various TRM Sections	Res EE Kits
23w CFL	Various TRM Sections	Res EE Kits
XXX Disabled Low Flow Swivel Aerator	Various TRM Sections	Res EE Kits
Furnace Whistle	Various TRM Sections	Res EE Kits
LED 12w	Various TRM Sections	Res EE Kits
XXX Disabled LED 6.5w	Various TRM Sections	Res EE Kits
LED 9w	Various TRM Sections	Res EE Kits
LED nightlight	Various TRM Sections	Res EE Kits
XXX Disabled Smart Strip	Various TRM Sections	Res EE Kits
XXXDisabled	Various TRM Sections	Res EE Kits

Measure	TRM Section	Initiative
XXX Disabled Low Flow Shower Head 1.6 GPM	Various TRM Sections	Res EE Kits
13/20/25 - 3 way CFL	Various TRM Sections	Res EE Kits
XXX Disabled 9w Globe	Various TRM Sections	Res EE Kits
23w CFL	Various TRM Sections	Res EE Kits
Low Flow Swivel Aerator	Various TRM Sections	Res EE Kits
Furnace Whistle	Various TRM Sections	Res EE Kits
XXX Disabled LED 12w	Various TRM Sections	Res EE Kits
XXX Disabled LED 6.5w	Various TRM Sections	Res EE Kits
LED 9w	Various TRM Sections	Res EE Kits
LED nightlight	Various TRM Sections	Res EE Kits
XXX Disabled Smart Strip	Various TRM Sections	Res EE Kits
XXXDisabled	Various TRM Sections	Res EE Kits
XXX Disabled Low Flow Shower Head 1.6 GPM	Various TRM Sections	Res EE Kits
XXX Disabled 13/20/25 - 3 way CFL	Various TRM Sections	Res EE Kits
XXX Disabled 9w Globe	Various TRM Sections	Res EE Kits
23w CFL	Various TRM Sections	Res EE Kits
XXX Disabled Low Flow Swivel Aerator	Various TRM Sections	Res EE Kits
Furnace Whistle	Various TRM Sections	Res EE Kits
XXX Disabled LED 12w	Various TRM Sections	Res EE Kits
XXX Disabled LED 6.5w	Various TRM Sections	Res EE Kits
LED 9w	Various TRM Sections	Res EE Kits
LED nightlight	Various TRM Sections	Res EE Kits
XXX Disabled Smart Strip	Various TRM Sections	Res EE Kits
XXXDisabled	Various TRM Sections	Res EE Kits
XXX Disabled Low Flow Shower Head 1.6 GPM	Various TRM Sections	Res EE Kits
XXX Disabled 13/20/25 - 3 way CFL	Various TRM Sections	Res EE Kits
XXX Disabled 9w Globe	Various TRM Sections	Res EE Kits
23w CFL	Various TRM Sections	Res EE Kits
72-75W equivalent LEDee	2.1.1	Upstream Lighting
Clothes Washer - Level 1	2.4.4	Res_Appliances
Clothes Dryer - (Elec w Moisture Sensor)	2.4.5	Res_Appliances
Dehumidifiers	2.4.8	Res_Appliances
Freezers	2.4.2	Res_Appliances
Refrigerators - Level 1	2.4.1	Res_Appliances
Clothes Dryer - (Elec Heat Pump)	2.4.5	Res_Appliances
Refrigerators - Level 2	2.4.1	Res_Appliances
Refrigerators - Level 3	2.4.1	Res_Appliances
Water Heater - Heat Pump	2.3.1	Res_Appliances
Water Heater - Solar	2.3.2	Res_Appliances
TVs	2.5.1	Upstream Electronics
Computers	2.5.2	Upstream Electronics
Imaging	2.5.2	Upstream Electronics
Monitors	2.5.2	Upstream Electronics
Central Air Conditioner - Level 2	2.2.1	Res HVAC
Central Air Conditioner - Level 3	2.2.1	Res HVAC
Ductless Mini-Split Heat Pump - Level 3	2.2.3	Res HVAC
Furnace Fans	2.2.1	Res HVAC
Heat Pump - Level 2	2.2.1	Res HVAC

Measure	TRM Section	Initiative
Heat Pump - Level 3	2.2.1	Res HVAC
Heat Pump - Water & GeoT - ES Tier 3	2.2.1	Res HVAC
PTAC - Level 2 - Multi Family	2.2.10	Res HVAC
PTHP - Level 2 - Multi Family	2.2.10	Res HVAC
HVAC - Maintenance	2.2.1	Res HVAC
Programmable Thermostat - Direct Install	IMP	Res HVAC
Programmable Thermostat - Store Bought	IMP	Res HVAC
3-way CFL (12/23/33)	Various TRM Sections	Res EE Kits
11W LED	Various TRM Sections	Res EE Kits
23w CFL	Various TRM Sections	Res EE Kits
LED Nite Lite	Various TRM Sections	Res EE Kits
9W LED	Various TRM Sections	Res EE Kits
Furnace Whistle	Various TRM Sections	Res EE Kits
Kitchen Swivel Aerator	Various TRM Sections	Res EE Kits
Over 150W equivalent CFL	2.1.1	Upstream Lighting
Over 150W equivalent LED	2.1.1	Upstream Lighting
Over 150W equivalent LED Specialty	2.1.1	Upstream Lighting
Over 150W equivalent LED Specialty	2.1.1	Upstream Lighting
Over 150W equivalent LEDee	2.1.1	Upstream Lighting
Under 25W equivalent CFL	2.1.1	Upstream Lighting
Under 25W equivalent LED	2.1.1	Upstream Lighting
Under 25W equivalent LED Specialty	2.1.1	Upstream Lighting
Under 25W equivalent LEDee	2.1.1	Upstream Lighting
Attic Insulation	2.6.1	Res DI
Air Sealing	2.6.6	Res DI
Showerhead	2.3.9	Res DI
Pipe Wrap	2.3.7	Res DI
CFL - 13W	2.1.1	Res DI
CFL - 18W	2.1.1	Res DI
CFL - 23W	2.1.1	Res DI
CFL - 9W	2.1.1	Res DI
LED - 9W	2.1.1	Res DI
Bath Aerator	2.3.8	Res DI
Kitchen Aerator	2.3.8	Res DI
CFL - 9W Specialty	2.1.1	Res DI
12/22/33 Watt 3-way CFL	2.1.1	Res DI
14W Globe CFL	2.1.1	Res DI
ENERGY STAR® Windows	2.6.2	Res DI
Wall Insulation	2.6.1	Res DI
Duct Sealing	2.2.6	Res DI
16W R30 Flood	2.1.1	Res DI
Furnace Whistle	2.2.7	Res DI
LED Night Light	2.1.4	Res DI
Smart Power Strips	2.5.3	Res DI
CFL - 19W	2.1.1	Res DI
CFL - 9W Floodlight	2.1.1	Res DI
CFL - 14W Floodlight	2.1.1	Res DI
CFL - 14W Candelabra	2.1.1	Res DI
CFL - 19W Globe	2.1.1	Res DI
CFL - 9W Candelabra	2.1.1	Res DI

Measure	TRM Section	Initiative
CFL - 9W Globe	2.1.1	Res DI
LED -11W	2.1.1	Res DI
CFL - 23W Floodlight	2.1.1	Res DI
HandHeld Showerhead	2.3.9	Res DI
LED 11/12W	2.1.1	Res DI
LED 5W Candelabra	2.1.1	Res DI
LED 6W Globe	2.1.1	Res DI
LED 14/15	2.1.1	Res DI
LED 11W R30 Flood	2.1.1	Res DI

C.3 Residential Low-Income Program Direct Install

For the gross impact evaluation effort, sampling initiatives were confined to distinct programs with the exception of the New Homes component of the Low-Income Energy Efficiency Program, which was evaluated in the general residential New Homes Initiative. The table below lists low-income residential measures in the Companies' tracking and reporting system and assigns them to their respective evaluation initiatives. Note that some of the measures are denoted as disabled in the tracking system because they are not currently offered. We retain these measures for completeness – if the measures will again be offered in Act 129, they will fall in their corresponding sampling initiatives in the table. The Home Energy Report measure is not listed in the table below, but the measure constitutes its own initiative.

Measure	TRM Section	Initiative
CREATE INT. ATTIC HATCH > 2 SQ. FT.	2.6.6	LI Direct Install
CREATE EXT. ATTIC HATCH UP TO 2 SQ. FT.	2.6.6	LI Direct Install
CREATE EXT. ATTIC HATCH > 2 SQ. FT.	2.6.6	LI Direct Install
CREATE KNEE WALL ACCESS	2.6.6	LI Direct Install
INSULATE ATTIC ACCESS-PUSH UP	2.6.6	LI Direct Install
INSULATE ATTIC ACC/FOLD. STAIRS	2.6.6	LI Direct Install
INSUL. & WXSTRIP PULL-DOWN ATTIC-PRE-FAB UNIT	2.6.6	LI Direct Install
INSUL.& WXSTRIP HORIZONTAL/PUSH-UP ATTIC HTCH-PRE-FAB UNIT	2.6.6	LI Direct Install
INSULATE & WXSTRIP WHOLE ATTIC DOOR	2.6.6	LI Direct Install
INSUL. & WXSTRIP WHOLE ATTIC DOOR (STAIRWAY)-PRE-FAB UNIT	2.6.6	LI Direct Install
ATTIC RECESSED LIGHTING BOXING	2.6.6	LI Direct Install
INSULATE ATTIC KNEE WALL	2.6.1	LI Direct Install
INSULATE ATTIC KNEE WALL PRE-FAB	2.6.1	LI Direct Install
FRAME SETS-ENERGY GUARD. OR EQUIVALENT ATTIC BOX	2.6.6	LI Direct Install
ENERGY GUARDIAN ACCESSORY PACK	2.6.6	LI Direct Install
FLOOR-FACED BAT FBGL R-11 16" ON CENTER	2.6.1	LI Direct Install
FLOOR-FACD BAT FBGL R-19 16" ON CENTER	2.6.1	LI Direct Install
FLOOR-FACD BAT FBGL R-19 24" ON CENTER	2.6.1	LI Direct Install
FLR. UNCOD. SP- VAPOR BARRIER-CRAWLSPACE	2.6.6	LI Direct Install
BREATHABLE MATERIAL-TYPAR/TYVEK -MOISTURE CONTROL	2.6.6	LI Direct Install
PERIMETER INSULATION-FACD FBGL R-11	2.6.1	LI Direct Install
PERIMETER INSULATION-FACD FBGL R-19	2.6.1	LI Direct Install

GARAGE- RIGID BOARD	2.6.6	LI Direct Install
GARAGE-FACD BAT FBGL R-19	2.6.1	LI Direct Install
MISC REPAIRS-CHIMNEY, FLUE, ETC.	2.6.6	LI Direct Install
INT. REPAIRS-FLOOR/WALL/CEILING..	2.6.6	LI Direct Install
EXHAUST FANS	2.6.6	LI Direct Install
VENT AN EXISTING EXHAUST TO OUTSIDE	2.6.6	LI Direct Install
DRYER VENT REPLACEMENT	2.6.6	LI Direct Install
DRYER VENT REPAIR	2.6.6	LI Direct Install
HEAT SYST./FURN. REPR. & RETROFIT	2.2.1	LI Direct Install
DUCT SEALING & REPAIR	2.2.6	LI Direct Install
DUCT INSULATION LESS THAN 6" IN DIAMETER	2.2.6	LI Direct Install
DUCT INSULATION GREATER THAN 6" DIAMETER	2.2.6	LI Direct Install
DUCT INSULATION SQUARE DUCTS	2.2.6	LI Direct Install
FURN./HEAT. SYSTEM REPLACEMENT	2.2.1	LI Direct Install
BASEBOARD REPAIR/REPLACE	2.6.6	LI Direct Install
FURNACE MAINT./TUNE-UP	2.2.1	LI Direct Install
REPLACE FURNACE FILTER	2.2.1	LI Direct Install
HEAT PUMP FILTER CLEANING/REPLACEMENT	2.2.1	LI Direct Install
HEAT PUMP COIL CLEANING-COIL ACCESSIBLE	2.2.1	LI Direct Install
HEAT PUMP COIL CLEANING-COIL NOT ACCESSIBLE	2.2.1	LI Direct Install
INSTALL AIR COND/APPLIANCE TIMER	2.2.1	LI Direct Install
EFFICIENT LIGHTING FIXTURES/COMPACT FLUORESCENT	2.1.1	LI Direct Install
DIMMABLE COMPACT FLUORESCENT LIGHTS	2.1.1	LI Direct Install
THREE-WAY COMPACT FLUORESCENT LIGHTS	2.1.1	LI Direct Install
R-30 AND R-40 COMPACT FLUORESCENT LIGHTS	2.1.1	LI Direct Install
3W AND 7W COMPACT FLUORESCENT LIGHTS	2.1.1	LI Direct Install
LIGHT FIXTURE OR SPECIALTY BULB REPLACEMENT	2.1.1	LI Direct Install
REPLACE AIR CONDITIONING FILTER	2.2.1	LI Direct Install
WINDOW/WALL A/C FILTER CLEANING/REPLACEMENT	2.2.1	LI Direct Install
CENTRAL AIR CONDITIONING TUNE-UP	2.2.1	LI Direct Install
CENTRAL A/C COIL CLEAN-COIL NOT ACCESSIBLE	2.2.1	LI Direct Install
COOLING SYSTEM REPLACEMENT- CENTRAL A/C	2.2.1	LI Direct Install
THERMOSTAT (REG.) RECALB./RELOCT/REPLAC.	2.2.8	LI Direct Install
LINE VOLTAGE THERMOSTAT	2.2.8	LI Direct Install
INSTALL SETBACK THERMOSTAT	2.2.8	LI Direct Install
CHANGEOUT AIR CONDITIONER--5000 BTU	2.2.1	LI Direct Install
CHANGEOUT AIR CONDITIONER--8000 BTU	2.2.1	LI Direct Install
CHANGEOUT AIR CONDITIONER--10000 BTU	2.2.1	LI Direct Install
CHANGEOUT AIR CONDITIONER--12000 BTU	2.2.1	LI Direct Install
CHANGEOUT AIR CONDITIONER--14000 BTU	2.2.1	LI Direct Install
CHANGEOUT AIR CONDITIONER--18000 BTU	2.2.1	LI Direct Install
WINDOW FILM	2.6.6	LI Direct Install
GRAVITY FILM EXCHANGE (GFX)	2.6.6	LI Direct Install
5 CU FT FREEZER CHEST/MANUAL	2.4.2	LI Direct Install
7 CU FT FREEZER CHEST/MANUAL	2.4.2	LI Direct Install
9 CU FT FREEZER CHEST/MANUAL	2.4.2	LI Direct Install
15 CU FT FREEZER CHEST/MANUAL	2.4.2	LI Direct Install
20 CU FT FREEZER CHEST/MANUAL	2.4.2	LI Direct Install
12 CU FT FREEZER UPRIGHT	2.4.2	LI Direct Install
14 CU FT FREEZER UPRIGHT FROST-FREE	2.4.2	LI Direct Install
14 CU FT FREEZER UPRIGHT MANUAL	2.4.2	LI Direct Install
17 CU FT FREEZER UPRIGHT FROST-FREE	2.4.2	LI Direct Install

17 CU FT FREEZER UPRIGHT/MANUAL	2.4.2	LI Direct Install
15 CUBIC FT. TOP MOUNT REFRIGERATOR	2.4.1	LI Direct Install
15 CUBIC FT. TOP MOUNT REFRIGERATOR (ICE)	2.4.1	LI Direct Install
18 CUBIC FT. TOP MOUNT REFRIGERATOR	2.4.1	LI Direct Install
18 CU FT TOP MOUNT REFRIGERATOR (ICE)	2.4.1	LI Direct Install
21 CUBIC FT. TOP MOUNT REFRIGERATOR	2.4.1	LI Direct Install
21 CU FT. TOP MOUNT REFRIGERATOR (ICE)	2.4.1	LI Direct Install
22 CU FT. SIDE/SIDE REFRIGERATOR (ICE)	2.4.1	LI Direct Install
22 CU FT TOP MOUNT REFRIGERATOR (NO ICE)	2.4.1	LI Direct Install
25 CU FT REFRIG SIDE/SIDE ICE	2.4.1	LI Direct Install
ADDITIONAL REFRIGERATOR/FREEZER REMOVAL	2.4.3	LI Direct Install
DRYER REPLACEMENT	2.4.5	LI Direct Install
TORCHERE LAMP	2.1.1	LI Direct Install
SMART STRIP POWER PLUG	2.5.3	LI Direct Install
FAUCET AERATOR-BATH	2.3.8	LI Direct Install
FAUCET AERATOR-KITCH	2.3.8	LI Direct Install
FAUCET AERATOR-WITH SWIVEL HEAD	2.3.8	LI Direct Install
ENERGY SAVING SHOWERHEAD W/O SHUTOFF	2.3.9	LI Direct Install
ENERGY SAVING SHOWERHEAD W/SHUTOFF	2.3.9	LI Direct Install
SHOWERHEAD - HANDHELD	2.3.9	LI Direct Install
WATER HEATER JACKET R-11	2.3.5	LI Direct Install
WATER HEATER JACKET TANK GREATER THAN 52 GALLONS	2.3.5	LI Direct Install
WATER HEATER INSULATION - LOW E OR EQUIVALENT	2.3.5	LI Direct Install
PIPE INSULATION - 3/4	2.3.7	LI Direct Install
PIPE INSULATION - 1/2"	2.3.7	LI Direct Install
TANK TEMPERATURE SETBACK	2.3.6	LI Direct Install
30 GAL ELEC HOT WATER TANK REMOVE/REPLACE	Null Measure	LI Direct Install
40 GAL ELEC. HOT WATER TANK REMOVE/REPLACE	2.3.1	LI Direct Install
52 GAL ELEC HOT WATER TANK REMOVE/REPLACE	2.3.1	LI Direct Install
80 GAL ELEC HOT WATER TANK REMOVE/REPLACE	2.3.1	LI Direct Install
INFILTRATION WORK INCLUDING BLOWER DOOR	2.6.6	LI Direct Install
RIGID BOARD HOLE REPAIR/AIR SEALING	2.6.6	LI Direct Install
TWO-PART FOAM PERIMETER INSULATION	2.6.6	LI Direct Install
FIBERGLASS PERIMETER INSULATION (R19)	2.6.1	LI Direct Install
RIGID BOARD PERIMETER INSULATION (1`)	2.6.6	LI Direct Install
DRYWALL PATCH W/TAPED JOINTS & TOP COAT	2.6.6	LI Direct Install
DRYWALL FULL SHEET W/TAPED JOINTS & TOP COAT	2.6.6	LI Direct Install
KITCHEN VENT COVER	2.6.6	LI Direct Install
INTERIOR ATTIC STAIR COVER	2.6.6	LI Direct Install
WHOLE HOUSE FAN COVER	2.6.6	LI Direct Install
INFILTRATION WORK EXCLUDING BLOWER DOOR	2.6.6	LI Direct Install
CAULK	2.6.6	LI Direct Install
CAULK - HIGH TEMPERATURE	2.6.6	LI Direct Install
AEROSOL FOAM SEALANT	2.6.6	LI Direct Install
AEROSOL FOAM SEALANT-HIGH TEMPERATURE	2.6.6	LI Direct Install
AIR TIGHT INSERT KIT OR EQUIVALENT FOR RECESSED LIGHTS	2.6.6	LI Direct Install
AIR CONDITIONER COVER-RIGID	2.6.6	LI Direct Install
AIR CONDITIONER COVER-SOFT	2.6.6	LI Direct Install
WINDOW QUILT	2.6.6	LI Direct Install
BLOWN SIDEWALL INSULATION - ASBESTOS	2.6.1	LI Direct Install
BLOWN SIDEWALL INSULATION - WOOD / ASPHALT	2.6.1	LI Direct Install

BLOWN SIDEWALL INSULATION - STUCCO/BRICK	2.6.1	LI Direct Install
BLOWN SIDEWALL INSULATION - ALUMINUM SIDING	2.6.1	LI Direct Install
BLOWN SIDEWALL INSULATION - VINYL SIDING	2.6.1	LI Direct Install
FIBERGLASS UNFINISHED WALL INSULATION (R13)	2.6.1	LI Direct Install
FIBERGLASS UNFINISHED WALL INSULATION-R19	2.6.1	LI Direct Install
WET SPRAY CELLULOSE INSULATION	2.6.1	LI Direct Install
EXT. DOOR - SWEEP	2.6.6	LI Direct Install
EXT. DOOR - WEATHER-STRIP	2.6.6	LI Direct Install
EXT. DOOR - FIX LOCK	2.6.6	LI Direct Install
EXT. DOOR - REPLACE LOCK	2.6.6	LI Direct Install
EXT. DOOR - REPAIR	2.6.6	LI Direct Install
EXT. DOOR - REPLACE	2.6.6	LI Direct Install
EXTERIOR DOOR - CONSTRUCT	2.6.6	LI Direct Install
EXT. DOOR - STORM DOOR	2.6.6	LI Direct Install
INT. DOOR - WEATHER-STRIP	2.6.6	LI Direct Install
EXT./INT. DOOR - INSULATE W/RIGID BD	2.6.6	LI Direct Install
WINDOW-REPL GLASS W/ GLAZE	2.6.6	LI Direct Install
WINDOW-REGLAZE ONLY	2.6.6	LI Direct Install
WINDOW-REPAIR/REPLACE SASH	2.6.6	LI Direct Install
WINDOW WEATHER-STRIP	2.6.6	LI Direct Install
WINDOW-REPLACE SASH LOCK	2.6.6	LI Direct Install
WINDOW-ADD PULLEY SEALS	2.6.6	LI Direct Install
REPLACEMENT WINDOW	2.6.6	LI Direct Install
INTERIOR STORM WINDOW W/CLIPS	2.6.6	LI Direct Install
INTERIOR STORM WINDOW W/O CLIPS	2.6.6	LI Direct Install
EXTERIOR STORM WINDOW/DOOR REPAIR	2.6.6	LI Direct Install
INSTALL EXTERIOR STORM DOOR/WINDOW	2.6.6	LI Direct Install
MOBILE HOME-INSTALL DOOR/STORM COMBO	2.6.6	LI Direct Install
MOBILE HOME-REPL. EXT PRIME DOOR	2.6.6	LI Direct Install
MOBILE HOME--INTERIOR STORM WINDOWS	2.6.6	LI Direct Install
MOBILE HOME--REPLACE PRIME WINDOWS	2.6.6	LI Direct Install
MOBILE HOME-SKIRTING	2.6.6	LI Direct Install
REFLECTIVE ROOF COAT	2.6.6	LI Direct Install
MOB. HOME-CEILING INSULATION - CELLULOSE	2.6.1	LI Direct Install
MOB. HOME-CEILING INSULATION - FIBERGLASS	2.6.1	LI Direct Install
MOB. HOME- FLOOR INSULATION (BELLY) CELLULOSE	2.6.1	LI Direct Install
MOBILE HOME FLOOR INSULATION--FIBERGLASS	2.6.1	LI Direct Install
TYPAR/TYVEK BELLY BOARD MOBILE HOME REPAIR	2.6.6	LI Direct Install
PLYWOOD OR RIGID BOARD BELLY BOARD MOBILE HOME REPAIR	2.6.6	LI Direct Install
CLEAN/SEAL/SECURE MOBILE HOME ELECTRIC HEAT REG. RISER	2.6.6	LI Direct Install
MOBILE HOME ROOF PATCH	2.6.6	LI Direct Install
R11 ATTIC FIBERGLASS BATTS	2.6.1	LI Direct Install
R13 ATTIC FIBERGLASS BATTS	2.6.1	LI Direct Install
R-19 ATTIC-NON FACD BATT FBGLS	2.6.1	LI Direct Install
R25 ATTIC FIBERGLASS BATTS	2.6.1	LI Direct Install
R30 ATTIC FIBERGLASS BATTS	2.6.1	LI Direct Install
R38 ATTIC FIBERGLASS BATTS	2.6.1	LI Direct Install
R19 PINK PLUS	2.6.1	LI Direct Install
BLOWN CELLULOSE UNFLOORED ATTIC INSULATION R19 OR LESS	2.6.1	LI Direct Install
BLOWN CELLULOSE UNFLOORED ATTIC INSULATION R20 OR GREATER	2.6.1	LI Direct Install

BLOWN CELLULOSE FLOORED (DENSE PACKED) ATTIC INSULATION R19 OR LESS	2.6.1	LI Direct Install
BLOWN CELLULOSE FLOORED (DENSE PACKED) ATTIC INSULATION R20 OR GREATER	2.6.1	LI Direct Install
PREP OR FOLLOW-UP TO AIR SEAL OR INSULATING	2.6.6	LI Direct Install
BOXING/DAMMING OF ATTIC HATCHES	2.6.6	LI Direct Install
BOXING/DAMMING OF CHIMNEYS	2.6.6	LI Direct Install
BOXING/DAMMING OF STORAGE AREAS	2.6.6	LI Direct Install
BOXING/DAMMING OF SOFFIT VENTS	2.6.6	LI Direct Install
BOXING/DAMMING FIXTURES-SEALED-END DUCT	2.6.6	LI Direct Install
BOXING/DAMMING FIXTURES (PRE-FAB 16" DAM)	2.6.6	LI Direct Install
BOXING/DAMMING FIXTURES (PRE-FAB 24" DAM)	2.6.6	LI Direct Install
CREATE INT. ATTIC HATCH UP TO 2 SQ.FT	2.6.6	LI Direct Install
CF1 9-13 watt CFL	2.1.1	LI Direct Install
CF2 14-16 watt CFL	2.1.1	LI Direct Install
CF3 17-20 watt CFL	2.1.1	LI Direct Install
CF4 21-25 watt CFL	2.1.1	LI Direct Install
SP 1 Smart Power Strip 6-9 outlets	2.5.3	LI Direct Install
SP 2 Smart Power Strip 10+ outlets	2.5.3	LI Direct Install
FLOOD/RECESSED CFL - 10-13 WATTS	2.1.1	LI Direct Install
FLOOD/RECESSED CFL - 14-16 WATTS	2.1.1	LI Direct Install
FLOOD/RECESSED CFL - 17-20 WATTS	2.1.1	LI Direct Install
FLOOD/RECESSED CFL - 21-25 WATTS	2.1.1	LI Direct Install
SPEC CFL - 2-9 WATTS	2.1.1	LI Direct Install
SPEC CFL - 10-13 WATTS	2.1.1	LI Direct Install
SPEC CFL - 14-16 WATTS	2.1.1	LI Direct Install
SPEC CFL - 17-20 WATTS	2.1.1	LI Direct Install
SPEC CFL - 21-25 WATTS	2.1.1	LI Direct Install
Furnace Whistle	2.2.7	LI Direct Install
LED Night Light	2.1.4	LI Direct Install
12 CU FT FREEZER UPRIGHT/MANUAL	2.4.2	LI Direct Install
13 CU FT FREEZER UPRIGHT MANUAL	2.4.2	LI Direct Install
14 CU FT FREEZER CHEST/FROSTFREE	2.4.2	LI Direct Install
15 CU FT REFRIGERATOR (ICE)	2.4.1	LI Direct Install
16 CU FT FREEZER UPRIGHT/FROSTFREE	2.4.2	LI Direct Install
16 CU FT FREEZER UPRIGHT/MANUAL	2.4.2	LI Direct Install
16 CU FT REFRIGERATOR	2.4.1	LI Direct Install
16 CU FT REFRIGERATOR (ICE)	2.4.1	LI Direct Install
17 CU FT REFRIGERATOR (ICE)	2.4.1	LI Direct Install
17 CUBIC FT. REFRIGERATOR	2.4.1	LI Direct Install
21 CU FT FREEZER UPRIGHT FROST FREE	2.4.2	LI Direct Install
22 CU FT REFRIGERATOR (ICE)	2.4.1	LI Direct Install
23 CU FT SIDE/SIDE REFRIGERATOR(ICE)	2.4.1	LI Direct Install
7 CU FT UPRIGHT FREEZER	2.4.2	LI Direct Install
A/C WINDOW UNIT - NO PRIOR UNIT	2.2.4	LI Direct Install
AIR CONDITIONER WINDOW/WALL GASKET	2.6.6	LI Direct Install
ATTIC BATT FBGLS R-38	2.6.1	LI Direct Install
ATTIC-BLN INSL R-10	2.6.1	LI Direct Install
ATTIC-BLN INSL R-19	2.6.1	LI Direct Install
ATTIC-BLN INSL R-20	2.6.1	LI Direct Install
ATTIC-BLN INSL R-25	2.6.1	LI Direct Install
ATTIC-BLN INSL R-27	2.6.1	LI Direct Install
ATTIC-BLN INSL R-30	2.6.1	LI Direct Install

ATTIC-BLN INSL R-38	2.6.1	LI Direct Install
ATTIC-BLN INSL R-8	2.6.1	LI Direct Install
BLOWN SIDEWALL INSULATION-BIBS	2.6.1	LI Direct Install
BLOWN SIDEWALL INSULATION-PLASTER/DRYW.	2.6.1	LI Direct Install
BOXING/DAMMING ATTIC HATCH - FIBERGLASS	2.6.6	LI Direct Install
CLEAN/SEAL/SECURE MOBILE HOME REG. RISER	2.6.6	LI Direct Install
DEHUMIDIFIER REPLACEMENT	2.4.8	LI Direct Install
DENSE PACK CANTILEVER	2.6.1	LI Direct Install
DISPOSAL AND INSTALLTION OF NEW AIR COND	2.2.1	LI Direct Install
ENERGY SAVING SHOWERHEAD	2.3.9	LI Direct Install
FLOOR-FACED BAT FBGL R-11 24 CTR	2.6.1	LI Direct Install
FLR. UNCOD. SP-FACD FBGL R11 16	2.6.1	LI Direct Install
GARAGE RIGID BOARD - 2 INCH	2.6.6	LI Direct Install
HEAT EXCHANGER REPLACEMENT	2.2.1	LI Direct Install
HEAT REFLECTOR	2.6.6	LI Direct Install
INSTALL CEILING FAN	2.4.10	LI Direct Install
INSTALL WHOLE HOUSE FAN	2.2.9	LI Direct Install
MOB. HOME-REPLACE FLOOR REG. 8X10	2.6.6	LI Direct Install
RIGID BOARD INSULATION 2 INCH	2.6.6	LI Direct Install
SPRAY FOAM-THERMAL/IGNITION BARRIER REQ	2.6.6	LI Direct Install
WATER HEATER T-STAT. - TEST/REPLACE	2.3.6	LI Direct Install
CHANGEOUT AIR CONDITIONER-15000 BTU	2.2.4	LI Direct Install
78A - Dimmable CFL	2.1.1	LI Direct Install
78F - Specialty CFL - Flood/Recessed	2.1.1	LI Direct Install
HPW-A - Install Heat Pump Water Heater 2.0 EF	2.3.1	LI Direct Install
HPW-B - Install Heat Pump Water Heater 2.3 EF	2.3.1	LI Direct Install
22 cu. Ft. SxS fridge (no ice)	2.4.1	LI Direct Install
25 cu. Ft. freezer chest/manual	2.4.2	LI Direct Install
Install heat pump water heater 2.0 EF	2.3.1	LI Direct Install
Install heat pump water heater 2.3 EF	2.3.1	LI Direct Install
Mobile home replace floor reg 4x10	2.6.6	LI Direct Install
Mobile home replace floor reg 4x12	2.6.6	LI Direct Install
Mobile home replace floor reg. 4x8	2.6.6	LI Direct Install
Safety test - atmospheric draft	2.6.6	LI Direct Install
25 cu ft refrigerator (side by side)	2.4.1	LI Direct Install
30 Gallon - .93 EF	Null Measure	LI Direct Install
30 Gallon - .94 EF	Null Measure	LI Direct Install
30 Gallon - .95 EF	Null Measure	LI Direct Install
40 Gallon - .93 EF	Null Measure	LI Direct Install
40 Gallon - .94 EF	Null Measure	LI Direct Install
40 Gallon - .95 EF	Null Measure	LI Direct Install
50 Gallon - .93 EF	Null Measure	LI Direct Install
50 Gallon - .94 EF	Null Measure	LI Direct Install
50 Gallon - .95 EF	Null Measure	LI Direct Install
80 Gallon - .93 EF	Null Measure	LI Direct Install
80 Gallon - .94 EF	Null Measure	LI Direct Install
80 Gallon - .95 EF	Null Measure	LI Direct Install
FW1 - Met-Ed	2.2.7	LI Direct Install
FW2 - Penelec	2.2.7	LI Direct Install
FW3 - Penn Power	2.2.7	LI Direct Install
FW4 - West Penn Power	2.2.7	LI Direct Install
Met-Ed - B2A	2.2.8	LI Direct Install
Penelec - B2B	2.2.8	LI Direct Install

Penn Power - B2C	2.2.8	LI Direct Install
West Penn Power - B2D	2.2.8	LI Direct Install
Removal of Additional Freezer	2.4.3	LI Direct Install
Energy Saving Showerhead with Shut Off	2.3.9	LI Direct Install
Faucet Aerator - Bath	2.3.8	LI Direct Install
Faucet Aerator - Kitchen	2.3.8	LI Direct Install
Faucet Aerator with Swivel Head	2.3.8	LI Direct Install
Pipe Ins. 1/2 inch from EHWH	2.3.7	LI Direct Install
Pipe Ins. 3/4 inch from EHWH	2.3.7	LI Direct Install
PIPE INSULATION - 3/4"	2.3.7	LI Direct Install
50 Gal .93EF Elec HWH Replace	Null Measure	LI Direct Install
50 Gal .94EF Elec HWH Replace	Null Measure	LI Direct Install
50 Gal .95EF Elec HWH Replace	Null Measure	LI Direct Install
50 Gal Elec. Hot Water Tank Remove/Replace	2.3.1	LI Direct Install
50 Gal Elec. Hot Water Tank Remove/Replace	Null Measure	LI Direct Install
Attic-BLN INSL R14	2.6.1	LI Direct Install
Attic-BLN INSL R33	2.6.1	LI Direct Install
Attic-BLN INSL R44	2.6.1	LI Direct Install
Ductless Mini-Split Heat Pump	2.2.3	LI Direct Install
LED - 13-14 WATT Flood	2.1.1	LI Direct Install
LED - 17 WATT Flood	2.1.1	LI Direct Install
LED - 2.3 WATT Globe	2.1.1	LI Direct Install
LED - 3.5 WATT Medium Base Torpedo	2.1.1	LI Direct Install
LED - 3.7-4.8 WATT Candelabra	2.1.1	LI Direct Install
LED - 6-8 WATT Standard Bulb	2.1.1	LI Direct Install
LED - 8 WATT Flood	2.1.1	LI Direct Install
LED - 9-13 WATT Standard Bulb	2.1.1	LI Direct Install
Ground Cover	2.6.6	LI Direct Install
Heat Pump Clean and Tune	2.2.1	LI Direct Install
LI Dehumidifier Recycling	IMP	LI ATI
LI Freezer Recycling	2.4.3	LI ATI
LI Refrigerator Recycling	2.4.3	LI ATI
LI Room Air Conditioner Recycling	2.2.5	LI ATI
Low Flow Swivel Aerator	Various TRM Sections	LI Kits
Furnace Whistle	Various TRM Sections	LI Kits
LED 12w	Various TRM Sections	LI Kits
LED 6.5w	Various TRM Sections	LI Kits
LED 9w	Various TRM Sections	LI Kits
LED nightlight	Various TRM Sections	LI Kits
XXX Disabled Smart Strip	Various TRM Sections	LI Kits
XXXDisabled	Various TRM Sections	LI Kits
Low Flow Shower Head 1.6 GPM	Various TRM Sections	LI Kits
13/20/25 - 3 way CFL	Various TRM Sections	LI Kits
XXX Disabled 9w Globe	Various TRM	LI Kits

	Sections	
23w CFL	Various TRM Sections	LI Kits
XXX Disabled Low Flow Swivel Aerator	Various TRM Sections	LI Kits
XXX Disabled Low Flow Shower Head 1.6 GPM	Various TRM Sections	LI Kits
LI Clothes Washers	2.4.4	LI Appliances
LI Clothes Dryer	2.4.5	LI Appliances
LI Dehumidifiers	2.4.8	LI Appliances
LI Freezers	2.4.2	LI Appliances
LI Refrigerators	2.4.1	LI Appliances
3-way CFL (12/23/33)	Various TRM Sections	LI Kits
11W LED	Various TRM Sections	LI Kits
LED Nite Lite	Various TRM Sections	LI Kits
9W LED	Various TRM Sections	LI Kits
Kitchen Swivel Aerator	Various TRM Sections	LI Kits
6W LED	Various TRM Sections	LI Kits
SILL BOX INSUL PRE CUT PRODUCT	2.6.6	LI Direct Install
LE9 - Retrofit Kit - 13-14 Watt Flood	2.1.1	LI Direct Install

Appendix D Evaluation Detail – Residential Appliance Turn-In Initiative

D.1 Gross Impact Evaluation

Gross impact evaluation for the Appliance Turn-In (ATI) Initiative involved customer verification surveys and TRM calculations of measure-level impacts. There are four distinct measures offered by the program: refrigerator recycling, freezer recycling, room AC (RAC) recycling, and dehumidifier recycling.

D.1.1 Gross Impact Evaluation Methodology

ADM's gross impact evaluation methodology was identical for all four EDCs. A TRM-based calculation was performed for each entry in the tracking and reporting system. The parameter values from the TRM (or for dehumidifiers, IMP) algorithms were taken from project-specific data from the tracking and reporting system when applicable, from TRM defaults, or from customer verification surveys. For refrigerators and freezers, measure attributes that participants would readily recall were determined from participant surveys, and the average parameter values were applied to all measures. Apart from measure verification, these attributes include the part-use factor, the location in the home where the appliance was used, and for refrigerators, whether the appliance was a primary or secondary unit. Technical attributes of the appliances, such as the age, capacity, and configuration, as collected by ARCA, were taken from program tracking and reporting data. TRM or IMP default parameters were used for room air conditioners (RACs) and dehumidifiers. Table 147 lists the data sources for gross impact calculation algorithms.

Table 147: Data Sources for the ATI Initiative Gross Impact Evaluation

Measure	TRM Parameter	Data Source
Refrigerator, Freezer	Appliance Age	Tracking and Reporting System
Refrigerator, Freezer	Pre-1990	Tracking and Reporting System
Refrigerator, Freezer	Appliance Size / Capacity	Tracking and Reporting System
Refrigerator, Freezer	Configuration/Type	Tracking and Reporting System
Refrigerator	Primary Usage	Participant Surveys
Refrigerator, Freezer	Part Use Factor	Participant Surveys
Refrigerator, Freezer	In Unconditioned Space?	Participant Surveys
Refrigerator, Freezer	CDD and HDD	TRM - Zip Code Lookup
RAC	Capacity	TRM Default
RAC	EER	TRM Default
RAC	RAC EFLH	TRM - Zip Code Lookup
RAC	CF	TRM Default
Dehumidifier	Capacity	IMP Default
Dehumidifier	Region (to determine kWh)	TRM - Zip Code Lookup
All Measures	Verification Rate	Participant Surveys

Both telephone and online surveys were conducted in PY8, and the two modes yielded compatible results. In PY9, the online survey mode was used for the general ATI program, and the telephone survey mode was largely reserved for Low-Income ATI participants.

The gross realization rates for energy savings were driven primarily by part-use factors for refrigerators and freezers as determined through verification surveys, and by the unit energy consumptions for refrigerators and freezers, as determined through measure attributes recorded in the tracking and reporting system. Although verification rates determined through surveys were approximately 100%, the realization rates are generally lower than 100% because the part-use factors are lower than the TRM default values, and the calculated unit energy consumptions were lower than what would expect from application of default parameters in the TRM.

D.1.2 Sampling

Each measure was treated as a separate stratum within the sampling initiative. The sample designs for the four EDCs are shown in Table 148, Table 149, Table 150, and Table 151. The population sizes and sample sizes represent individual appliances rather than individual customers.

Table 148: ATI Initiative Gross Impact Sample Design for Met-Ed

Stratum	Population Size	Achieved Sample Size	Evaluation Activity
Refrigerators	4,043	82	Survey (online)
Freezers	1,042	51	
Dehumidifiers	288	34	
RACs	478	34	
Program Total	**5,851**	**201**	

Table 149: ATI Initiative Gross Impact Sample Design for Penelec

Stratum	Population Size	Achieved Sample Size	Evaluation Activity
Refrigerators	3,522	97	Survey (online)
Freezers	1,000	45	
Dehumidifiers	1,000	27	
RACs	1,000	40	
Program Total	**6,522**	**209**	

Table 150: ATI Initiative Gross Impact Sample Design for Penn Power

Stratum	Population Size	Achieved Sample Size	Evaluation Activity
Refrigerators	1,273	53	Survey (online)
Freezers	1,000	30	
Dehumidifiers	1,000	15	
RACs	1,000	9	
Program Total	**4,273**	**107**	

Table 151: ATI Initiative Gross Impact Sample Design for WPP

Stratum	Population Size	Achieved Sample Size	Evaluation Activity
Refrigerators	4,592	88	Survey (online)
Freezers	1,000	38	
Dehumidifiers	1,000	33	
RACs	1,000	29	
Program Total	**7,592**	**188**	

D.1.3 Results for Energy

The gross realization rates for energy, along with relative precisions, are shown in Table 152, Table 153, Table 154, and Table 155 for Met-Ed, Penelec, Penn Power, and WPP respectively.

Table 152: ATI Initiative Energy Gross Realization Rates for Met-Ed

Stratum	PYRTD MWh/yr	Energy Realization Rate	CV	Relative Precision at 85% C.L.
Refrigerators	3,816	95.8%	0.5	8.0%
Freezers	865	82.7%	0.5	10.1%
Dehumidifiers	72	229.0%	0.5	12.3%
RACs	54	106.6%	0.5	12.3%
Program Total	**4,808**	**95.5%**	**0.5**	**6.2%**

Table 153: ATI Initiative Energy Gross Realization Rates for Penelec

Stratum	PYRTD MWh/yr	Energy Realization Rate	CV	Relative Precision at 85% C.L.
Refrigerators	3,732	96.3%	0.5	7.3%
Freezers	725	80.8%	0.5	10.7%
Dehumidifiers	74	125.0%	0.5	13.9%
RACs	34	83.4%	0.5	11.4%
Program Total	**4,565**	**94.2%**	**0.5**	**5.9%**

Table 154: ATI Initiative Energy Gross Realization Rates for Penn Power

Stratum	PYRTD MWh/yr	Energy Realization Rate	CV	Relative Precision at 85% C.L.
Refrigerators	1,375	81.3%	0.5	9.9%
Freezers	284	78.2%	0.5	13.1%
Dehumidifiers	26	245.5%	0.5	18.6%
RACs	9	87.6%	0.5	24.0%
Program Total	**1,695**	**83.3%**	**0.5**	**6.8%**

Table 155: ATI Initiative Energy Gross Realization Rates for WPP

Stratum	PYRTD MWh/yr	Energy Realization Rate	CV	Relative Precision at 85% C.L.
Refrigerators	4,708	101.2%	0.5	7.7%
Freezers	1,064	81.3%	0.5	11.7%
Dehumidifiers	75	212.1%	0.5	12.5%
RACs	38	85.4%	0.5	13.4%
Program Total	**5,884**	**98.9%**	**0.5**	**6.5%**

D.1.4 Results for Demand

The gross realization rates for demand, along with relative precisions, are shown in Table 156, Table 157, Table 158, and Table 159 for Met-Ed, Penelec, Penn Power, and WPP respectively.

Table 156: ATI Initiative Demand Gross Realization Rates for Met-Ed

Stratum	PYRTD MW/yr	Demand Realization Rate	CV	Relative Precision at 85% C.L.
Refrigerators	0.43	95.8%	0.5	8.0%
Freezers	0.10	82.7%	0.5	10.1%
Dehumidifiers	0.03	117.9%	0.5	12.3%
RACs	0.12	86.1%	0.5	12.3%
Program Total	**0.68**	**93.1%**	**0.5**	**5.4%**

Table 157: ATI Initiative Demand Gross Realization Rates for Penelec

Stratum	PYRTD MW/yr	Demand Realization Rate	CV	Relative Precision at 85% C.L.
Refrigerators	0.42	96.3%	0.5	7.3%
Freezers	0.08	80.8%	0.5	10.7%
Dehumidifiers	0.03	74.8%	0.5	13.9%
RACs	0.08	83.3%	0.5	11.4%
Program Total	**0.61**	**91.5%**	**0.5**	**5.2%**

Table 158: ATI Initiative Gross Realization Rates for Penn Power

Stratum	PYRTD MW/yr	Demand Realization Rate	CV	Relative Precision at 85% C.L.
Refrigerators	0.15	81.3%	0.5	9.9%
Freezers	0.03	78.2%	0.5	13.1%
Dehumidifiers	0.01	142.8%	0.5	18.6%
RACs	0.02	87.5%	0.5	24.0%
Program Total	**0.22**	**84.4%**	**0.5**	**6.4%**

Table 159: ATI Initiative Demand Gross Realization Rates for WPP

Stratum	PYRTD MW/yr	Demand Realization Rate	CV	Relative Precision at 85% C.L.
Refrigerators	0.53	101.2%	0.5	7.7%
Freezers	0.12	81.3%	0.5	11.7%
Dehumidifiers	0.03	121.1%	0.5	12.5%
RACs	0.09	82.9%	0.5	13.4%
Program Total	**0.76**	**96.8%**	**0.5**	**5.7%**

D.2 NET IMPACT EVALUATION

D.2.1 Net Impact Evaluation Methodology

The net-to-gross evaluation for the Appliance Turn-in program followed the participant self-report methodology outlined in the PA Evaluation Framework. Net-to-gross was estimated for the program for each FirstEnergy EDC.

The participant self-report methodology was implemented following the common approach outlined in Appendix B of the evaluation framework. Tetra Tech added a question to identify customers who would have kept the recycled unit at least a year longer, since program results represent first-year annual savings. This clarifies that customers who respond they would have removed the unit, but at some point, in the future, are really more appropriately characterized as keeping the unit for at least the program year in question. Individual free-ridership rates from the participant survey were weighted to adjust for sampling differences, non-response, and claimed energy savings to calculate overall estimates.

The Appliance Turn-in program is not designed to promote spillover since it does not push customers to implement energy efficiency projects outside of FirstEnergy's programs. Because the participant survey is already lengthy, containing both gross and net impact questions, the evaluation team did not collect spillover information from customers. Moreover, because the Companies offer incentives for efficient new refrigerators and freezers, it is possible that the most likely spillover may overlap with gross impacts for the Efficient Products program and lead to undesired double-counting of net impacts.

Overall NTG ratios for the Appliance Turn-in program are higher than identified during Phase II evaluation, in part because of the addition of the question clarifying the timing of the participant's plans to remove their old unit in the absence of the program.

D.2.2 Sampling

The sample designs for the four EDCs are shown in Table 160, Table 161, Table 162, and Table 163 for Met-Ed, Penelec, Penn Power, and WPP respectively. The focus of the NTG surveys was on refrigerators and freezers because these two measures accounted for 98% of reported savings.

Table 160: ATI Initiative Net-to-Gross Sampling for Met-Ed

Stratum	Population Size	Achieved Sample Size	Response Rate
All	5,851	165	34.9%
Program Total	**5,851**	**165**	**34.9%**

Table 161: ATI Initiative Net-to-Gross Sampling for Penelec

Stratum	Population Size	Achieved Sample Size	Response Rate
Refrigerators	6,522	177	34.9%
Program Total	**6,522**	**177**	**34.9%**

Table 162: ATI Initiative Net-to-Gross Sampling for Penn Power

Stratum	Population Size	Achieved Sample Size	Response Rate
Refrigerators	4,273	110	32.7%
Program Total	**4,273**	**110**	**32.7%**

Table 163: ATI Initiative Net-to-Gross Sampling for WPP

Stratum	Population Size	Achieved Sample Size	Response Rate
Refrigerators	7,592	162	32.0%
Program Total	**7,592**	**162**	**32.0%**

D.2.3 Net Impact Evaluation Results

The PYTD verified gross energy impacts, free ridership, spillover, net-to-gross ratios, and relative precisions for net-to-gross are shown in Table 164, Table 165, Table 166, and Table 167for Met-Ed, Penelec, Penn Power, and WPP respectively.

Table 164: ATI Initiative Net-to-Gross Results for Met-Ed

Stratum	PYVTD MWh	Free Ridership (%)	Spillover (%)	NTG Ratio	Relative Precision (@ 85% CL)
All	4,593	51.0%	0.0%	49.0%	8.4%
Program Total	**4,593**	**51.0%**	**0.0%**	**49.0%**	**8.4%**

Table 165: ATI Initiative Net-to-Gross Results for Penelec

Stratum	PYVTD MWh	Free Ridership (%)	Spillover (%)	NTG Ratio	Relative Precision (@ 85% CL)
Refrigerators	4,301	55.0%	0.0%	45.0%	8.1%
Program Total	**4,301**	**55.0%**	**0.0%**	**45.0%**	**8.1%**

Table 166 ATI Initiative Net-to-Gross Results for Penn Power

Stratum	PYVTD MWh	Free Ridership (%)	Spillover (%)	NTG Ratio	Relative Precision (@ 85% CL)
Refrigerators	1,412	42.0%	0.0%	58.0%	10.3%
Program Total	**1,412**	**42.0%**	**0.0%**	**58.0%**	**10.3%**

Table 167 ATI Initiative Net-to-Gross Results for WPP

Stratum	PYVTD MWh	Free Ridership (%)	Spillover (%)	NTG Ratio	Relative Precision (@ 85% CL)
Refrigerators	5,820	49.0%	0.0%	51.0%	8.5%
Program Total	**5,820**	**49.0%**	**0.0%**	**51.0%**	**8.5%**

Appendix E Evaluation Detail – EE Kits Initiative

E.1 Gross Impact Evaluation

The Energy Efficiency Kits (EE Kits) initiative has three sub-components. The first two subcomponents, EE Kits and Online Audit Kits are administered by PowerDirect. Both components involve delivery of conservation kits to program participants, but the Online Audit component requires that customers participate in an online home energy audit, while the main program component, EE Kits, distributes kits to customers that submit an online or telephonic request for conservation kits. The third subcomponent, the School Education program, is administered by AM Conservation Group (AMCG), and distributes conservation kits to students at participating schools. The program also distributes kits by mail but collaborates with local schools to develop an energy efficiency oriented educational component for children.

E.1.1 Gross Impact Evaluation Methodology

ADM's gross impact evaluation methodology was identical for all four EDCs and for all kit types, although separate samples and realization rates are developed for each kit type (School Kits, Online Audit Kits, and EE Kits). In the EE Kit and Online Audit Kit subprograms, two separate types of energy conservation kits were sent to customers depending on their hot water fuel source. The kits provided to customers with electric water heating included LED lamps, CFLs, LED night lights, energy saving aerators, a furnace whistle, and an energy saving showerhead. The kits provided to customers with non-electric water heating consists of LED lamps, CFLs, LED night lights, and a furnace whistle. School kits included LED lamps, CFLs, LED night lights, an energy saving faucet aerator, and a furnace whistle.

In evaluating the gross impact analysis for the energy conservation kits, 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 the program year;
3. The installation rate or in-service rate (ISR) 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, customers moving, or other such scenarios.

The first item has been determined through application of the partially deemed savings protocols in the 2016 TRM. The second item, the total number and type of kits mailed to customers, is determined by reviewing the program tracking and reporting system.

The third item, installation rates, are determined through online and telephone customer verification surveys, except for CFLs which are given "deemed" installation rates of 0.92 (later multiplied by the kit receipt rate as determined through surveys), consistent with the TRM.

For a particular site in a sample, the installation rate for each kit element takes on a binary value of 1, if the element is installed in accordance to the principles that define that element as an

energy efficiency measure, and 0 otherwise. In particular, faucet aerators and 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. 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.

The ISRs for kit components are expected to be dynamic quantities. Previous evaluations have shown that the ISR for residential lighting approaches 100%, but over a period of several years. This is in part the reason behind relating the ISR to the kit receipt rate, rather than to ISRs reported by customers, as survey ISRs represent a snapshot in time. While it is expected that the ISR for lighting may gradually increase as lamps installed in a home burn out and are replaced by lamps in the kit, the ISRs for other kit items may be relatively stable since the number of potential replacement scenarios are limited (e.g. a home may have dozens of general service lamps, but only one furnace filter, kitchen aerator, or showerhead). In Figure 27, we plot the ISR vs. survey lag (defined as the time between kit receipt and verification surveys and taken from our PY8 evaluation effort[15]) for various kit components. In this figure, the ISR for lamps is estimated through general questions (installed some, none, or all the supplied lamps), while other ISRs are constructed according to the methods described above. The figure suggests that ISRs for lighting do tend to grow with time, while ISRs for other items are relatively static after a brief ramp-up period.

[15] This comparison was conducted in PY8 to help guide our analysis approach relative to survey lag and recall effects. The analysis was not repeated in PY9.

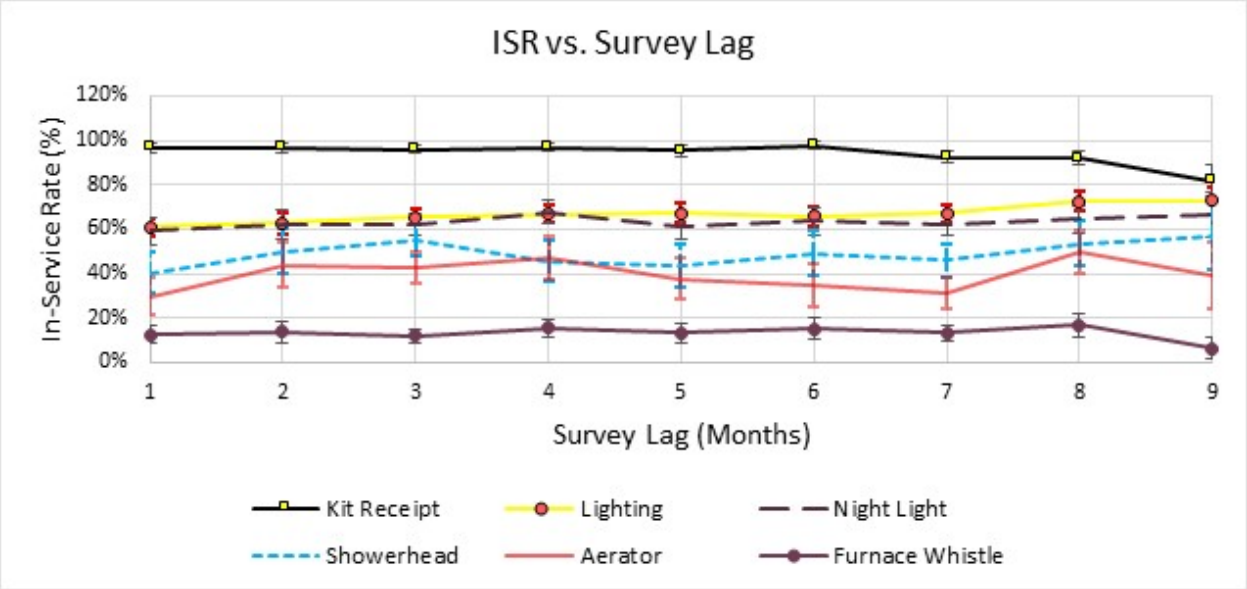

Figure 27: ISR vs. Survey Lag for Kit Components

Both telephone and online surveys were conducted in PY8. The two modes yielded compatible results, so each survey response for a given stratum was given equal weight. Due to the compatibility of results observed in PY8, the costlier telephone survey mode was reserved primarily to reach quotas in certain sampling strata without having to send out new batches of online survey invites. We intend to continue to depend primarily on the online surveys, as they allow for efficient data acquisition and large sample sizes.

The gross realization rates for energy savings were driven primarily by in-service rates for the kit components. The realization rates were generally higher than 100% because impact values reported for the 9W LEDs were developed with the assumption of a 29W baseline. However, the 9W LEDs supplied by PowerDirect supplied 800 lumens and mapped to a 43W baseline. The in-service rates as determined by surveys were comparable to those used in planning assumptions.

E.1.2 Sampling

The low-income kits are treated as a separate initiative and are discussed in Appendix O. Each kit type was treated as a separate stratum within the sampling initiative. The sample designs for the four EDCs are shown in Table 168, Table 169, Table 170, and Table 171.

Table 168: EE Kits Initiative Gross Impact Sample Design for Met-Ed

Stratum	Population Size	Achieved Sample Size	Evaluation Activity
EE Kits - Electric	25,805	115	Survey (phone + online)
EE Kits - Standard	30,619	100	
Online Kits - Electric	1,524	172	
Online Kits - Standard	1,004	68	
School Education kits	2,392	49	
Program Total	**61,344**	**504**	

Table 169: EE Kits Initiative Gross Impact Sample Design for Penelec

Stratum	Population Size	Achieved Sample Size	Evaluation Activity
EE Kits - Electric	21,373	119	Survey (phone + online)
EE Kits - Standard	29,324	116	
Online Kits - Electric	1,254	124	
Online Kits - Standard	832	75	
School Education kits	1,691	37	
Program Total	**54,474**	**471**	

Table 170: EE Kits Initiative Gross Impact Sample Design for Penn Power

Stratum	Population Size	Achieved Sample Size	Evaluation Activity
EE Kits - Electric	6,269	109	Survey (phone + online)
EE Kits - Standard	8,830	94	
Online Kits - Electric	381	44	
Online Kits - Standard	279	20	
School Education kits	346	18	
Program Total	**16,105**	**285**	

Table 171: EE Kits Initiative Gross Impact Sample Design for WPP

Stratum	Population Size	Achieved Sample Size	Evaluation Activity
EE Kits - Electric	25,198	142	Survey (phone + online)
EE Kits - Standard	26,064	154	
Online Kits - Electric	2,595	276	
Online Kits - Standard	1,299	113	
School Education kits	3,145	87	
Program Total	**58,301**	**772**	

E.1.3 Results for Energy

The gross realization rates for energy, along with relative precisions, are shown in Table 172, Table 173, Table 174, and Table 175 for Met-Ed, Penelec, Penn Power, and WPP respectively.

Table 172: EE Kits Initiative Energy Gross Realization Rates for Met-Ed

Stratum	PYRTD MWh/yr	Energy Realization Rate	CV	Relative Precision at 85% C.L.
EE Kits - Electric	10,082	135.129%	0.5	6.7%
EE Kits - Standard	8,371	123.199%	0.5	7.2%
Online Kits - Electric	246	113.8%	0.5	5.2%
Online Kits - Standard	122	132.2%	0.5	8.4%
School Education kits	839	101.5%	0.5	10.2%
Program Total	**19,660**	**128.3%**	**0.5**	**4.7%**

Table 173: EE Kits Initiative Energy Gross Realization Rates for Penelec

Stratum	PYRTD MWh/yr	Energy Realization Rate	CV	Relative Precision at 85% C.L.
EE Kits - Electric	8,805	124.6%	0.5	6.6%
EE Kits - Standard	8,658	121.5%	0.5	6.7%
Online Kits - Electric	213	119.6%	0.5	6.1%
Online Kits - Standard	109	122.8%	0.5	7.9%
School Education kits	638	96.8%	0.5	11.7%
Program Total	**18,423**	**122.1%**	**0.5**	**4.5%**

Table 174: EE Kits Initiative Energy Gross Realization Rates for Penn Power

Stratum	PYRTD MWh/yr	Energy Realization Rate	CV	Relative Precision at 85% C.L.
EE Kits - Electric	2,590	123.1%	0.5	6.8%
EE Kits - Standard	2,611	121.9%	0.5	7.4%
Online Kits - Electric	65	98.6%	0.5	10.2%
Online Kits - Standard	36	122.3%	0.5	15.5%
School Education kits	130	103.6%	0.5	16.5%
Program Total	**5,432**	**121.7%**	**0.5**	**4.9%**

Table 175: EE Kits Initiative Energy Gross Realization Rates for WPP

Stratum	PYRTD MWh/yr	Energy Realization Rate	CV	Relative Precision at 85% C.L.
EE Kits - Electric	10,320	126.9%	0.5	6.0%
EE Kits - Standard	7,619	121.8%	0.5	5.8%
Online Kits - Electric	436	115.6%	0.5	4.1%
Online Kits - Standard	167	127.5%	0.5	6.5%
School Education kits	1,161	103.5%	0.5	7.6%
Program Total	**19,702**	**123.3%**	**0.5**	**3.9%**

E.1.4 Results for Demand

The gross realization rates for demand, along with relative precisions, are shown in Table 176, Table 177, Table 178, Table 179 for Met-Ed, Penelec, Penn Power, and WPP respectively.

Table 176: EE Kits Initiative Demand Gross Realization Rates for Met-Ed

Stratum	PYRTD MW/yr	Demand Realization Rate	CV	Relative Precision at 85% C.L.
EE Kits - Electric	1.09	141.0%	0.5	7%
EE Kits - Standard	0.94	127.1%	0.5	7%
Online Kits - Electric	0.03	118.2%	0.5	5%
Online Kits - Standard	0.01	144.8%	0.5	8%
School Education kits	0.10	113.2%	0.5	10%
Program Total	**2.17**	**133.5%**	**0.5**	**4.6%**

Table 177: EE Kits Initiative Demand Gross Realization Rates for Penelec

Stratum	PYRTD MW/yr	Demand Realization Rate	CV	Relative Precision at 85% C.L.
EE Kits - Electric	0.86	127.5%	0.5	7%
EE Kits - Standard	0.85	136.9%	0.5	7%
Online Kits - Electric	0.02	124.6%	0.5	6%
Online Kits - Standard	0.01	147.7%	0.5	8%
School Education kits	0.07	103.1%	0.5	12%
Program Total	**1.81**	**131.1%**	**0.5**	**4.5%**

Table 178: EE Kits Initiative Gross Realization Rates for Penn Power

Stratum	PYRTD MW/yr	Demand Realization Rate	CV	Relative Precision at 85% C.L.
EE Kits - Electric	0.28	126.6%	0.5	7%
EE Kits - Standard	0.29	140.2%	0.5	7%
Online Kits - Electric	0.01	103.9%	0.5	10%
Online Kits - Standard	0.00	157.7%	0.5	16%
School Education kits	0.01	118.9%	0.5	17%
Program Total	**0.59**	**133.0%**	**0.5**	**4.9%**

Table 179: EE Kits Initiative Demand Gross Realization Rates for WPP

Stratum	PYRTD MW/yr	Demand Realization Rate	CV	Relative Precision at 85% C.L.
EE Kits - Electric	1.18	130.0%	0.5	6%
EE Kits - Standard	0.93	130.8%	0.5	6%
Online Kits - Electric	0.05	122.8%	0.5	4%
Online Kits - Standard	0.02	145.4%	0.5	6%
School Education kits	0.14	105.6%	0.5	8%
Program Total	**2.33**	**128.8%**	**0.5**	**3.9%**

E.2 NET IMPACT EVALUATION

E.2.1 Net Impact Evaluation Methodology

The net-to-gross evaluation for the Energy Efficiency Kits measures was based on self-report data from program participants. This followed the self-report methodologies for free-ridership and spillover from the PA Evaluation Framework. Kits contribute a significant portion of FirstEnergy's residential portfolio savings and several sub-programs operate with this delivery method. The evaluation sampled and analyzed kits as a high-impact measure (HIM) based on the definition in the evaluation framework. This analysis included the Opt-In Kits, School Kits, and Online Audit kits provided by FirstEnergy, since there are minimal differences in the delivery of these measures. Individual free-ridership and spillover rates from the participant survey were weighted to adjust for sampling differences, non-response, and claimed energy savings to calculate overall estimates.

Overall NTG ratios are approximately 20 percent higher than estimates from Phase II evaluation. The previous evaluation did not correctly assess the program influence portion of the common approach to free ridership, so the analysis assumed a mid-point of 25 percent. The program influence scores for Phase III are around 5 percent, which reflects the difference of approximately 20 percent between Phase II and III results. The intention portion was also analyzed and weighted based on the measures the customer received; this additional analysis detail did not produce major differences in results than Phase II analysis.

E.2.2 Sampling

Each measure was treated as a separate stratum within the sampling initiative. The sample designs for the four EDCs are shown Table 180. Note that the survey effort crossed program years, and PY9 participant counts are listed, though the counts are similar to those of PY8.

Table 180: EE Kits Initiative Net-to-Gross Sampling for Met-Ed

EDC	Population Size	Achieved Sample Size	Response Rate
Met-Ed	61,344	172	14.0%
Penelec	54,474	171	14.0%
Penn Power	16,105	181	15.0%
WPP	58,301	193	16.0%

E.2.3 Net Impact Evaluation Results

The PYTD verified gross energy impacts, free ridership, spillover, net-to-gross ratios, and relative precisions for net-to-gross are shown in Table 181.

Table 181: EE Kits Initiative Net-to-Gross Results for Met-Ed

Stratum	PYVTD MWh	Free Ridership (%)	Spillover (%)	NTG Ratio	Relative Precision (@ 85% CL)
Met-Ed	25,230	21.0%	3.0%	82.0%	5.5%
Penelec	22,491	20.0%	3.0%	83.0%	5.5%
Penn Power	6,613	20.0%	2.0%	82.0%	5.4%
WPP	24,290	20.0%	2.0%	82.0%	5.2%

Appendix F Home Energy Reports Impact Evaluation Detail

F.1 Gross Impact Evaluation

The Behavioral Modification subprogram provides home energy reports to residential customers in the FirstEnergy PA service territory. These reports detail customers' historical energy usage, providing tips on ways customers can save energy, and promoting other programs in FirstEnergy's residential energy efficiency portfolio. The subprogram is divided between standard residential customers and Low-Income customers, with Low-Income customers receiving reports more frequently than participants in the standard residential subprogram and exclusively receiving low-cost or no-cost tips in their reports. The subprogram is administered as a randomized control trial (RCT) and participants are enrolled in experimental cohorts, with the frequency and start date of each cohort differing for the four EDCs. A monthly billing analysis regression is the primary activity used to calculate savings. Each participant cohort is modeled separately to generate verified gross usage savings. The following section describes ADM's gross impact evaluation methodology.

F.1.1 Data Preparation and Analysis Procedure

F.1.1.1 Data Gathering

Monthly billing data dating back to 12 months prior to each experimental cohort's treatment start date through May 2017 was requested from FirstEnergy for all participants. Monthly billing data was provided with indicators identifying whether the monthly bill was estimated or based on an actual meter read. Control vs. treatment indicators were also provided in the billing data set. Demographic information such as participant account number, etc. were masked in the billing data set. ADM utilized a map of customer IDs to utility account numbers for use in dual participation analysis.

F.1.1.2 Data Preparation

Much of FirstEnergy's service territories currently rely on traditional meter reads, which require a technician to record a customer's metered usage. Due to environmental and resource restrictions, it is not feasible for actual meter data to be obtained monthly. To accommodate these restrictions, FirstEnergy generates an estimated metered read based on load shapes and customer's historical usage. The customer's subsequent metered bill then features an adjustment factor to accommodate for any differences between the estimated read and the actual read.

As part of the data preparation process, ADM corrected for estimated reads and adjusted actual reads by using a "true-up" process. For each metered read and all estimated reads immediately preceding it, ADM totaled the billed usage and number of days spanning those bills. The total billed usage for that cumulative period was then divided by the total number of days to generate an average usage per day value. This average usage per day value was then multiplied by the number of days in each individual bill in order to generate a corrected usage value. Because

the number of estimated reads per actual read is inconsistent, the number of estimated reads prior to the first actual read in the provided dataset could not be assumed. Therefore, the first metered read and all estimated reads preceding it were excluded from the dataset. Similarly, estimated reads that did not have a corresponding actual read (generally towards the tail end of provided billing data) were also excluded from analysis. Equation 1 and Table 182 provide the algorithm and inputs for calculating the adjusted usage for billing data after the first metered read and all prior estimated reads have been excluded.

$$Adjusted\ usage = \sum_{i}^{n} Billed\ usage \times \frac{Billing\ days_m}{\sum_{i}^{n} Billing\ days}$$

Equation 1: Adjusted usage calculation for billing usage true-up.

Table 182: Definition of inputs for adjusted usage calculation.

Variable	Definition
i	First estimated bill in a sequence of estimated bills leading to a metered bill.
n	A metered bill providing an adjustment factor for preceding estimated bills.
m	The billing month of interest.
Billed usage	The total kWh billed in a monthly bill.
Billing days	The total number of days in a monthly bill's billing period.

Billing periods for customers do not fall on consistent dates between participants. For example, one customer's June bill may run from May 16th to June 17th while another's may run from May 20th to June 20th. Furthermore, the billing periods do not correspond to calendar months. In order to make the monthly billing data consistent between participants, ADM calendarized the data. Calendarization is the process of correcting monthly billing data to match calendar dates. For example, if 15 days in a billing period belonged to June and 15 days belonged to July 50% of the billed usage would be attributed to June and 50% attributed to July. The proportionated usage and number of days that fall under a given calendar month are then summed to generate a calendarized usage value and a number of billed days for that month.

Equation 2 and Table 183 provide the algorithm for calculating the monthly usage for a given calendar month.

$$Monthly\ usage_m = \sum_{i}^{n} \left(Adjusted\ usage_i \times \frac{Month\ days_i}{Billing\ days_i} \right)$$

Equation 2: Monthly usage calculation.

Table 183: Definition of inputs for monthly usage calculation.

Variable	Definition
i	First bill containing the month of interest.
n	Last bill containing the month of interest.
m	Month of interest.
Monthly usage	The calendarized monthly usage for a given month.
Month days	The number of days belonging to the month of interest in a given billing period.
Billing days	The total number of days in a given billing period

In addition to calculating the monthly usage, the number of billed days per month was also calculated by summing together the number of billed days in a corresponding month. Equation 3 provides the algorithm for calculating the number of days billed in a given month.

$$Billed\ days_m = \sum_{i}^{n} Month\ days_i$$

Equation 3: Billed days calculation.

After calendarization was completed, an average daily usage value was calculated by dividing the monthly usage by the number of billed days in a month. Customer months that had less than one billed day or exceed the total number of days in that calendar month for that year were excluded from analysis—months that meet these criteria have overlapping bills and are unreliable for analysis. Months that were present after a customer's move out date were also be excluded from analysis. Customer months in which average daily usage exceeded 300 kWh or was less than -300 kW were considered outliers and were excluded from analysis. Partial-month data for the most recent available billing period was be removed from the data set. Furthermore, only the billing data from the past 12 months prior to the wave enrollment start date were used for analysis.

F.1.1.3 Billing Analysis

ADM utilized a lagged seasonal (LS) multivariate regression model to estimate program savings for all experimental cohorts. The LS model is specified in the equation below:

$$kWh_{imy} = \beta_0 + \sum_{m=1}^{12}\sum_{y=2011}^{2021} \mathrm{I}_{my} * \beta_{mys} * (AvgPre_i + AvePreSummer_i + AvePreWinter_i) + \sum_{m=1}^{12}\sum_{y=2011}^{2021} \mathrm{I}_{my} * \tau_{my} * \mathrm{treatment}_{imy} + \varepsilon_{imy}$$

Equation 4: Formula specifying the lagged seasonal regression model.

The variables above are defined in Table 184 below. The regression coefficient of the interaction between the month post-treatment and the treatment dummy variable represents the average treatment effect per home for that given month. A negative regression coefficient represents a savings in the overall billed usage for the treatment group. Taking the negative of

that coefficient will represents the daily kWh savings attributable to the treatment effect for that month per home.

Table 184: Definition of variables in the lagged seasonal regression model.

Variable	Definition
$\mathrm{kWh}_{\mathrm{imy}}$	Customer i's average daily energy usage in bill month m in year y.
β_0	Intercept of the regression equation.
I_{my}	Equal to one for each monthly bill month m, year y, and zero otherwise.
β_{mys}	The coefficient on the bill month m, year y indicator variable interacted with season s.
$AvgPre_i$	Average daily usage for customer i in the pre-treatment period.
$AvePreSummer_i$	Average daily usage for customer i in the pre-treatment period during June through September.
$AvePreWinter_i$	Average daily usage for customer i in the pre-treatment period during December through March.
$\mathrm{treatment}_{\mathrm{imy}}$	The treatment indicator variable. Equal to one when the treatment is in effect for the treatment group. Zero otherwise. Always zero for the control group.
τ_{my}	The estimated treatment effect in kWh per day per customer; the main parameter of interest.
$\varepsilon_{\mathrm{imy}}$	The error terms.

F.1.1.4 Dual Participation Analysis

Participants in both the treatment and control groups participate in other FirstEnergy energy efficiency programs. Furthermore, the "Home Energy Report" measure received by participants in the treatment group may cause treatment group participants to seek out other programs and measures offered in the FirstEnergy efficiency portfolio to a greater extent than the control group. To the extent that the treatment group participates in other FirstEnergy programs at a rate above and beyond that of the control group, those incremental savings will be reflected in the gross energy savings calculated using the method above. However, savings for these items will also have been attributed to their respective programs and subprograms. ADM corrected for dual participation that occurred after treatment began to the extent that the treatment group participated at a higher rate than the control group.

Adjustment for Downstream Measures

For downstream measures, ADM conducted a review of the tracking and reporting system for each experimental cohort to identify EE program participation that occurred from the treatment start date onwards. The following steps detail the process of correcting for these measures:

1. The measures for the treatment group and control group were assigned to an appropriate month based on the reported date of installation for measures installed after the treatment start date.
2. For each month of the program year, the annual savings for all measures installed prior to the month of interest dating back to the treatment start date that

had not yet reached the end of their effective useful life were summed for all active participants for each group. For measures installed prior to the current Program Year, ADM used verified savings for dual participation analysis. For measures installed during the Program Year, ADM utilized reported savings as verification activities occurred concurrently to the evaluation of the Behavioral Modification subprogram.

3. The totaled savings for each group was then divided by 365.25 and then divided by the number of active customers in each group to create a daily average dual participation savings value per home.
4. For each month, the daily average dual participation savings value per home for the control group was then subtracted from the daily average dual participation savings value per home from the treatment group. This resulted in an adjustment factor which was then subtracted from the daily savings value extrapolated from the billing analysis prior to using these values to calculate gross verified energy savings.

Adjustment for Upstream Measures

Adjustments for upstream measures was conducted in accordance to the Phase III Evaluation Framework. The adjustment was cast as a multiplier and applied after the correction for the downstream energy efficiency programs and the initial calculation of annual savings for the program year for a given participant wave. The multiplier values depended on the number of years since program enrollment for a given participation wave and are summarized in Table 5 10 below.

Table 185: Adjustment factors for dual participation in upstream programs.

Years Since Enrollment	Adjustment multiplier for upstream program
1	99.25%
2	98.5%
3	97.75%
4 or more	97%

F.1.1.5 Gross Energy Savings Calculation

Gross energy savings can be calculated by taking the treatment effect in a given month (the negative of the regression coefficient of the treatment effect for a given month minus the downstream dual participation adjustment factor for that month), multiplying it by the number of days in the month, the number of active treatment group participants in that month, and the upstream adjustment multiplier. Equation 5 demonstrates the algorithm for calculating verified savings for the model for each month in the program year.

$$kWh\ savings_{my} = \tau_{my} \times days_{my} \times number\ of\ participants_{my} \times upstream\ adjustment\ multiplier$$

Equation 5: kWh savings calculation.

The variables in the above equation are defined in Table 186 below.

Table 186: Definition of variables for kWh savings calculation.

Variable	Definition
τ_{my}	The average daily treatment effect for month *my*—the inverse of the regression coefficient from the regression model minus the downstream dual participation correction factor.
my	The month of interest.
$upstream\ adjustment\ multiplier$	The upstream adjustment multiplier for the experimental cohort.

Savings were calculated for each wave separately and then summed together to determine the total savings for each initiative (standard residential v. Low-Income) per EDC. Monthly savings were added together to generate annual savings.

Table 187: Dual participation correction results by EDC and participation wave.

Wave	Treat	Control	Delta	Wave	Treat	Control	Delta
ME-1	25,845	24,865	980	PN-1	25,845	24,865	980
ME-1-LI	3,935	3,972	-36	PN-1-LI	3,935	3,972	-36
ME-2	11,384	10,482	902	PN-2	11,384	10,482	902
ME-2-LI	555	542	13	PN-2-LI	555	542	13
ME-3	1,868	1,654	215	PN-3	1,868	1,654	215
WP-1	20,034	18,531	1,503	PN-3-LI	20,034	18,531	1,503
WP-1-LI	2,397	2,351	46	PP-1	2,397	2,351	46
WP-2	2,311	2,243	68	PP-1-LI	2,311	2,243	68
WP-2-LI	770	751	18	PP-2	770	751	18
WP-3	2,405	2,094	311	PP-2-LI	2,405	2,094	311

F.1.1.6 Gross Demand Savings Calculation

ADM developed a model for predicting gross demand savings using the monthly gross energy savings calculated above and 8,760 load profiles for three residential end uses (heat pumps, interior lighting, and flat).

Step 1: Normalize kWh Usage

ADM normalized the kWh savings value predicted by the impact evaluation regression model into a percent savings value by dividing each month's savings by the total annual savings as follows:

$$\%\ savings_{my} = {kWh\ savings_{my}}\Big/{kWh\ savings_{y}}$$

Equation 6: Monthly savings normalization calculation.

Step 2: Calculate Monthly Load Factors for Component Variables

The model assumes a linear relationship between the end uses of interest and the percent savings calculated above. Because load shape information is available for multiple residential end uses at an 8,760 resolution, ADM can estimate the relationship between end use load shapes and percent savings in order to estimate total demand savings. In order to make sure that the model is interpretable, hourly load factors must be aggregated to a monthly resolution, providing a monthly load shape with 12 data points. To calculate monthly load shapes, ADM will take the sum of all hourly loads in a given month for each end use of interest.

Step 3: Multivariate Regression

In order to determine the relationship between the percent savings and the residential end uses, ADM used a multivariate regression approach. Because the model was used to assign weights to each end use, ADM held the intercept constant at 0 to ensure that the model produced percent weights for each end use. The following equation provides the model specification used in Program Year 8:

$$\%\ savings_{my} = \beta_1 end\ use_{heat\ pump} + \beta_2 end\ use_{interior\ lighting} + \beta_3 end\ use_{flat}$$

Equation 7: End use weight regression model.

The regression coefficients for the above regression equation represent the relationship of each of the component variables to percent savings. Because both independent and dependent variables are calculated in units of months, the numerator of the regression weights are time invariant and can be used to estimate the percent contribution across any unit of time.

Step 4: Demand Savings Calculation

After obtaining the percent weight of each of the three end uses, the 8,760 end use load profiles are then scaled by applying the percent weight to the normalized end use load profile. The total normalized whole house load can then be assumed to be the sum of the weighted load of the three end uses at a given hour. Averaging this value for all hours of the peak demand window will provide an average peak demand whole building load. Multiplying this value by the total annual kWh savings will then predict the kW savings for the program year.

As with gross energy savings, ADM anticipates that some participants in the treatment group will also participate in other FirstEnergy programs. Because the peak demand savings is predicted from the dual participation adjusted monthly savings, an additional adjustment does not be made.

F.1.2 Program Participation Levels

Table 188 provides a table of the participation levels. The nomenclature in the table includes a prefix to denote the EDC, a suffix of "-LI" for low-income groups, and a number that identifies waves of participants sequentially. The first wave started in July 2012, the second wave in January 2014, and the third wave in December 2014.

Table 188 – PY9 Participation Bill Counts by Month and Cohort.

Wave	Jun-16	Jul-16	Aug-16	Sep-16	Oct-16	Nov-16	Dec-16	Jan-17	Feb-17	Mar-17	Apr-17	May-17
ME-1	74,374	74,170	73,942	73,604	73,346	76,436	76,089	75,709	75,403	75,143	74,834	74,574
ME-1-LI	10,220	10,157	10,112	10,043	9,966	10,749	10,644	10,557	10,475	10,398	10,324	10,269
ME-2	49,042	48,865	48,690	48,420	48,200	50,831	50,486	50,175	49,918	49,696	49,436	49,214
ME-2-LI	2,219	2,201	2,186	2,157	2,127	2,385	2,354	2,329	2,297	2,269	2,249	2,231
ME-3	11,291	11,228	11,158	11,069	10,980	11,887	11,779	11,650	11,559	11,489	11,403	11,341
PN-1	48,140	48,012	47,911	47,787	47,630	49,263	49,101	48,912	48,705	48,542	48,371	48,245
PN-1-LI	6,439	6,416	6,391	6,339	6,297	6,725	6,674	6,610	6,561	6,517	6,484	6,456
PN-2	63,233	63,034	62,850	62,567	62,328	65,326	64,965	64,578	64,238	63,966	63,674	63,407
PN-2-LI	1,627	1,620	1,610	1,599	1,586	1,736	1,717	1,696	1,672	1,663	1,643	1,633
PN-3	27,414	27,303	27,181	27,000	26,835	28,768	28,516	28,263	28,060	27,904	27,713	27,542
PN-3-LI	8,806	8,725	8,661	8,556	8,466	9,530	9,401	9,254	9,132	9,030	8,938	8,868
PP-1	17,278	17,201	17,180	17,110	17,051	17,683	17,613	17,546	17,486	17,428	17,365	17,320
PP-1-LI	2,087	2,073	2,069	2,057	2,041	2,193	2,174	2,154	2,140	2,128	2,111	2,097
PP-2	7,062	7,021	7,010	6,976	6,945	7,275	7,236	7,199	7,162	7,133	7,101	7,071
PP-2-LI	817	811	807	800	793	884	878	865	853	847	833	819
WP-1	114,433	114,140	113,876	113,452	113,104	117,004	116,517	116,087	115,655	115,338	114,985	114,671
WP-1-LI	11,130	11,068	11,005	10,922	10,817	11,717	11,609	11,491	11,408	11,327	11,246	11,192
WP-2	17,767	17,709	17,659	17,578	17,523	18,282	18,175	18,088	18,015	17,949	17,869	17,822
WP-2-LI	4,060	4,026	3,993	3,944	3,894	4,382	4,319	4,265	4,205	4,165	4,120	4,079
WP-3	27,422	27,290	27,187	27,013	26,886	28,549	28,311	28,093	27,915	27,786	27,652	27,523

F.1.3 Adjustment for 2012 Low-Income vs. Standard Residential Savings

During the initial wave of participants in 2012, separate Low-Income and standard residential groups were not established as part of program implementation. As part of the Phase III implementation, Low-Income treatment and control participants were identified and treated as a separate cohort from their standard residential counterparts. In accordance with Phase III efficiency goals, a number of treatment group homes were dropped from the standard residential cohorts while fewer to no homes were dropped from the corresponding Low-Income group.

Equivalence testing done in PY8, as part of our evaluation plan development showed initial imbalances between treatment and control groups for some of the Low-Income cohorts when looking at annual pre-treatment energy usage. Simultaneously, unlike the standard residential cohorts, the Low-Income cohorts showed high levels of volatility in predicting program year savings. This volatility could be due to the imbalance in treatment vs. control groups, high level of variability in billing data due to breaking of the randomized control trial in creating the Low-Income group, or overall smaller cohort sizes for the Low-Income groups.

To compensate for this volatility, the program year savings for the 2012 Low-Income and standard residential cohorts were corrected by taking the sum of the Low-Income group savings and its corresponding standard residential cohort. For each EDC, the summed savings was then proportioned back to the Low-Income group and the standard residential group by taking the proportion of pre-treatment annual energy consumption belonging to each group (i.e., the proportion of pre-treatment annual energy usage for all Low-Income treatment customers over the sum of the annual energy usage for all Low-Income and standard residential treatment customers). This adjustment took place after calculating cohort-level savings as modeled

through the lagged seasonal model regression but prior to dual participation adjustment. Demand savings, similarly, were modeled after all adjustments to energy savings took place and therefore do not require additional adjustments.

F.1.4 Results

The reported and verified energy savings are shown in Table 189 below. The values below include dual participation adjustments. The last column of the table shows model absolute precisions for each cohort, and also combined for each distinct initiative. Table 190 shows the reported and verified demand reduction for each EDC and initiative.

Table 189: Verified Energy Savings and Absolute Precisions by EDC and Wave

Operating Company	Experimental Cohort	PYRTD (MWh)	PYVTD (MWh)	Relative Savings (%)	Absolute Precision at 95% CL
Met Ed	ME-1	21,637	22,135	2.20%	0.15%
Met Ed	ME-2	8,720	8,921	1.35%	0.19%
Met Ed	ME-3	2,875	2,941	1.99%	0.44%
Met Ed	**Total for EEH Program**	**33,232**	**33,997**	**1.96%**	**0.12%**
Met Ed	ME-1-LI	2,877	3,397	2.35%	0.50%
Met Ed	ME-2-LI	638	753	2.04%	0.68%
Met Ed	**Total for LI Program**	**3,514**	**4,151**	**2.29%**	**0.43%**
Penelec	PN-1	9,806	10,214	1.73%	0.18%
Penelec	PN-2	6,762	7,043	1.27%	0.21%
Penelec	PN-3	2,005	2,089	1.11%	0.34%
Penelec	**Total for EEH Program**	**18,573**	**19,346**	**1.50%**	**0.13%**
Penelec	PN-1-LI	1,546	1,531	1.88%	0.50%
Penelec	PN-2-LI	363	359	1.66%	0.79%
Penelec	PN-3-LI	485	480	0.73%	0.54%
Penelec	**Total for LI Program**	**2,394**	**2,370**	**1.61%**	**0.39%**
Penn Power	PP-1	3,349	3,569	1.76%	0.26%
Penn Power	PP-2	2,566	2,735	2.23%	0.34%
Penn Power	**Total for EEH Program**	**5,915**	**6,304**	**1.96%**	**0.21%**
Penn Power	PP-1-LI	450	470	1.85%	0.82%
Penn Power	PP-2-LI	298	311	2.20%	1.07%
Penn Power	**Total for LI Program**	**748**	**782**	**1.99%**	**0.66%**
WPP	WP-1	23,387	22,144	1.30%	0.17%
WPP	WP-2	6,205	5,876	1.84%	0.25%
WPP	WP-3	3,578	3,388	0.93%	0.29%
WPP	**Total for EEH Program**	**33,171**	**31,407**	**1.36%**	**0.14%**
WPP	WP-1-LI	2,422	2,387	1.38%	0.68%
WPP	WP-2-LI	971	957	1.74%	0.56%
WPP	**Total for LI Program**	**3,394**	**3,344**	**1.48%**	**0.54%**

Table 190: Demand reported and verified demand reductions for the HER Initiative

Operating Company	Initiative	PYRTD MW/yr	PYVTD MW/yr	Demand Realization Rate
Met Ed	Non-LI	4.10	3.84	94%
Met Ed	LI	0.43	0.47	108%
Penelec	Non-LI	3.03	2.18	72%
Penelec	LI	0.39	0.27	69%
Penn Power	Non-LI	0.96	0.71	75%
Penn Power	LI	0.12	0.09	73%
WPP	Non-LI	5.02	3.50	70%
WPP	LI	0.51	0.37	73%

Appendix G Evaluation Detail – Residential Direct Install Initiative

The Residential Direct Install Initiative is comprised of the Home Energy Assessment program implemented by GoodCents. A participant in this program is defined as a unique address in the program, multiple projects can be installed at one address.

This program consists of a comprehensive residential energy audits performed by GoodCents along with energy efficiency measures directly installed in the customer's residences. The audit evaluates the performance of the participant's home heating and cooling system, insulation, windows, appliances, building shell and lighting equipment. The audit is used to identify energy savings opportunities. Some low-cost energy savings measures are directly installed in the consumer home during the same day. Low costs measures installed directly during the day of audit can be light bulbs, nightlights, smart power strips, furnace whistles, aerators, showerheads, and pipe insulation. Major measures, (attic insulation, wall insulation, air sealing, and windows) can also be installed. These measures are usually installed after the initial audit.

The initial audit cost the customer $350. The customer can receive $200 worth of energy savings products installed during the day of the audit. Customer can apply for a rebate of $250 after the initial audit. The implementer and the customer also discuss major measure installation possibilities. A major measure typically requires a significant investment from the customer. Customer, which installed major measures, can receive an additional $100 for saving more than 2,000 kWh and $150 for saving more than 3,000 kWh.

G.1 Gross Impact Evaluation

G.1.1 Gross Impact Evaluation Methodology

Gross impact evaluation for the Res DI Initiative involved stratified sampling with specific measurement and verification processes for each sampling stratum. The program tracking and

reporting system is at the measure level, but also identifies the rebate application and participant address associated with each measure. In general, there can be multiple measures per application and even multiple applications per household. An example of the latter scenario is when a household first undergoes an initial audit with direct installation of low-cost measures, but later has major measures installed as identified in the audit report. The subsequent retrofits would be captured in a separate rebate application. Major measures are considered attic insulation, wall insulation, air sealing, and windows measures.

ADM aggregated all measures by unique address and then placed each household in one of three strata: Participants that had one or more major measures, participants without major measures and with high energy savings, and participants without major measures and with low energy savings. Evaluation activities for each stratum are described below.

G.1.1.1 Participants with Weatherization Measures

Engineering calculation reviews were performed on all participants with major measures. Engineering calculations were checked for TRM compliance. The customer's zip code was used to determine EFLHs, HDDs, and CDDs. Reviews also consisted of a document review to verify HVAC equipment and water heating equipment.

G.1.1.2 Non-Weatherization Participants with High Energy Savings

A sample of customers in this stratum were contacted to determine stratum level in-service rates. Furthermore, a document review to verify HVAC equipment and water heating equipment was performed.

G.1.1.3 Non-Weatherization Participants with Low Energy Savings

Most of the measures installed in this sampling stratum consisted of lamps, showerheads, aerators, and LED night lights.

For lighting measures, efficient wattage ranges and bulb type are stated in equipment name column of the customer tracking data. ADM used data from the upstream lighting program to determine average baseline watts and average energy efficient watts for each unique lighting equipment name. The hours of use are assumed to be 3 hours because the bulb installation location is not known. TRM defaults were used for other portions of the calculation.

Reviews consisted of a document review to verify HVAC equipment and water heating equipment. Default TRM in-service rates were used for this stratum.

Gross impacts for aerators and showerheads are calculated according to the PA TRM. If the water heater type fuel type is known, and verified with a document review, then a factor of 100% is applied for homes with electric water heating, 0% for home that have non-electric water heating, and the TRM default 43% in cases where water heater fuel type is not determinable.

Information provided by applicants on rebate forms was used to verify heating and cooling equipment types for accounts which received attic insulation. Insulation areas, baseline and

post-installation insulation R-values were provided in the rebate forms or from accompanying project documentation. The heating and cooling degree days and equivalent full-load hours were found using the TRM's zip code lookup table to the project's reference city.

Residential air sealing measures used $CFM50_{post}$ and $CFM50_{pre}$ values found in the project rebate forms. The heating equipment type cooling equipment type were also found on the rebate forms. The reference city was found using the TRM's zip code look up table.

The default savings values were used for the smart strip plug outlets. All smart strips were assumed tier-1 smart strips unspecified use 5-plug power strips.

TRM section 2.6.2 was to verify energy savings for window installations. The reference city was found using the TRM's zip code look up table. Heating and cooling types were found in rebate forms. No supporting documentation (invoices, specs sheet) was given for the windows installations; therefore, this measure was found to have zero savings

Table 191 lists the data sources for gross impact calculation algorithms.

Table 191: Data Sources for the ATI Initiative Gross Impact Evaluation

Measure	TRM Parameter	Value	Units	Data Source
All Measures	ISR	Varies	percent	inspection reports
Lighting	Wbase	Varies	W	TRM defaults using lamp spec sheets or PY9 upstream lighting program
Lighting	Wee	Varies	W	spec sheets or PY9 upstream lighting program
Lighting, LED Night Lights	HOU	Varies	hours	TRM default
Lighting, Attic Insulation	CF	Varies	fraction	TRM default
Lighting	IEkWh	Varies	percent	based on EDC
Lighting	IEkW	Varies	percent	based on EDC
LED Night Light	Wnl	0.5	W	TRM default
LED Night Light	Wbase	7	W	TRM default
Attic Insulation	Rbase	Varies	°F·ft^2·h/Btu	Project audit forms, phone converstations with contractor
Attic Insulation	Ree	Varies	°F·ft^2·h/Btu	Project audit forms or phone converstations with contractor
Wall Insulation	Rbase	Varies	°F·ft^2·h/Btu	TRM defaults
Wall Insulation	Ree	Varies	°F·ft^2·h/Btu	TRM defaults
Attic Insulation, Wall Insulation	HDD, CDD	Varies	Varies	TRM - Zip Code Lookup
Attic Insulation, Wall Insulation	Area	Varies	ft^2	Project audit forms
Attic Insulation, Wall Insulation	EER, SEER, HSPF, COP, GSHPDF, GSER	Varies	number	TRM default
Attic Insulation, Wall Insulation	DUA	0.75	fraction	TRM default
Attic Insulation	AHF	1.056	fraction	TRM default
Air Sealing	CFM50base	Varies	cfm	Project audit forms
Air Sealing	CFM50ee	Varies	cfm	Project audit forms
Air Sealing	UEScitysystem	Varies	text	TRM - Zip Code Lookup
Air Sealing	UDScitysystem	Varies	text	TRM - Zip Code Lookup
Air Sealing, Windows, Attic Insulation, Wall Insulation	Equipment Type	Varies	text	Verification table from GoodCents database, customer tracking data, project audit forms
Pipe Insulation, Aerators, Showerheads	Water heater type	Varies	text	Verification table from GoodCents database
Pipe Insulation	unit energy savings	9.43	kWh/ft	TRM default
Pipe Insulation	unit peak demand reduction	0.000759	kW/ft	TRM default
Smart Power Strip	# of plug	unspecified use	number	assumption
Smart Power Strip	Entertainment Center	unspecified use	text	assumption
Aerators, Showerhead	Housing Type	Varies	text	asumed single family
Aerators, Showerhead	Flow Rate (gpm)	1.5	gpm	TRM default

G.1.2 Sampling

The sampling strategy for gross impact evaluation is summarized in Table 192, Table 193, Table 194, and Table 195 for Met-Ed, Penelec, Penn Power, and WPP respectively.

Table 192: Res DI Initiative Gross Impact Sample Design for Met-Ed

Stratum	MWh Threshold	Population Size	Achieved Sample Size	Evaluation Activity
Weatherization	n/a	6	6	Desk Review
High Savings	650	72	5	
Low Savings	n/a	50	50	
Program Total		**128**	**61**	

Table 193: Res DI Initiative Gross Impact Sample Design for Penelec

Stratum	MWh Threshold	Population Size	Achieved Sample Size	Evaluation Activity
Weatherization	n/a	1	0	Desk Review
High Savings	650	87	8	
Low Savings	n/a	62	62	
Program Total		**150**	**70**	

Table 194: Res DI Initiative Gross Impact Sample Design for Penn Power

Stratum	MWh Threshold	Population Size	Achieved Sample Size	Evaluation Activity
Weatherization	n/a	0	0	Desk Review
High Savings	700	30	6	
Low Savings	n/a	30	30	
Program Total		**60**	**36**	

Table 195: Res DI Initiative Gross Impact Sample Design for WPP

Stratum	MWh Threshold	Population Size	Achieved Sample Size	Evaluation Activity
Weatherization	n/a	7	7	Desk Review
High Savings	670	74	9	
Low Savings	n/a	76	76	
Program Total		**157**	**92**	

G.1.3 Results for Energy

The gross realization rates for energy, along with relative precisions, are shown in Table 196, Table 197, Table 198, and Table 199 for Met-Ed, Penelec, Penn Power, and WPP respectively.

Table 196: Res DI Initiative Energy Gross Realization Rates for Met-Ed

Stratum	MWh Threshold	PYRTD MWh/yr	Energy Realization Rate	CV	Relative Precision at 85% C.L.
Weatherization	n/a	44	58.8%	0.5	0%
High Savings	650	52	114.0%	0.4	25%
Low Savings	n/a	25	105.4%	0.4	0%
Program Total		**121**	**92.1%**	**n/a**	**13.1%**

Table 197: Res DI Initiative Energy Gross Realization Rates for Penelec

Stratum	MWh Threshold	PYRTD MWh/yr	Energy Realization Rate	CV	Relative Precision at 85% C.L.
Weatherization	n/a	2	89.5%	0.5	0%
High Savings	650	67	127.5%	0.4	19%
Low Savings	n/a	29	120.1%	0.4	0%
Program Total		**98**	**124.6%**	**n/a**	**13.7%**

Table 198: Res DI Initiative Energy Gross Realization Rates for Penn Power

Stratum	MWh Threshold	PYRTD MWh/yr	Energy Realization Rate	CV	Relative Precision at 85% C.L.
Weatherization	n/a	0	0.0%	0.5	0%
High Savings	700	23	117.3%	0.4	21%
Low Savings	n/a	19	113.5%	0.4	0%
Program Total		**42**	**115.6%**	**n/a**	**11.7%**

Table 199: Res DI Initiative Energy Gross Realization Rates for WPP

Stratum	MWh Threshold	PYRTD MWh/yr	Energy Realization Rate	CV	Relative Precision at 85% C.L.
Weatherization	n/a	15	99.6%	0.5	0%
High Savings	670	62	124.3%	0.4	18%
Low Savings	n/a	42	114.0%	0.4	0%
Program Total		**120**	**117.5%**	**n/a**	**9.9%**

G.1.4 Results for Demand

The gross realization rates for demand, along with relative precisions, are shown Table 200, Table 201, Table 202, and Table 203 for Met-Ed, Penelec, Penn Power, and WPP respectively.

Table 200: Res DI Initiative Demand Gross Realization Rates for Met-Ed

Stratum	MWh Threshold	PYRTD MW/yr	Demand Realization Rate	CV	Relative Precision at 85% C.L.
Weatherization	n/a	0.00	80.4%	0.5	0%
High Savings	650	0.01	109.4%	0.4	25%
Low Savings	n/a	0.00	99.8%	0.4	0%
Program Total		**0.01**	**100.2%**	**n/a**	**13.9%**

Table 201: Res DI Initiative Demand Gross Realization Rates for Penelec

Stratum	MWh Threshold	PYRTD MW/yr	Demand Realization Rate	CV	Relative Precision at 85% C.L.
Weatherization	n/a	0.00	111.9%	0.5	0%
High Savings	650	0.01	110.4%	0.4	19%
Low Savings	n/a	0.00	102.6%	0.4	0%
Program Total		**0.01**	**108.1%**	**n/a**	**13.7%**

Table 202: Res DI Initiative Gross Realization Rates for Penn Power

Stratum	MWh Threshold	PYRTD MW/yr	Demand Realization Rate	CV	Relative Precision at 85% C.L.
Weatherization	n/a	0.00	0.0%	0.5	0%
High Savings	700	0.00	112.2%	0.4	21%
Low Savings	n/a	0.00	108.0%	0.4	0%
Program Total		**0.01**	**110.3%**	**n/a**	**11.7%**

Table 203: Res DI Initiative Demand Gross Realization Rates for WPP

Stratum	MWh Threshold	PYRTD MW/yr	Demand Realization Rate	CV	Relative Precision at 85% C.L.
Weatherization	n/a	0.00	111.6%	0.5	0%
High Savings	670	0.01	127.2%	0.4	18%
Low Savings	n/a	0.01	117.3%	0.4	0%
Program Total		**0.01**	**122.4%**	**n/a**	**10.3%**

G.2 Net Impact Evaluation

G.2.1 Net Impact Evaluation Methodology

An independent net impact evaluation was not conducted for this initiative because the initiative accounts for less than 0.1% of portfolio impacts, as averaged for the four PA Companies. The program impacts are distributed between a small number of high-savings whole-house retrofit projects, and a larger number of projects that involve measures that are also offered in the EE Kits initiative. We use the NTG from EE Kits as a proxy for this Res DI program's NTG.

Appendix H – Residential New Construction Initiative

The Residential New Construction program incentivizes builders to adopt energy efficient building practices. This includes building envelope improvements, high-efficiency HVAC equipment, duct sealing, and installation of ENERGY STAR® appliances and lighting. Participants are defined as each unique dwelling unit (e.g. unique mailing address).

All submitted projects used REM/Rate to generate reported energy and demand impacts.

H.1 Gross Impact Evaluation

H.1.1 Gross Impact Evaluation Methodology

Gross impact evaluation for the Residential New Construction (Res NC) Initiative involved reviewing the software models submitted with each sampled project, performing on-site verification of model inputs, and re-running modified models through the same software used by program HERS raters. Models were modified based on site-inspection information obtained by the implementer (PSD) during their quality control inspections, or ADM. Models were also modified to zero out the savings calculated for lighting improvements, appliances, and water heaters. Modified models were then run against the reference home to obtain ex post energy savings and demand reductions for weather sensitive measures. Ex post savings for lighting, appliances, and water heaters were obtained from corresponding TRM algorithms. Additional algorithm parameters required by the TRM but not required by software inputs were obtained through the on-site verification efforts.

H.1.1.1 On-Site Inspections

Two types of on-site inspections were performed for the impact evaluation effort:

- Diagnostic inspection w/blower door and duct blaster
- Visual inspection without blower door and duct blaster

Diagnostic inspections include the same activity as visual inspections with the addition of blower door and duct blaster testing to verify duct leakage and whole house infiltration rates.

Visual inspection includes the following:

- Building Characteristics
  - Orientation (N, NE, E, SE, etc.)
  - Housing type (SF detached, Townhouse inside unit, Townhouse end unit, etc.)
  - Number of floors on or above grade
  - Conditioned sq. ft.
  - Number of bedrooms
  - Window type, size and orientation
  - Ceiling heights
- Envelope
  - Foundation type (slab, conditioned basement, unconditioned basement, etc.)
  - Wall and ceiling insulation R-values

    - Slab and framed floor insulation
    - Rim/band joist insulation
    - Number of exterior doors
- HVAC
    - Make and model
    - SEER, capacity, and HSPF
    - For gas furnaces, electric auxiliary energy usage (EAE) as obtained from the AHRI database
    - Programmable thermostat is installed
    - Duct location (conditioned space, attic)
    - Type of mechanical ventilation if necessary
- Water heating
    - Type (storage, instantaneous)
    - Fuel (gas, electric resistance, heat pump)
    - Size in gallons
    - Energy factor as obtained from the AHRI database
- Lighting
    - Percent efficient installed interior, exterior, and in the garage. In cases of discrepancies, lighting counts were reported in the notes section of the checklist. ADM visual inspections reported lighting counts in each of these three areas.
    - Identification of source (incandescent, LED, or CFL)
- Appliances
    - An ENERGY STAR® appliance was installed at the time of inspection
    - kWh/yr for refrigerators and dishwashers
    - Fuel for ranges and cooktops
    - ADM visual inspections included make and model of each installed appliance

H.1.1.2 Engineering Model Reviews

Submitted building models were reviewed as part of the evaluation activities. These reviews included the following activities:

- Baseline specifications are accurate per the TRM
- Model inputs are reasonable and self-consistent
- Models are consistent with actual as-built homes

  Each sampled home was reviewed for consistency with actual as-built homes. In cases where submitted models differed from as-built homes, models were modified prior to generating ex post values.

H.1.1.3 TRM Impact Evaluation

The PA TRM requires that impacts from lighting and appliances are evaluated with relevant TRM protocols rather than within engineering simulation models. The REM/Rate models submitted by participating HERS raters reflect that building as-found, and therefore include the impacts of efficient lighting and appliances. ADM recalculates energy and demand impacts for

sampled projects by altering the REM/Rate models to remove any impacts associated with lighting and appliances, and then adds back the associated impacts as calculated with TRM protocols.

H.1.2 Sampling

Sampling for the New Homes initiative requires close coordination with the implementation team. Projects are typically sampled prior to rebate approval. As such, the sampling is not strictly a simple random sample drawn from the tracking and reporting system. Rather, ADM samples randomly from projects that were part of PSD's quality assurance sample, and supplements with randomly selecting homes that are eligible for QA/QC visits (but before the rebates are approved and the homes are sold). The only exception is Penelec, where ADM reviewed a census of the homes that were inspected by PSD. Our sampling approach is essentially unaltered since Phase I and allows us to leverage data gathered during QA/QC inspections, much like the process used for the low-income program evaluation. Furthermore, but sampling "ahead" of the tracking and reporting system, we can observe homes in near-final stages of construction, so that it is generally easier to verify building envelope characteristics. The sampling strategy for gross impact evaluation is summarized in Table 203, Table 205, Table 206, and Table 207 for Met-Ed, Penelec, Penn Power, and WPP respectively. We use an error ratio of 0.26 for calculating achieved precision levels. This error ratio is derived from evaluated sample points from all four EDCs. Our 15% relative precision targets were met for all EDCs, including Penelec. As with previous years, the program in the Penelec service territory was only a fraction of the size of the program in other service territories.

Table 204: RES NC Initiative Gross Impact Sample Design for Met-Ed

Stratum	Population Size	Achieved Sample Size	Evaluation Activity
All	441	20	Model Review / On-Site
Program Total	**441**	**20**	

Table 205: RES NC Initiative Gross Impact Sample Design for Penelec

Stratum	Population Size	Achieved Sample Size	Evaluation Activity
All	88	7	Model Review / On-Site
Program Total	**88**	**7**	

Table 206: RES NC Initiative Gross Impact Sample Design for Penn Power

Stratum	Population Size	Achieved Sample Size	Evaluation Activity
All	533	20	Model Review / On-Site
Program Total	**533**	**20**	

Table 207: RES NC Initiative Gross Impact Sample Design for WPP

Stratum	Population Size	Achieved Sample Size	Evaluation Activity
All	603	21	Model Review / On-Site
Program Total	**603**	**21**	

H.1.3 Results for Energy

The gross realization rates for energy, along with relative precisions, are shown in Table 208, Table 209, Table 210, and Table 211 for Met-Ed, Penelec, Penn Power, and WPP respectively.

Table 208: RES NC Initiative Energy Gross Realization Rates for Met-Ed

Stratum	PYRTD MWh/yr	Energy Realization Rate	CV	Relative Precision at 85% C.L.
All	1,358	74.2%	0.221	7%
Program Total	**1,358**	**74.2%**	**0.221**	**7%**

Table 209: RES NC Initiative Energy Gross Realization Rates for Penelec

Stratum	PYRTD MWh/yr	Energy Realization Rate	CV	Relative Precision at 85% C.L.
All	193	70.2%	0.221	12%
Program Total	**193**	**70.2%**	**0.221**	**12%**

Table 210: RES NC Initiative Energy Gross Realization Rates for Penn Power

Stratum	PYRTD MWh/yr	Energy Realization Rate	CV	Relative Precision at 85% C.L.
All	972	80.4%	0.221	7%
Program Total	**972**	**80.4%**	**0.221**	**7%**

Table 211: Res DI Initiative Energy Gross Realization Rates for WPP

Stratum	PYRTD MWh/yr	Energy Realization Rate	CV	Relative Precision at 85% C.L.
All	1,572	77.5%	0.221	7%
Program Total	**1,572**	**77.5%**	**0.221**	**7%**

H.1.4 Results for Demand

The gross realization rates for demand, along with relative precisions, are shown Table 212, Table 213, Table 214, and Table 215 for Met-Ed, Penelec, Penn Power, and WPP respectively.

Table 212: RES NC Initiative Demand Gross Realization Rates for Met-Ed

Stratum	PYRTD MW/yr	Demand Realization Rate	CV	Relative Precision at 85% C.L.
All	0.45	146.7%	0.221	7%
Program Total	**0.45**	**146.7%**	**0.221**	**7%**

Table 213: RES NC Initiative Demand Gross Realization Rates for Penelec

Stratum	PYRTD MW/yr	Demand Realization Rate	CV	Relative Precision at 85% C.L.
All	0.06	126.5%	0.221	12%
Program Total	**0.06**	**126.5%**	**0.221**	**12%**

Table 214: RES NC Initiative Gross Realization Rates for Penn Power

Stratum	PYRTD MW/yr	Demand Realization Rate	CV	Relative Precision at 85% C.L.
All	0.43	130.0%	0.221	7%
Program Total	**0.43**	**130.0%**	**0.221**	**7%**

Table 215: RES NC Initiative Demand Gross Realization Rates for WPP

Stratum	PYRTD MW/yr	Demand Realization Rate	CV	Relative Precision at 85% C.L.
All	0.64	147.9%	0.221	7%
Program Total	**0.64**	**147.9%**	**0.221**	**7%**

H.2 Net Impact Evaluation

H.2.1 Net Impact Evaluation Methodology

An independent net impact evaluation was not conducted for this initiative in PY9. However, rather than using a proxy 50% Net-to-Gross ratio as in PY8, Tetra Tech conducted secondary NTG research and found that the average evaluated NTG for six comparable programs (two in PA, two in MD, one in MO and one in UT) is 0.6. This value is used for cost effectiveness calculations of the New Homes program component in PY9. A more direct NTG study is planned for PY10.

Appendix I Evaluation Detail – Residential Upstream Lighting Initiative

I.1 Gross Impact Evaluation

The Upstream Lighting initiative provides point of sale incentives on energy efficient lighting products at participating retailers. The program also provides for the promotion of energy efficient lighting at retailers, including product placement, signage, and staff training. Contact information for downstream participants is not collected, as this is an upstream program. The number of participants is reported as the number of packs of lamps. The average pack size is approximately three, the lamps to participants ratio is approximately three.

I.1.1 Gross Impact Evaluation Methodology

Gross impact evaluation for the Upstream Lighting Initiative involved a database review to reconcile invoices with tracking and reporting data and to calculate lamp-specific impacts according to the 2016 PA TRM, and a general population telephone survey to determine cross-sector sales. The impact evaluation process is described below.

I.1.1.1 Review of Sales Invoices and Determination of ISR

ADM conducted a review and obtained invoices for the lamps sold by participating retailers. These invoices are matched to the tracking and reporting (tracking and reporting) system to confirm proper counts and characteristics of the lamps and packages. The information regarding lamp types and quantities in the tracking and reporting system was found to be consistent with the reviewed invoices. Given this finding, the default 92% ISR is applied in the impact calculations. In the event that discrepancies are found between invoiced and tracked quantities.

I.1.1.2 Determination of Baseline and Efficient Lamp Watts

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 energy and demand impacts.

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

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.

I.1.1.1 Treatment of Non ENERY STAR® LED Lamps

In PY8, approximately 21% of rebated LED lamps were not ENERGY STAR® ® qualified at the start of PY8. However, approximately 43% of those LED models have since qualified for ENERGY STAR® ®. The non-qualifying lamps have similar light output and color rendition, but often have shorter measure lives (at the beginning of PY8, the ENERGY STAR® ® lifetime requirement was 25,000 hours, but the requirement has since been relaxed to 15,000 hours). The non-qualifying "value" LEDs had considerable price advantages last year, and were offered as a transitional measure given the changes in ENERGY STAR® ® standards. The price advantage is now minimal, however, and the Companies stopped rebating non-qualifying LEDs at the end of PY8. Only a trace of non-ENERGY STAR® ® LEDs are in the tracking system in the first quarter of PY9, and they were apparently all purchased in PY8.

I.1.1.2 Determination of Cross Sector Sales

Since upstream program tracking data do not contain customer information, a general population survey was conducted in PY8 to identity program participants and to determine the fraction of lamps that are installed in various nonresidential settings. The online survey targeted up to 1,000 residential customers combined over the four FirstEnergy PA EDCs. ADM and Tetra Tech monitored interim results and reduced the target to about 600. A total of 573 surveys were completed. The survey instrument included initial questions to positively identify program participants, and then asked how many lamps they purchased and where the lamps were installed.

The weight for each facility type is taken to be the number of lamps purchased by the respondent, divided by the total number of lamps purchased by all respondents. If customers reported that they installed lamps in both residences and businesses, a follow up call asked for the proportion of lamps installed in each location. Not all customers could be contacted for a follow-up call, but the majority of such customers did respond. Based on these responses, 50.2% of the purchased lamps were installed in businesses. This proportion was then applied to cases where a customer reported having installed lamps in both a business and a residence but could not be reached for follow up.

The instrument included seven facility types that have previously been identified as likely places of lamp installation, along with an open-ended response for other facility types. The responses were then mapped to TRM building types for determination of hours of use, coincidence factors, and GNI status according to the assignment scheme shown in Table 216. If a precise determination of business type is not possible after a review all responses in the "Other" category (last line of Table 216), the building is mapped to the "Miscellaneous" TRM building type, and the GNI status is set to non-GNI.

Table 216: Mapping of cross sector sales survey responses to TRM building types and GNI status.

Nonresidential Facility Type	TRM Building Type	GNI
Office	Office	No
Retail store	Retail	No
Health care facility	Health	Yes
Hotel / motel / lodging	Lodging	No
Restaurant	Restaurant	No
School	Education	Yes
Place of worship	Institutional	Yes
Other	Determined from response	

Out of 571 completed survey responses (5,409 efficient lamps purchased in the last 12 months), 9 customers reported installing a total of 120 lamps in businesses. Another 32 customers reported installing a total of 655 lamps both in homes and businesses, and of the 655, 329 were determined to be installed in businesses (228 by direct confirmation and 101 by proportionating as discussed above). The fraction of efficient lamps that are installed in non-residential settings is 449/5,409=8.3%. Of the 449 lamps, total of 35 were determined to be installed in GNI facilities, so that the GNI cross sector rate is 35/5,409=0.65%. The cross-sector rate is higher than determined in PY4 or PY6 (the rate has climbed from 4.9%% to 5.8% to 8.3%). Although a definite cause for the increase is not known, a possible explanation is that small businesses are more willing to install efficient screw-based lamps than before due to the increased availability and reduced costs of LEDs.

I.1.1.3 Determination of Hours of Use and Coincidence Factor

The daily hours of use and peak coincidence factor for lamps installed in the residential sector are taken as the corresponding values for efficient lamps as installed in the overall household in the 2016 PA TRM. Nonresidential hours of use and coincidence factors are calculated by building type according to Table 3-5 of the TRM. Weighted average HOU and CF are developed for the total nonresidential cross-sector lamps, and separately for the subset of cross-sector lamps that are installed in GNI facilities. The TRM parameters, their associated weights according to the cross-sector sales survey, and overall weighted averaged results are shown in Table 217.

Table 217: HOU, CF, IF, and overall weighting for cross-sector sales.

Building Type	HOU	CF	IF_kWh	IF_kW	Weight	% GNI
Education	2,944	0.39	0.00	0.192	4%	100%
Exterior	3,833	0.00	0.00	0	0%	0%
Grocery	7,798	0.99	0.00	0.192	0%	0%
Health	2,476	0.47	0.00	0.192	0%	100%
Industrial Manufacturing – 1 Shift	2,857	0.57	0.00	0.192	1%	0%
Industrial Manufacturing – 2 Shift	4,730	0.57	0.00	0.192	0%	0%
Industrial Manufacturing – 3 Shift	6,631	0.57	0.00	0.192	0%	0%
Institutional/Public Service	1,456	0.23	0.00	0.192	4%	100%
Lodging	2,925	0.38	0.00	0.192	0%	0%
Miscellaneous/Other	2,001	0.33	0.00	0.192	18%	0%
Multi-Family Common Areas	5,950	0.62	0.00	0.192	3%	0%
Office	1,420	0.26	0.00	0.192	60%	0%
Parking Garages	6,552	0.62	0.00	0	0%	0%
Restaurant	3,054	0.55	0.00	0.192	0%	0%
Retail	2,383	0.56	0.00	0.192	10%	0%
Warehouse	2,815	0.50	0.00	0.192	0%	0%
Weighted Average - All C&I	**1,821**	**0.32**	**0.00**	**0.192**	100%	
Weighted Average - GNI	**2,222**	**0.31**	**0.00**	**0.192**		

I.1.1.4 Determination of HVAC Interactive Effects

Residential HVAC interactive effects factors are determined separately for each EDC in a two-step process. As a first step, we use data from the 2014 Act 129 Residential Baseline Study to estimate the fraction of lamps that are installed in conditioned space. The fraction of lamps in conditioned space is the ratio of the number of eligible interior sockets to the total number of eligible sockets for each EDC. This fraction is presented in Table 218.

Table 218: Determination of the fraction of lamps in conditioned space by EDC.

EDC	Number of Interior Lamps	Number of Exterior Lamps	Interior lamps as a % of total lamps
Met-Ed	45	6	88%
Penelec	35	4	90%
Penn Power	49	5	91%
West Penn	49	6	89%

As a second step the residential interactive factors from the PA TRM are adjusted through multiplication by the percentages in the last column of Table 218. The adjusted interactive effects are shown in Table 219.

The interactive effects for nonresidential lighting are taken from Table 3-9 from the 2016 PA TRM. The default values of 0 and 0.192 for unknown space conditioning are appropriate for this calculation effort.

Table 219: Original and adjusted energy and demand interactive effects by EDC.

EDC	IE_kWh	ADJ_IE_kW	IE_kW	ADJ_IE_kW
Met-Ed	-8%	-7%	13%	11%
Penelec	1%	1%	10%	9%
Penn Power	0%	0%	20%	18%
WPP	-2%	-2%	30%	27%

Table 220 lists the data sources for gross impact calculation algorithms.

Table 220: Data Sources for the ATI Initiative Gross Impact Evaluation

Evaluation Parameter	Data Source	Value
Verification of Quantity	Invoice to SSRS comparison	Varies
Baseline Watts	Lookup based on lumens, type	Varies
Watts	Lookup from EnergyStar DB and online searches	Varies
Lumens	Lookup from EnergyStar DB and online searches	Varies
Lamp Type	Lookup from EnergyStar DB and online searches	Varies
Residential Daily Hour of Use	TRM Table 2-5 HOU for Efficient Lamps in Household	3
Residential Coincidence Factor	TRM Table 2-5 CF for Efficient Lamps in Household	0.106
Residential IF_kWh	TRM Table 2-6, per EDC, for lamps installed indoors	Varies
Residential IF_kW	TRM Table 2-6, per EDC, for lamps installed indoors	Varies
Residential % Installed Indoors	2014 Baseline Study Figure 5-12 and Table 5-50	Varies
Percent Nonresidential	Cross Sector Sales Survey*	5.00%
Percent GNI	Cross Sector Sales Survey*	1.00%
Nonresidential Hour of Use	Cross Sector Sales Survey* and TRM Table 3-5	1,821
Nonresidential CF	Cross Sector Sales Survey* and TRM Table 3-5	0.32
GNI Hours of Use	Cross Sector Sales Survey* and TRM Table 3-5	2,222
GNI CF	Cross Sector Sales Survey* and TRM Table 3-5	0.31
Nonesidential IF_kWh	TRM Table 2-6, per EDC, for lamps installed indoors	0
Nonesidential IF_kW	TRM Table 2-6, per EDC, for lamps installed indoors	0.192
*Cross sector sales survey results are applied to all four EDCs		

I.1.2 Sampling

Of the three gross impact evaluation activities conducted for this initiative, only the invoice review component involved sampling. The sampling was conducted on a simple random basis. The relative precision on the cross-sector rate is estimated to be 30%, but this translates to approximately 3% at the initiative level. The sample design for this initiative is summarized in Table 221 below.

Table 221: Gross Impact Sample Design for the Upstream Lighting Initiative

EDC	Population Size	Achieved Sample Size	Evaluation Activity
Met-Ed	331,893	Census	Database Review
		50	Invoice Review
		211	X-Sector Sales Survey
Met-Ed Total	331,893	261	
Penelec	294,345	Census	Database Review
		50	Invoice Review
		211	X-Sector Sales Survey
Penelec Total	294,345	261	
Penn Power	93,392	Census	Database Review
		50	Invoice Review
		211	X-Sector Sales Survey
Penn Power Total	93,392	261	
WPP	285,066	Census	Database Review
		50	Invoice Review
		211	X-Sector Sales Survey
WPP Total	285,066	261	

I.1.3 Results for Energy

The gross realization rates for energy, along with relative precisions, are shown in Table 222.

Table 222: Upstream Lighting Initiative Energy Gross Realization Rates

EDC	PYRTD MWh/yr	Energy Realization Rate	CV	Relative Precision at 85% C.L.
Met-Ed	22,061	128.6%	0.5	10%
Penelec	25,498	119.3%	0.5	10%
Penn Power	9,631	129.2%	0.5	10%
WPP	24,180	122.4%	0.5	10%

I.1.4 Results for Demand

The gross realization rates for demand, along with relative precisions, are shown Table 223.

Table 223: Upstream Lighting Initiative Demand Gross Realization

EDC	YRTD MW/	and Realization	CV	Precision at
Met-Ed	2.62	139.8%	0.5	10%
Penelec	2.69	133.5%	0.5	10%
Penn Power	1.12	141.1%	0.5	10%
WPP	3.10	130.1%	0.5	10%

I.2 NET IMPACT EVALUATION

I.2.1 Net Impact Evaluation Methodology

Upstream lighting net-to-gross was based on both customer and retailer survey responses. The retailer analysis was conducted on retailers' estimates of the increased sales, or sales lift, of ENERGY STAR® ® LEDs and CFLs that was attributable to the program incentives during PY8. This analysis very likely underestimates the program's net-to-gross since the program includes other components that may increase sales, such as customer awareness and education and retailer stocking practices. These other components are not captured by the sales lift analysis. The sales lift results were weighted by the retailer's gross energy savings.

Lighting net-to-gross results are presented across all four FirstEnergy EDCs because of the low number of responses for individual EDCs. Net-to-gross was noticeably lower for West Penn Power than for the other three EDCs, however this is based on fewer than 20 interviews. The average net-to-gross based on sales lift is 36 percent for LEDs and 27 percent for CFLs.

The survey also asked retailers to rate the overall influence of the program on their sales of program-eligible products. The responses on a 1 to 5 scale were converted to a percent, with 1 (little or no influence) being 0 percent and 5 (extremely influential) being 100 percent influence. This metric attempts to capture the influence of the incentive as well as the other program components. The average influence rating was 80 percent for LEDs, suggesting the program is still very influential in stores' sales of these products, and 57 percent for CFLs, suggesting the influence on sales of these products is more moderate. These results indicate that the program's influence is likely higher than what is captured by the sales lift methodology.

The Customer NTG score is adapted from the self-report methodology described in the evaluation framework. This data acquisition mode is not ideal since participants are often unaware that they participated in the program (that is, they may not notice or recall that the efficient lamps are rebated by their utility company), but the survey instrument was modified to enable a discussion of customers' purchasing preferences even if they were not aware of the upstream discounts at the time of purchase. The program is not designed to induce spillover, so the customer NTG is only based on free ridership analysis. The customer NTG was analyzed per EDC.

The results from the retailer and customer surveys were averaged to arrive at a blended estimate of net-to-gross for the program. Overall, the customer NTG was lower than the retailer estimates for LEDs and higher than the retailer estimates for CFLs.

The net-to-gross results for these measures are lower than reported during Phase II, however the Phase III analysis implemented a completely different methodology. Phase II results were based on the influence ratings noted above, and the results of that analysis were very similar to the influence ratings reported in Phase III. This suggests the program's influence has been relatively stable over the past several years.

An econometric price elasticity analysis was also planned for PY8, however, detailed pricing information for lamps at participating stores was not available. If it becomes apparent that the information continues to be unavailable, ADM and Tetra Tech will work with FirstEnergy and its

ICSP, Honeywell, to experiment with incentive levels in a manner that will enable econometric analysis even with the absence of lamp pricing data.

I.2.2 Sampling

Both retailers and participants were contacted for net impact evaluation purposes. The sample designs for the four EDCs are shown in Table 224. Note that PY9 participant counts are shown, but the actual survey effort occurred during PY8, and targeted randomly selected customers, since participant contact information is not collected for the upstream program.

Table 224: Upstream Lighting Initiative Net-to-Gross Sampling

EDC	Stratum	Population Size	Achieved Sample Size	Response Rate
Met-Ed	Retalers	33	12	36%
	Customers	331,893	176	6%
Met-Ed Total		n/a	n/a	n/a
Penelec	Retalers	44	16	36%
	Customers	294,345	169	6%
Penele Total		n/a	n/a	n/a
Penn Power	Retalers	14	9	64%
	Customers	93,392	183	6%
Penn Power Total		n/a	n/a	n/a
WPP	Retalers	39	19	49%
	Customers	285,066	143	5%
WPP Total		n/a	n/a	n/a

I.2.3 Net Impact Evaluation Results

The PYTD verified gross energy impacts, free ridership, spillover, net-to-gross ratios, and relative precisions for net-to-gross are shown in Table 225.

Table 225: Upstream Lighting Initiative Net-to-Gross Results for Met-Ed

EDC	PYVTD MWh	Free Ridership (%)	Spillover (%)	NTG Ratio	Relative Precision (@ 85% CL)
Met-Ed	28,376	63.0%	0.0%	37.0%	17.4%
Penelec	30,424	66.2%	0.0%	33.8%	15.4%
Penn Power	12,439	61.2%	0.0%	38.8%	15.3%
WPP	29,605	73.4%	0.0%	26.6%	13.3%

Appendix J Evaluation Detail – Residential Upstream Electronics Initiative

J.1 Gross Impact Evaluation

The Upstream Electronic initiative provides retailers incentives for the promotion of energy efficient computers, monitors, televisions, and imaging equipment. Each rebated item is counted as one participant for reporting purposes.

J.1.1 Gross Impact Evaluation Methodology

Gross impact evaluation for the Upstream Electronics Initiative involved a database review to reconcile invoices with tracking and reporting data and to calculate lamp-specific impacts according to the 2016 PA TRM. The impact evaluation process is described below.

J.1.1.1 Review of Sales Invoices and Determination of Product Eligibility

ADM conducted a review and obtained invoices for the computers, monitors, televisions, and imaging equipment sold by participating retailers. These invoices are matched to the tracking and reporting (T&R) system to confirm proper counts and characteristics of rebated items. The information regarding item types and quantities in the T&R system was found to be consistent with the reviewed invoices. If discrepancies are found between invoiced and tracked quantities, a verification rate is generated by dividing the invoiced quantity by the tracked quantity and applied to calculated energy and demand savings.

J.1.1.2 Determination of ENERGY STAR® Status

To calculate verified impacts, ADM developed a make/model specific equipment map. For each unique stock keeping unit (SKU) description, ADM categorized the equipment type as one of the following:

- Computer
- Monitor
- Television
- Imaging Equipment

Imaging equipment was further sub-divided based on imaging equipment technology (multifunction device, printer, or scanner) and ink-type (inkjet, laser, or thermal transfer/impact). ADM utilized ENERGY STAR® databases for the program year to determine equipment eligibility. Impacts for all equipment are determined using deemed savings tables from the TRM.

J.1.2 Sampling

Of the two gross impact evaluation activities conducted for this initiative, only the invoice review component involved sampling. The sampling was conducted on a simple random basis. The sample design for this initiative is summarized in Table 226 below.

Table 226: Upstream Electronics Initiative Sample Design

EDC	Population Size	Achieved Sample Size	Evaluation Activity
Met-Ed	13,206	Census	Database Review
		Census	Invoice Review
Met-Ed Total	**13,206**	**13206**	
Penelec	6,228	Census	Database Review
		Census	Invoice Review
Penelec Total	**6,228**	**6228**	
Penn Power	4,725	Census	Database Review
		Census	Invoice Review
Penn Power Total	**4,725**	**4725**	
WPP	22,064	Census	Database Review
		Census	Invoice Review
WPP Total	**22,064**	**22,064**	

J.1.3 Results for Energy

The gross realization rates for energy, along with relative precisions, are shown in Table 227, Table 228, Table 229, and Table 230 for Met-Ed, Penelec, Penn Power, and WPP respectively.

Table 227: Upstream Electronics Initiative Energy Gross Realization Rates for Met-Ed

Stratum	PYRTD MWh/yr	Energy Realization Rate	CV	Relative Precision at 85% C.L.
TV	339	107.4%	0.5	0.0%
Imaging	60	80.1%	0.5	0.0%
Computer	50	100.0%	0.5	0.0%
Monitor	32	100.0%	0.5	0.0%
Program Total	**481**	**102.8%**	**0.5**	**0.0%**

Table 228: Upstream Electronics Initiative Energy Gross Realization Rates for Penelec

Stratum	PYRTD MWh/yr	Energy Realization Rate	CV	Relative Precision at 85% C.L.
TV	155	102.7%	0.5	0.0%
Imaging	30	89.3%	0.5	0.0%
Computer	30	100.0%	0.5	0.0%
Monitor	13	100.0%	0.5	0.0%
Program Total	**229**	**100.4%**	**0.5**	**0.0%**

Table 229: Upstream Electronics Initiative Energy Gross Realization Rates for Penn Power

Stratum	PYRTD MWh/yr	Energy Realization Rate	CV	Relative Precision at 85% C.L.
TV	106	102.6%	0.5	0.0%
Imaging	24	88.0%	0.5	0.0%
Computer	27	100.0%	0.5	0.0%
Monitor	14	100.0%	0.5	0.0%
Program Total	**170**	**99.9%**	**0.5**	**0.0%**

Table 230: Upstream Electronics Initiative Energy Gross Realization Rates for WPP

Stratum	PYRTD MWh/yr	Energy Realization Rate	CV	Relative Precision at 85% C.L.
TV	538	108.0%	0.5	0.0%
Imaging	108	85.0%	0.5	0.0%
Computer	105	100.0%	0.5	0.0%
Monitor	51	100.0%	0.5	0.0%
Program Total	**803**	**103.4%**	**0.5**	**0.0%**

J.1.4 Results for Demand

The gross realization rates for demand, along with relative precisions, are shown Table 231, Table 232, Table 233, and Table 234 for Met-Ed, Penelec, Penn Power, and WPP respectively.

Table 231: Upstream Electronics Initiative Demand Gross Realization Rates for Met-Ed

Stratum	PYRTD MW/yr	Demand Realization Rate	CV	Relative Precision at 85% C.L.
TV	0.03	115.3%	0.5	0.0%
Imaging	0.01	52.7%	0.5	0.0%
Computer	0.01	100.6%	0.5	0.0%
Monitor	0.00	106.7%	0.5	0.0%
Program Total	**0.05**	**98.2%**	**0.5**	**0.0%**

Table 232: Upstream Electronics Initiative Demand Gross Realization Rates for Penelec

Stratum	PYRTD MW/yr	Demand Realization Rate	CV	Relative Precision at 85% C.L.
TV	0.01	110.2%	0.5	0.0%
Imaging	0.01	58.8%	0.5	0.0%
Computer	0.00	100.6%	0.5	0.0%
Monitor	0.00	106.7%	0.5	0.0%
Program Total	**0.03**	**96.0%**	**0.5**	**0.0%**

Table 233: Upstream Electronics Initiative Gross Realization Rates for Penn Power

Stratum	PYRTD MW/yr	Demand Realization Rate	CV	Relative Precision at 85% C.L.
TV	0.01	110.1%	0.5	0.0%
Imaging	0.00	57.9%	0.5	0.0%
Computer	0.00	100.6%	0.5	0.0%
Monitor	0.00	106.7%	0.5	0.0%
Program Total	**0.02**	**95.0%**	**0.5**	**0.0%**

Table 234: Upstream Electronics Initiative Demand Gross Realization Rates for WPP

Stratum	PYRTD MW/yr	Demand Realization Rate	CV	Relative Precision at 85% C.L.
TV	0.05	115.9%	0.5	0.0%
Imaging	0.02	56.0%	0.5	0.0%
Computer	0.01	100.6%	0.5	0.0%
Monitor	0.01	106.7%	0.5	0.0%
Program Total	**0.09**	**98.1%**	**0.5**	**0.0%**

J.2 NET IMPACT EVALUATION

J.2.1 Net Impact Evaluation Methodology

A net impact evaluation was not conducted for the upstream electronics program in PY9 but will be conducted in PY10. The net-to-gross ratio from the Phase II evaluation of this program component, 49.5%, was applied for calculation of portfolio-level net verified impacts and for net-level TRC calculations

Appendix K Evaluation Detail – Residential HVAC Initiative

The Residential HVAC initiative provides rebates to customers who purchase high efficiency HVAC equipment, Tune-Up an existing HVAC system, install a new programmable thermostat, or replace an existing furnace fan with a new high-efficiency one. Enhanced rebates are provided for CEE tier 2 and tier 3 HVAC systems.

Participants are defined as each separate measure rebated. Thus, the rebate application, rather than the customer is the sampling unit for gross impact evaluation.

K.1 Gross Impact Evaluation

K.1.1 Gross Impact Evaluation Methodology

Each component of gross impact evaluation is described below.

Mini-Splits

Ductless mini-splits (ACs and heat pumps) were also looked up on AHRI similar to the other HVAC system types, but several additional steps were taken to determine gross impacts. EFLHs were determined through the TRM classification of “primary zone” or “secondary zone”. Participant survey responses were used to determine the TRM classification based on which room the systems were installed in as rebate applications do not include this information. The TRM default value was used for CF. The baseline system type was determined from participant surveys. Several response fields were considered to determine the baseline including whether the mini-split installation supplemented an existing HVAC system. In cases where there was no existing heating or cooling, or the respondent did not know what type of existing system they had, the baseline was taken to be an ASHP or ducted mini-split (both have SEERbase = 14 and HSPFbase = 8.2). Baseline efficiencies were taken from TRM table 2-21 according to the type of baseline system.

Thermostats

Programmable thermostats were classified by the features they possess according to the IMP: conventional programmable, basic smart, or advanced smart. The corresponding features are: programmable schedule, remote access, and occupancy sensing. These features were looked up on manufacturer websites and compiled into a database. For each sampled thermostat measure, the IMP classification was looked up in the database based on its features. The IMP classification was used to determine the Energy Saving Factors (ESFcool and ESFheat) used in the IMP algorithm. The baseline thermostat was determined based on the rebate application. In cases where the existing thermostat was broken or non-existing, a manual baseline was assumed.

Furnace Fans

High-efficiency furnace fan energy savings relied on the deemed values in the TRM. ADM used the results of participant surveys to determine the verification rate.

HVAC Maintenance

Default TRM parameters were used for HVAC Tune-Up calculations. Heating and cooling capacities were determined from the rebate application for sampled units. For tune-ups performed on AC units, the kWh heat term in the TRM algorithm was taken to be zero.

PTACs and PTHPs

As there were only a handful of PTACs and PTHPs reported across all four EDCs, ADM elected to pass these measures through the evaluation process with no activity.

Table 235 lists the data sources for gross impact calculation algorithms.

Table 235: Data Sources for the Res HVAC Initiative Gross Impact Evaluation

Measure	TRM Parameter	Data Source
All Measures	Appliance Age	Tracking and Reporting System
All HVAC Equipment	AHRI # (to get other TRM paremeters)	Invoice Inspections and Tracking Data
All HVAC Equipment	Heating Capacity	Tracking and Reporting System
All HVAC Equipment	Cooling Capacity	Tracking and Reporting System
HVAC Maintenance	Heating Capacity	Invoice Inspections
HVAC Maintenance	Cooling Capacity	Invoice Inspections
All	SEER/EER/HSPF/COP	AHRI database refrence
Minisplits	EFLH	ZIP lookup and survey for room type
Minisplits	Baseline Type	Customer Surveys
Programmable Thermostats	Install Type	Application Review
Programmable Thermostats	Thermostat Type	Application Review
Programmable Thermostats	Heating System Type	Application Review
Programmable Thermostats	Cooling System Type	Application Review
Programmable Thermostats	Baseline Thermostat Type	Application Review

K.1.1.1 Determination of Verification Rate

ADM performed online surveys on a random sample of customers selected from the tracking and reporting data. Nearly all contacted customers verified that they have purchased and installed the stated HVAC measures. The verification rates are used to inform measure-level realization rates.

K.1.1.2 Invoice and Application Review

ADM obtained invoices and applications from Honeywell. For each application, ADM verified that the manufacturer name and model number in the tracking and reporting system matches those on the invoice and rebate application. In general, all sampled measures were matched to qualifying product lists. ADM independently retrieved the attributes necessary for TRM and IMP calculations from various supporting databases which were compiled for this purpose. These include the AHRI database and manufacturer websites. 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. In such cases, straightforward manual correction of the make or model numbers results in positive identification of the involved equipment in the supporting databases.

K.1.1.3 Calculation Review using TRM algorithm and parameters

For HVAC measures with partially deemed TRM (or IMP) protocols, the T&R system reported impacts with one savings scenario rather than with specific scenarios that occur in measure implementation. For example, values from planning assumptions for capacity and efficiency are used rather than HVAC system-specific values. 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 project-specific attributes to calculate "On-TRM" impacts.

The average per-unit gross verified impact for a given measure is the product of the measure-specific verification rate as determined from customer surveys, and the average calculated impacts as described above.

The following provide additional details into the calculation review procedure:

CACs and ASHPs

Central HVAC systems were looked up on the AHRI database to determine individual measure attributes for use in the TRM algorithms. These attributes include heating and cooling capacities, and seasonal efficiency ratios (SEER and HSPF). EFLHs were taken from TRM table 2-12 based on the reported zip code or zip code obtained through participant surveys if the reported zip code was overridden by the respondent. The TRM default value was used for CF. Baseline efficiencies were taken as TRM defaults assuming a replace on burnout scenario rather than early retirement[16].

GSHPs

Ground-source heat pump make and model numbers, or AHRI certificate numbers, are cross-referenced on the AHRI database to determine equipment parameters for use in the TRM algorithm. EFLHs were determined through zip code lookups as provided in the T&R data or with zip codes from survey data if overridden by respondents. The TRM default value for CF was used. Other TRM default values used include GSHPDF, GSER, GSOP, and GSPK. Baseline efficiencies were also taken as TRM defaults for a replace on burnout scenario with an ASHP as the baseline system.

For GSHP units larger than 65 kBtuh, the commercial algorithm in section 3.2.3 of the TRM was used to calculate impacts. Here the baseline efficiencies were taken from TRM table 3-36. In these cases, the replace on burnout scenario assumes kWh_{pump} and kW_{pump} for the baseline ASHP are zero.

[16] Although early retirements are eligible and do occur in the program, the downstream rebate program does not have any special provisions, such as mandatory pre-inspections, to accommodate early retirement. For this program, early retirement is viewed by ADM as a phenomenon that may increase net impacts, but not gross impacts.

Mini-Splits

Ductless mini-splits (ACs and heat pumps) were also looked up on AHRI similar to the other HVAC system types, but several additional steps were taken to determine gross impacts. EFLHs were determined through the TRM classification of "primary zone" or "secondary zone". Participant survey responses were used to determine the TRM classification based on which room the systems were installed in as rebate applications do not include this information. The TRM default value was used for CF. The baseline system type was determined from participant surveys. Several response fields were taken into account to determine the baseline including whether the mini-split installation supplemented an existing HVAC system. In cases where there was no existing heating or cooling, or the respondent did not know what type of existing system they had, the baseline was taken to be an ASHP or *ducted* mini-split (both have $SEER_{base}$ = 14 and $HSPF_{base}$ = 8.2). Baseline efficiencies were taken from TRM table 2-21 according to the type of baseline system.

Thermostats

Programmable thermostats were classified by the features they possess according to the IMP: conventional programmable, basic smart, or advanced smart. The corresponding features are: programmable schedule, remote access, and occupancy sensing. These features were looked up on manufacturer websites and compiled into a database. For each sampled thermostat measure, the IMP classification was looked up in the database based on its features. The IMP classification was used to determine the Energy Saving Factors (ESF_{cool} and ESF_{heat}) used in the IMP algorithm. The baseline thermostat was determined based on the rebate application. In cases where the existing thermostat was broken or non-existing, a manual baseline was assumed.

Furnace Fans

High-efficiency furnace fan energy savings relied on the deemed values in the TRM. ADM used the results of participant surveys to determine the verification rate.

HVAC Maintenance

Default TRM parameters were used for HVAC Tune-Up calculations. Heating and cooling capacities were determined from the rebate application for sampled units. For tune-ups performed on AC units, the kWh_{heat} term in the TRM algorithm was taken to be zero.

PTACs and PTHPs

As there were only three PTACs and zero PTHPs reported, ADM elected to pass these measures through the evaluation process with no activity.

K.1.2 Sampling

Each measure was treated as a separate stratum within the sampling initiative. The sample designs for the four EDCs are shown in Table 236, Table 237, Table 238, and Table 239.

Table 236: Res HVAC Initiative Gross Impact Sample Design for Met-Ed

Stratum	Population Size	Achieved Sample Size (Survey)	Achieved Sample Size (Desk Review)
ASHP	349	13	12
Mini-Split HP	287	13	15
GSHP	47	4	2
CAC	426	9	9
Furnace Fan	217	9	5
Thermostat	1,041	11	33
HVAC Tune-Up	115	5	0
PTAC	0	0	0
PTHP	1	0	0
Program Total	**2,482**	**64**	**76**

Table 237: Res HVAC Initiative Gross Impact Sample Design for Penelec

Stratum	Population Size	Achieved Sample Size (Survey)	Achieved Sample Size (Desk Review)
ASHP	94	13	4
Mini-Split HP	493	7	7
GSHP	16	5	1
CAC	84	10	2
Furnace Fan	246	8	6
Thermostat	621	10	29
HVAC Tune-Up	293	2	3
PTAC	1	0	0
PTHP	0	0	0
Program Total	**1,848**	**55**	**52**

Table 238: Res HVAC Initiative Gross Impact Sample Design for Penn Power

Stratum	Population Size	Achieved Sample Size (Survey)	Achieved Sample Size (Desk Review)
ASHP	87	8	8
Mini-Split HP	44	5	5
GSHP	7	2	2
CAC	34	5	3
Furnace Fan	292	5	19
Thermostat	287	9	22
HVAC Tune-Up	44	1	1
PTAC	0	0	0
PTHP	1	0	0
Program Total	**795**	**35**	**60**

Table 239: Res HVAC Initiative Gross Impact Sample Design for WPP

Stratum	Population Size	Achieved Sample Size (Survey)	Achieved Sample Size (Desk Review)
ASHP	418	10	7
Mini-Split HP	371	6	6
GSHP	48	3	3
CAC	150	9	2
Furnace Fan	755	5	8
Thermostat	1,218	13	18
HVAC Tune-Up	809	1	8
PTAC	0	0	0
PTHP	0	0	0
Program Total	**3,769**	**47**	**52**

K.1.3 Results for Energy

The gross realization rates for energy, along with relative precisions, are shown in Table 240, Table 241, Table 242, and Table 243 for Met-Ed, Penelec, Penn Power, and WPP respectively.

Table 240: Res HVAC Initiative Energy Gross Realization Rates for Met-Ed

Stratum	PYRTD MWh/yr	Energy Realization Rate	CV	Relative Precision at 85% C.L.
ASHP	272	113.9%	0.5	20.4%
Mini-Split HP	239	86.9%	0.5	18.1%
GSHP	75	124.7%	0.5	49.8%
CAC	92	144.6%	0.5	23.7%
Furnace Fan	97	100.0%	0.5	31.8%
Thermostat	62	395.1%	0.5	12.3%
HVAC Tune-Up	20	100.0%	0.5	100.0%
PTAC	0	100.0%	0.5	0.0%
PTHP	0	100.0%	0.5	100.0%
Program Total	**857**	**129.2%**	**0.5**	**9.40%**

Table 241: Res HVAC Initiative Energy Gross Realization Rates for Penelec

Stratum	PYRTD MWh/yr	Energy Realization Rate	CV	Relative Precision at 85% C.L.
ASHP	78	128.6%	0.5	35.2%
Mini-Split HP	411	117.8%	0.5	27.0%
GSHP	25	119.9%	0.5	69.7%
CAC	18	112.9%	0.5	50.3%
Furnace Fan	110	100.0%	0.5	29.0%
Thermostat	37	186.5%	0.5	13.1%
HVAC Tune-Up	50	132.0%	0.5	41.4%
PTAC	0	100.0%	0.5	100.0%
PTHP	0	100.0%	0.5	100.0%
Program Total	**729**	**120.7%**	**0.5**	**16.36%**

Table 242: Res HVAC Initiative Energy Gross Realization Rates for Penn Power

Stratum	PYRTD MWh/yr	Energy Realization Rate	CV	Relative Precision at 85% C.L.
ASHP	73	104.5%	0.5	24.3%
Mini-Split HP	37	84.0%	0.5	30.3%
GSHP	11	121.7%	0.5	43.0%
CAC	8	141.6%	0.5	39.7%
Furnace Fan	130	100.0%	0.5	16.0%
Thermostat	17	280.3%	0.5	14.8%
HVAC Tune-Up	8	208.6%	0.5	71.2%
PTAC	0	100.0%	0.5	100.0%
PTHP	0	100.0%	0.5	100.0%
Program Total	**284**	**114.9%**	**0.5**	**10.13%**

Table 243: Res HVAC Initiative Energy Gross Realization Rates for WPP

Stratum	PYRTD MWh/yr	Energy Realization Rate	CV	Relative Precision at 85% C.L.
ASHP	346	131.1%	0.5	27.0%
Mini-Split HP	309	108.2%	0.5	29.2%
GSHP	76	127.6%	0.5	40.2%
CAC	33	101.7%	0.5	50.6%
Furnace Fan	337	100.0%	0.5	25.3%
Thermostat	73	173.6%	0.5	16.8%
HVAC Tune-Up	139	123.5%	0.5	25.3%
PTAC		100.0%	0.5	0.0%
PTHP	0	100.0%	0.5	100.0%
Program Total	**1,313**	**118.3%**	**0.5**	**12.20%**

K.1.4 Results for Demand

The gross realization rates for demand, along with relative precisions, are shown in Table 244, Table 245, Table 246, and Table 247 for Met-Ed, Penelec, Penn Power, and WPP respectively.

Table 244: Res HVAC Initiative Demand Gross Realization Rates for Met-Ed

Stratum	PYRTD MW/yr	Demand Realization Rate	CV	Relative Precision at 85% C.L.
ASHP	0.07	170.1%	0.5	20.4%
Mini-Split HP	0.10	26.2%	0.5	18.1%
GSHP	0.01	187.9%	0.5	49.8%
CAC	0.07	259.9%	0.5	23.7%
Furnace Fan	0.02	100.0%	0.5	31.8%
Thermostat	0.00	100.0%	0.5	12.3%
HVAC Tune-Up	0.01	100.0%	0.5	100.0%
PTAC	0.00	100.0%	0.5	100.0%
PTHP	0.00	100.0%	0.5	9.4%
Program Total	**0.28**	**135.2%**	**0.5**	**13.92%**

Table 245: Res HVAC Initiative Demand Gross Realization Rates for Penelec

Stratum	PYRTD MW/yr	Demand Realization Rate	CV	Relative Precision at 85% C.L.
ASHP	0.02	220.7%	0.5	35.2%
Mini-Split HP	0.17	8.5%	0.5	27.0%
GSHP	0.00	233.4%	0.5	69.7%
CAC	0.01	252.4%	0.5	50.3%
Furnace Fan	0.03	100.0%	0.5	29.0%
Thermostat	0.00	100.0%	0.5	13.1%
HVAC Tune-Up	0.03	103.6%	0.5	41.4%
PTAC	0.00	100.0%	0.5	100.0%
PTHP	0.00	100.0%	0.5	16.4%
Program Total	**0.26**	**60.9%**	**0.5**	**18.04%**

Table 246: Res HVAC Initiative Gross Realization Rates for Penn Power

Stratum	PYRTD MW/yr	Demand Realization Rate	CV	Relative Precision at 85% C.L.
ASHP	0.02	169.4%	0.5	24.3%
Mini-Split HP	0.01	25.1%	0.5	30.3%
GSHP	0.00	287.9%	0.5	43.0%
CAC	0.01	296.6%	0.5	39.7%
Furnace Fan	0.03	100.0%	0.5	16.0%
Thermostat	0.00	100.0%	0.5	14.8%
HVAC Tune-Up	0.01	116.5%	0.5	71.2%
PTAC	0.00	100.0%	0.5	100.0%
PTHP	0.00	100.0%	0.5	10.1%
Program Total	**0.08**	**121.8%**	**0.5**	**13.15%**

Table 247: Res HVAC Initiative Demand Gross Realization Rates for WPP

Stratum	PYRTD MW/yr	Demand Realization Rate	CV	Relative Precision at 85% C.L.
ASHP	0.08	211.7%	0.5	27.0%
Mini-Split HP	0.12	17.3%	0.5	29.2%
GSHP	0.01	276.3%	0.5	40.2%
CAC	0.03	203.0%	0.5	50.6%
Furnace Fan	0.08	100.0%	0.5	25.3%
Thermostat	0.00	100.0%	0.5	16.8%
HVAC Tune-Up	0.09	88.0%	0.5	25.3%
PTAC	0.00	100.0%	0.5	100.0%
PTHP	0.00	100.0%	0.5	12.2%
Program Total	**0.42**	**105.8%**	**0.5**	**14.24%**

K.2 NET IMPACT EVALUATION

K.2.1 Net Impact Evaluation Methodology

The net-to-gross evaluation for the downstream HVAC measures, conducted in PY8, was based on self-report data from program participants. This followed the self-report methodologies for free-ridership and spillover from the PA Evaluation Framework. Participants were randomly sampled since the savings for these sub-programs are relatively small and do not qualify for the higher level of rigor of high-impact measures. Individual free-ridership and spillover rates from the participant survey were weighted to adjust for sampling differences, non-response, and claimed energy savings to calculate overall estimates.

Overall NTG ratios were slightly lower than those determined in the Phase II evaluation, as customers reported higher levels of free ridership.

K.2.2 Sampling

Tetra Tech sampled randomly from all participants on record in the Companies' tracking and reporting systems in early PY8Q4. The sample designs for the four EDCs are shown in Table 248, Table 249, Table 250, and Table 251 for Met-Ed, Penelec, Penn Power, and WPP respectively (note the population sizes correspond to the current program year, which are similar to PY8 counts, but the achieved sample sizes and response rates are from the PY8 NTG effort).

Table 248: Res HVAC Initiative Net-to-Gross Sampling for Met-Ed

Stratum	Population Size	Achieved Sample Size	Response Rate
All Rebates	2,482	74	26.0%
Program Total	**2,482**	**74**	**26.0%**

Table 249: Res HVAC Initiative Net-to-Gross Sampling for Penelec

Stratum	Population Size	Achieved Sample Size	Response Rate
All Rebates	1,848	72	26.0%
Program Total	**1,848**	**72**	**26.0%**

Table 250: Res HVAC Initiative Net-to-Gross Sampling for Penn Power

Stratum	Population Size	Achieved Sample Size	Response Rate
All Rebates	795	46	29.0%
Program Total	**795**	**46**	**29.0%**

Table 251: Res HVAC Initiative Net-to-Gross Sampling for WPP

Stratum	Population Size	Achieved Sample Size	Response Rate
All Rebates	3,769	74	26.0%
Program Total	**3,769**	**74**	**26.0%**

K.2.3 Net Impact Evaluation Results

The PYTD verified gross energy impacts, free ridership, spillover, net-to-gross ratios, and relative precisions for net-to-gross are shown in Table 252, Table 253, Table 254, and Table 255 for Met-Ed, Penelec, Penn Power, and WPP respectively.

Table 252: Res HVAC Initiative Net-to-Gross Results for Met-Ed

Stratum	PYVTD MWh	Free Ridership (%)	Spillover (%)	NTG Ratio	Relative Precision (@ 85% CL)
All Rebates	1,107	55.0%	0.0%	45.0%	12.6%
Program Total	**1,107**	**55.0%**	**0.0%**	**45.0%**	**12.6%**

Table 253: Res HVAC Initiative Net-to-Gross Results for Penelec

Stratum	PYVTD MWh	Free Ridership (%)	Spillover (%)	NTG Ratio	Relative Precision (@ 85% CL)
All Rebates	881	49.0%	1.0%	52.0%	12.7%
Program Total	**881**	**49.0%**	**1.0%**	**52.0%**	**12.7%**

Table 254 Res HVAC Initiative Net-to-Gross Results for Penn Power

Stratum	PYVTD MWh	Free Ridership (%)	Spillover (%)	NTG Ratio	Relative Precision (@ 85% CL)
All Rebates	326	47.0%	3.0%	56.0%	15.5%
Program Total	**326**	**47.0%**	**3.0%**	**56.0%**	**15.5%**

Table 255 Res HVAC Initiative Net-to-Gross Results for WPP

Stratum	PYVTD MWh	Free Ridership (%)	Spillover (%)	NTG Ratio	Relative Precision (@ 85% CL)
All Rebates	1,554	52.0%	1.0%	49.0%	12.6%
Program Total	**1,554**	**52.0%**	**1.0%**	**49.0%**	**12.6%**

Appendix L Evaluation Detail – Residential Appliances and LI Residential Appliances Initiatives

Residential Appliances and LI Appliances are two separate initiatives in ADM's PY8 evaluation plan. While the program process is the same between the two, the measures and rebate levels differ. Refrigerators, Freezers, Clothes Washers, Clothes Dryers, and Dehumidifiers are rebated under both initiatives, but under the LI Appliance initiative, the rebates are increased by $25. Income eligibility is attested to by the customer on the rebate application by providing "Number of Household Residents" and "Gross Household Income". Heat Pump Water Heaters are rebated under the Residential Appliances initiative, but not under the LI Appliances initiative. Enhanced rebates are available to the Residential Appliance initiative participants for purchasing a CEE Tier 2 or Tier 3 Refrigerator.

Participants are defined as each separate appliance rebated. Additional rebates provided to LI customers are not included in participation counts. Thus, the rebate application, rather than the customer is the sampling unit for gross impact evaluation.

Gross impact evaluation activities are identical for the two initiatives. Separate survey samples were maintained in PY8 to assess whether demographic differences would affect the realization rates for the measures. No significant differences were found, however. The PY8 report discussed the possibility of combining the two groups into the same initiative. We have opted to maintain separate samples for the Res LI appliance rebates. Although it is not required to evaluate this Initiative each year, we opt to maintain a small sample each year to retain the ability to provide timely feedback if evaluation issues arise.

L.1 Gross Impact Evaluation

L.1.1 Gross Impact Evaluation Methodology

Each component of gross impact is described below.

L.1.1.1 Verification Surveys

ADM performed telephone and online surveys on a random sample of customers selected from the tracking and reporting data. Nearly all contacted customers verified that they have purchased and installed the stated appliances. The verification rates are used to inform measure-level realization rates

L.1.1.2 Invoice and Application Review

ADM obtained invoices and applications from the Honeywell. For each application, ADM verified that the manufacturer name and model number in the tracking and reporting system matches those on the invoice and rebate application. In general, all sampled appliances were matched to the qualifying ENERGY STAR® product lists. 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. In such cases,

straightforward manual correction of the make or model numbers results in positive identification of the involved equipment in the supporting databases.

L.1.1.3 Saving Calculations with TRM Algorithms and Parameters

For measures with partially deemed TRM (or IMP) protocols, the T&R system reported impacts with one savings scenario rather than with specific scenarios that occur in measure implementation. For example, values from planning assumptions for capacity and efficiency are used rather than rebate-specific values. 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 project-specific attributes to calculate "On-TRM" impacts.

The average per-unit gross verified impact for a given measure is the product of the measure-specific verification rate as determined from customer surveys, and the average calculated impacts as described above.

The following provide additional details into the calculation review procedure.

Table 256 lists the data sources for gross impact calculation algorithms.

Table 256: Data Sources for the Res Appliances Initiative Gross Impact Evaluation

Measure	TRM Parameter	Data Source
All Measures	Capacity	Invoice and Application Review
Refrigerator, Freezer	Pre-1990	Tracking and Reporting System
Refrigerator, Freezer	Appliance Size / Capacity	Tracking and Reporting System
Refrigerator, Freezer	Configuration/Type	Tracking and Reporting System
Refrigerator	Primary Usage	Participant Surveys
Refrigerator, Freezer	Part Use Factor	Participant Surveys
Refrigerator, Freezer	In Unconditioned Space?	Participant Surveys
Refrigerator, Freezer	CDD and HDD	TRM - Zip Code Lookup
RAC	Capacity	TRM Default
RAC	EER	TRM Default
RAC	RAC EFLH	TRM - Zip Code Lookup
RAC	CF	TRM Default
Dehumidifier	Region (to determine kWh)	TRM - Zip Code Lookup
All Measures	Verification Rate	Participant Surveys

The gross realization rates for energy savings were driven primarily by the reported energy savings in the tracking and reporting system. In general, the reported energy and demand impacts are calculated with conservative assumptions of market-average efficiencies and capacities.

L.1.2 Sampling

Each measure was treated as a separate stratum within the sampling initiative. The sample designs for the four EDCs are shown in Table 257, Table 258, Table 259, and Table 260.

Table 257: Res Appliances Initiative Gross Impact Sample Design for Met-Ed

Stratum	Population Size	Achieved Sample Size (Survey)	Achieved Sample Size (Desk Review)
Heat Pump Water Heater	208	13	8
Clothes Washer	1,568	4	13
Dehumidifier	924	9	7
Refrigerator	1,459	2	8
Clothes Dryer	705	6	5
Freezer	213	2	0
Program Total	**5,077**	**36**	**41**

Table 258: Res Appliances Initiative Gross Impact Sample Design for Penelec

Stratum	Population Size	Achieved Sample Size (Survey)	Achieved Sample Size (Desk Review)
Heat Pump Water Heater	106	7	4
Clothes Washer	1,118	7	9
Dehumidifier	1,725	7	12
Refrigerator	1,258	4	8
Clothes Dryer	395	5	3
Freezer	226	1	0
Program Total	**4,828**	**31**	**36**

Table 259: Res Appliances Initiative Gross Impact Sample Design for Penn Power

Stratum	Population Size	Achieved Sample Size (Survey)	Achieved Sample Size (Desk Review)
Heat Pump Water Heater	20	3	4
Clothes Washer	442	6	16
Dehumidifier	442	6	14
Refrigerator	419	4	10
Clothes Dryer	195	0	11
Freezer	80	0	0
Program Total	**1,598**	**19**	**55**

Table 260: Res Appliances Initiative Gross Impact Sample Design for WPP

Stratum	Population Size	Achieved Sample Size (Survey)	Achieved Sample Size (Desk Review)
Heat Pump Water Heater	143	5	5
Clothes Washer	1,784	4	9
Dehumidifier	1,766	7	14
Refrigerator	1,729	3	8
Clothes Dryer	776	0	6
Freezer	382	0	4
Program Total	**6,580**	**19**	**46**

The sample designs for the Res LI Appliance Initiative are shown in Table 261, Table 262, Table 263, and Table 264.

Table 261: Res LI Appliances Initiative Gross Impact Sample Design for Met-Ed

Stratum	Population Size	Achieved Sample Size (Survey)	Achieved Sample Size (Desk Review)
Clothes Washer	65	0	6
Dehumidifier	13	0	0
Refrigerator	45	0	3
Clothes Dryer	31	0	4
Freezer	8	0	0
Program Total	**162**	**0**	**13**

Table 262: Res LI Appliances Initiative Gross Impact Sample Design for Penelec

Stratum	Population Size	Achieved Sample Size (Survey)	Achieved Sample Size (Desk Review)
Clothes Washer	86	0	4
Dehumidifier	77	0	3
Refrigerator	78	0	5
Clothes Dryer	39	0	1
Freezer	14	0	0
Program Total	**294**	**0**	**13**

Table 263: Res LI Appliances Initiative Gross Impact Sample Design for Penn Power

Stratum	Population Size	Achieved Sample Size (Survey)	Achieved Sample Size (Desk Review)
Clothes Washer	26	0	3
Dehumidifier	13	0	1
Refrigerator	15	0	3
Clothes Dryer	11	0	1
Freezer	5	0	0
Program Total	**70**	**0**	**8**

Table 264: Res LI Appliances Initiative Gross Impact Sample Design for WPP

Stratum	Population Size	Achieved Sample Size (Survey)	Achieved Sample Size (Desk Review)
Clothes Washer	82	0	5
Dehumidifier	48	0	3
Refrigerator	49	0	1
Clothes Dryer	26	0	0
Freezer	9	0	0
Program Total	**214**	**0**	**9**

L.1.3 Results for Energy

The gross realization rates for energy, along with relative precisions, are shown in Table 265, Table 266, Table 267, and Table 268 for Met-Ed, Penelec, Penn Power, and WPP respectively. In general, gross realization rates were far above 100% for both energy and demand. The primary reason for the high realization rates is generally conservative ex ante values for clothes washers (93 kWh per unit) and heat pump water heaters (1,389 kWh per unit).

Table 265: Res Appliances Initiative Energy Gross Realization Rates for Met-Ed

Stratum	PYRTD MWh/yr	Energy Realization Rate	CV	Relative Precision at 85% C.L.
Heat Pump Water Heater	289	132.2%	0.5	25.0%
Clothes Washer	146	131.5%	0.5	19.9%
Dehumidifier	128	84.8%	0.5	27.1%
Refrigerator	97	96.4%	0.5	25.4%
Clothes Dryer	18	108.3%	0.5	32.1%
Freezer	5	100.0%	0.5	100.0%
Program Total	**683**	**117.2%**	**0.5**	**13.7%**

Table 266: Res Appliances Initiative Energy Gross Realization Rates for Penelec

Stratum	PYRTD MWh/yr	Energy Realization Rate	CV	Relative Precision at 85% C.L.
Heat Pump Water Heater	147	142.6%	0.5	35.3%
Clothes Washer	104	152.5%	0.5	23.9%
Dehumidifier	240	103.0%	0.5	20.7%
Refrigerator	85	90.8%	0.5	25.4%
Clothes Dryer	10	113.0%	0.5	41.4%
Freezer	5	100.0%	0.5	100.0%
Program Total	**591**	**120.0%**	**0.5**	**14.1%**

Table 267: Res Appliances Initiative Energy Gross Realization Rates for Penn Power

Stratum	PYRTD MWh/yr	Energy Realization Rate	CV	Relative Precision at 85% C.L.
Heat Pump Water Heater	28	148.6%	0.5	32.2%
Clothes Washer	41	183.1%	0.5	17.7%
Dehumidifier	61	94.0%	0.5	18.9%
Refrigerator	28	95.9%	0.5	22.5%
Clothes Dryer	5	112.8%	0.5	29.8%
Freezer	2	100.0%	0.5	100.0%
Program Total	**165**	**126.3%**	**0.5**	**10.9%**

Table 268: Res Appliances Initiative Energy Gross Realization Rates for WPP

Stratum	PYRTD MWh/yr	Energy Realization Rate	CV	Relative Precision at 85% C.L.
Heat Pump Water Heater	199	146.2%	0.5	31.6%
Clothes Washer	166	149.2%	0.5	23.9%
Dehumidifier	245	111.0%	0.5	19.2%
Refrigerator	117	96.8%	0.5	25.4%
Clothes Dryer	19	113.0%	0.5	41.4%
Freezer	9	205.5%	0.5	50.6%
Program Total	**755**	**127.6%**	**0.5**	**13.0%**

The gross realization rates for energy and relative precisions for the Res LI Appliances Initiative are shown in Table 269, Table 270, Table 271, and Table 272 for Met-Ed, Penelec, Penn Power, and WPP respectively.

Table 269: Res LI Appliances Initiative Energy Gross Realization Rates for Met-Ed

Stratum	PYRTD MWh/yr	Energy Realization Rate	CV	Relative Precision at 85% C.L.
Clothes Washer	6	119.0%	0.5	39.6%
Dehumidifier	2	100.0%	0.5	100.0%
Refrigerator	3	70.5%	0.5	56.8%
Clothes Dryer	1	241.5%	0.5	47.5%
Freezer	0	100.0%	0.5	100.0%
Program Total	**12**	**111.9%**	**0.5**	**28.2%**

Table 270: Res LI Appliances Initiative Energy Gross Realization Rates for Penelec

Stratum	PYRTD MWh/yr	Energy Realization Rate	CV	Relative Precision at 85% C.L.
Clothes Washer	8	161.3%	0.5	49.7%
Dehumidifier	11	81.3%	0.5	57.6%
Refrigerator	5	112.1%	0.5	44.1%
Clothes Dryer	1	109.5%	0.5	100.0%
Freezer	0	100.0%	0.5	100.0%
Program Total	**25**	**115.0%**	**0.5**	**30.1%**

Table 271: Res LI Appliances Initiative Energy Gross Realization Rates for Penn Power

Stratum	PYRTD MWh/yr	Energy Realization Rate	CV	Relative Precision at 85% C.L.
Clothes Washer	3	207.8%	0.5	55.3%
Dehumidifier	2	131.7%	0.5	97.8%
Refrigerator	1	98.9%	0.5	52.6%
Clothes Dryer	0	114.7%	0.5	97.1%
Freezer	0	100.0%	0.5	100.0%
Program Total	**6**	**158.3%**	**0.5**	**41.8%**

Table 272: Res LI Appliances Initiative Energy Gross Realization Rates for WPP

Stratum	PYRTD MWh/yr	Energy Realization Rate	CV	Relative Precision at 85% C.L.
Clothes Washer	8	183.7%	0.5	44.1%
Dehumidifier	7	97.6%	0.5	56.9%
Refrigerator	3	99.2%	0.5	100.0%
Clothes Dryer	1	100.0%	0.5	100.0%
Freezer	0	100.0%	0.5	100.0%
Program Total	**19**	**134.7%**	**0.5**	**32.3%**

L.1.4 Results for Demand

The gross realization rates for demand, along with relative precisions, are shown in Table 273, Table 274, Table 275, and Table 276 for Met-Ed, Penelec, Penn Power, and WPP respectively.

Table 273: Res Appliances Initiative Demand Gross Realization Rates for Met-Ed

Stratum	PYRTD MW/yr	Demand Realization Rate	CV	Relative Precision at 85% C.L.
Heat Pump Water Heater	0.02	152.3%	0.5	25.0%
Clothes Washer	0.02	136.4%	0.5	19.9%
Dehumidifier	0.03	83.6%	0.5	27.1%
Refrigerator	0.01	87.7%	0.5	25.4%
Clothes Dryer	0.00	95.8%	0.5	32.1%
Freezer	0.00	100.0%	0.5	100.0%
Program Total	**0.08**	**111.0%**	**0.5**	**12.6%**

Table 274: Res Appliances Initiative Demand Gross Realization Rates for Penelec

Stratum	PYRTD MW/yr	Demand Realization Rate	CV	Relative Precision at 85% C.L.
Heat Pump Water Heater	0.01	164.3%	0.5	35.3%
Clothes Washer	0.01	158.2%	0.5	23.9%
Dehumidifier	0.06	101.5%	0.5	20.7%
Refrigerator	0.01	82.6%	0.5	25.4%
Clothes Dryer	0.00	99.9%	0.5	41.4%
Freezer	0.00	100.0%	0.5	100.0%
Program Total	**0.09**	**112.9%**	**0.5**	**13.9%**

Table 275: Res Appliances Initiative Gross Realization Rates for Penn Power

Stratum	PYRTD MW/yr	Demand Realization Rate	CV	Relative Precision at 85% C.L.
Heat Pump Water Heater	0.00	171.2%	0.5	32.2%
Clothes Washer	0.00	190.0%	0.5	17.7%
Dehumidifier	0.02	92.7%	0.5	18.9%
Refrigerator	0.00	87.2%	0.5	22.5%
Clothes Dryer	0.00	99.8%	0.5	29.8%
Freezer	0.00	100.0%	0.5	100.0%
Program Total	**0.03**	**114.2%**	**0.5**	**11.1%**

Table 276: Res Appliances Initiative Demand Gross Realization Rates for WPP

Stratum	PYRTD MW/yr	Demand Realization Rate	CV	Relative Precision at 85% C.L.
Heat Pump Water Heater	0.01	168.4%	0.5	31.6%
Clothes Washer	0.02	154.8%	0.5	23.9%
Dehumidifier	0.06	109.4%	0.5	19.2%
Refrigerator	0.01	88.0%	0.5	25.4%
Clothes Dryer	0.00	99.9%	0.5	41.4%
Freezer	0.00	176.3%	0.5	50.6%
Program Total	**0.11**	**121.4%**	**0.5**	**12.2%**

The gross realization rates for demand and relative precisions for the Res LI Appliances Initiative are shown in Table 273, Table 274, Table 275, and Table 276 for Met-Ed, Penelec, Penn Power, and WPP respectively.

Table 277: Res LI Appliances Initiative Demand Gross Realization Rates for Met-Ed

Stratum	PYRTD MW/yr	Demand Realization Rate	CV	Relative Precision at 85% C.L.
Clothes Washer	0.00	119.9%	0.5	39.6%
Dehumidifier	0.00	100.0%	0.5	100.0%
Refrigerator	0.00	64.1%	0.5	56.8%
Clothes Dryer	0.00	168.7%	0.5	47.5%
Freezer	0.00	100.0%	0.5	100.0%
Program Total	**0.00**	**106.8%**	**0.5**	**32.7%**

Table 278: Res LI Appliances Initiative Demand Gross Realization Rates for Penelec

Stratum	PYRTD MW/yr	Demand Realization Rate	CV	Relative Precision at 85% C.L.
Clothes Washer	0.00	158.6%	0.5	49.7%
Dehumidifier	0.00	80.1%	0.5	57.6%
Refrigerator	0.00	102.0%	0.5	44.1%
Clothes Dryer	0.00	100.9%	0.5	100.0%
Freezer	0.00	100.0%	0.5	100.0%
Program Total	**0.00**	**100.7%**	**0.5**	**32.9%**

Table 279: Res LI Appliances Initiative Gross Realization Rates for Penn Power

Stratum	PYRTD MW/yr	Demand Realization Rate	CV	Relative Precision at 85% C.L.
Clothes Washer	0.00	204.4%	0.5	55.3%
Dehumidifier	0.00	129.7%	0.5	97.8%
Refrigerator	0.00	89.9%	0.5	52.6%
Clothes Dryer	0.00	105.7%	0.5	97.1%
Freezer	0.00	100.0%	0.5	100.0%
Program Total	**0.00**	**145.7%**	**0.5**	**49.2%**

Table 280: Res LI Appliances Initiative Demand Gross Realization Rates for WPP

Stratum	PYRTD MW/yr	Demand Realization Rate	CV	Relative Precision at 85% C.L.
Clothes Washer	0.00	180.7%	0.5	44.1%
Dehumidifier	0.00	96.2%	0.5	56.9%
Refrigerator	0.00	90.2%	0.5	100.0%
Clothes Dryer	0.00	100.0%	0.5	100.0%
Freezer	0.00	100.0%	0.5	100.0%
Program Total	**0.00**	**120.0%**	**0.5**	**32.7%**

L.2 NET IMPACT EVALUATION

L.2.1 Net Impact Evaluation Methodology

The net-to-gross evaluation for the downstream Appliances measures was based on self-report data from program participants. This followed the self-report methodologies for free-ridership and spillover from the PA Evaluation Framework. Participants were randomly sampled since the savings for these sub-programs are relatively small and do not qualify for the higher level of rigor of high-impact measures. Individual free-ridership and spillover rates from the participant survey were weighted to adjust for sampling differences, non-response, and claimed energy savings to calculate overall estimates.

Overall NTG ratios were slightly lower than those found in the Phase II evaluation, as customers reported lower amounts of spillover. A net impact evaluation was not conducted for the Low-Income Appliances Initiative. An NTG ratio of 100% is used for reporting of net impacts and for cost effectiveness testing for the Low-Income Appliances Initiative.

L.2.2 Sampling

Tetra Tech sampled randomly from all participants on record in the Companies' tracking and reporting systems in early PY8Q4. The sample designs for the four EDCs are shown in Table 281, Table 282, Table 283, and Table 284 for Met-Ed, Penelec, Penn Power, and WPP. Note that the tables show PY9 population counts but PY8 achieved sample sizes, but the participant counts are comparable between the two program years, and both are large compared to the sample sizes.

Table 281: Res Appliances Initiative Net-to-Gross Sampling for Met-Ed

Stratum	Population Size	Achieved Sample Size	Response Rate
All Rebates	5,077	76	27.0%
Program Total	**5,077**	**76**	**27.0%**

Table 282: Res Appliances Initiative Net-to-Gross Sampling for Penelec

Stratum	Population Size	Achieved Sample Size	Response Rate
All Rebates	4,828	72	26.0%
Program Total	**4,828**	**72**	**26.0%**

Table 283: Res Appliances Initiative Net-to-Gross Sampling for Penn Power

Stratum	Population Size	Achieved Sample Size	Response Rate
All Rebates	1,598	71	25.0%
Program Total	**1,598**	**71**	**25.0%**

Table 284: Res Appliances Initiative Net-to-Gross Sampling for WPP

Stratum	Population Size	Achieved Sample Size	Response Rate
All Rebates	6,580	72	26.0%
Program Total	**6,580**	**72**	**26.0%**

L.2.3 Net Impact Evaluation Results

The PYTD verified gross energy impacts, free ridership, spillover, net-to-gross ratios, and relative precisions for net-to-gross are shown in Table 285, Table 286, Table 287, and Table 288 for Met-Ed, Penelec, Penn Power, and WPP. In PY8, the free ridership rates tended to be approximately 10% higher than those obtained from the previous NTG study in PY6.

Table 285: Res Appliances Initiative Net-to-Gross Results for Met-Ed

Stratum	PYVTD MWh	Free Ridership (%)	Spillover (%)	NTG Ratio	Relative Precision (@ 85% CL)
All Rebates	800	52.0%	4.0%	52.0%	12.4%
Program Total	**800**	**52.0%**	**4.0%**	**52.0%**	**12.4%**

Table 286: Res Appliances Initiative Net-to-Gross Results for Penelec

Stratum	PYVTD MWh	Free Ridership (%)	Spillover (%)	NTG Ratio	Relative Precision (@ 85% CL)
All Rebates	709	53.0%	1.0%	48.0%	12.7%
Program Total	**709**	**53.0%**	**1.0%**	**48.0%**	**12.7%**

Table 287 Res Appliances Initiative Net-to-Gross Results for Penn Power

Stratum	PYVTD MWh	Free Ridership (%)	Spillover (%)	NTG Ratio	Relative Precision (@ 85% CL)
All Rebates	209	56.0%	3.0%	47.0%	12.8%
Program Total	**209**	**56.0%**	**3.0%**	**47.0%**	**12.8%**

Table 288 Res Appliances Initiative Net-to-Gross Results for WPP

Stratum	PYVTD MWh	Free Ridership (%)	Spillover (%)	NTG Ratio	Relative Precision (@ 85% CL)
All Rebates	963	50.0%	0.0%	50.0%	12.7%
Program Total	**963**	**50.0%**	**0.0%**	**50.0%**	**12.7%**

Appendix M Evaluation Detail – Low-Income Residential Appliance Turn-In Initiative

M.1 Gross Impact Evaluation

Gross impact evaluation for the Low-Income Appliance Turn-In (LI ATI) Initiative included customer verification surveys and TRM calculations of measure-level impacts. There are four distinct measures offered by the program: refrigerator recycling, freezer recycling, room AC (RAC) recycling, and dehumidifier recycling.

M.1.1 Gross Impact Evaluation Methodology

ADM's gross impact evaluation methodology was identical for all four EDCs. A TRM-based calculation was performed for each entry in the tracking and reporting system. The parameter values from the TRM (or for dehumidifiers, IMP) algorithms were taken from project-specific data from the tracking and reporting system when applicable, from TRM defaults, or from customer verification surveys. For refrigerators and freezers, measure attributes that participants would readily recall were determined from participant surveys, and the average parameter values were applied to all measures. Apart from measure verification, these attributes include the part-use factor, the location in the home where the appliance was used, and for refrigerators, whether the appliance was a primary or secondary unit. Technical attributes of the appliances, such as the age, capacity, and configuration, as collected by ARCA, were taken from program tracking and reporting data. TRM or IMP default parameters were used tor room air conditioners (RACs) and dehumidifiers. Table 289 lists the data sources for gross impact calculation algorithms.

Table 289: Data Sources for the LI ATI Initiative Gross Impact Evaluation

Measure	TRM Parameter	Data Source
Refrigerator, Freezer	Appliance Age	Tracking and Reporting System
Refrigerator, Freezer	Pre-1990	Tracking and Reporting System
Refrigerator, Freezer	Appliance Size / Capacity	Tracking and Reporting System
Refrigerator, Freezer	Configuration/Type	Tracking and Reporting System
Refrigerator	Primary Usage	Participant Surveys
Refrigerator, Freezer	Part Use Factor	Participant Surveys
Refrigerator, Freezer	In Unconditioned Space?	Participant Surveys
Refrigerator, Freezer	CDD and HDD	TRM - Zip Code Lookup
RAC	Capacity	TRM Default
RAC	EER	TRM Default
RAC	RAC EFLH	TRM - Zip Code Lookup
RAC	CF	TRM Default
Dehumidifier	Capacity	IMP Default
Dehumidifier	Region (to determine kWh)	TRM - Zip Code Lookup
All Measures	Verification Rate	Participant Surveys

The gross realization rates for energy savings were driven primarily by part-use factors for refrigerators and freezers as determined through verification surveys, and by the unit energy consumptions for refrigerators and freezers, as determined through measure attributes recorded in the tracking and reporting system. Although verification rates determined through surveys were approximately 100%, the realization rates are generally lower than 100% because the part-use factors are lower than the TRM default values, and the calculated unit energy consumptions were lower than what would expect from application of default parameters in the TRM.

M.1.2 Sampling

Each measure was treated as a separate stratum within the sampling initiative. The sample designs for the four EDCs are shown in Table 290, Table 291, Table 292, and Table 293. The population sizes and sample sizes represent individual appliances rather than individual customers. Most surveys were conducted online, with telephone surveys employed to meet sample quotas if only a few more sample points were needed.

Table 290: LI ATI Initiative Gross Impact Sample Design for Met-Ed

Stratum	Population Size	Achieved Sample Size	Evaluation Activity
Refrigerators	575	31	Survey (phone + online)
Freezers	151	12	
Dehumidifiers	28	1	
RACs	97	10	
Program Total	**851**	**54**	

Table 291: LI ATI Initiative Gross Impact Sample Design for Penelec

Stratum	Population Size	Achieved Sample Size	Evaluation Activity
Refrigerators	722	36	Survey (phone + online)
Freezers	132	24	
Dehumidifiers	37	7	
RACs	86	4	
Program Total	**977**	**71**	

Table 292: LI ATI Initiative Gross Impact Sample Design for Penn Power

Stratum	Population Size	Achieved Sample Size	Evaluation Activity
Refrigerators	225	29	Survey (phone + online)
Freezers	36	2	
Dehumidifiers	15	4	
RACs	22	4	
Program Total	**298**	**39**	

Table 293: LI ATI Initiative Gross Impact Sample Design for WPP

Stratum	Population Size	Achieved Sample Size	Evaluation Activity
Refrigerators	647	41	Survey (phone + online)
Freezers	142	12	
Dehumidifiers	27	4	
RACs	74	13	
Program Total	**890**	**70**	

M.1.3 Results for Energy

The gross realization rates for energy, along with relative precisions, are shown in Table 294, Table 295, Table 296, and Table 297 for Met-Ed, Penelec, Penn Power, and WPP respectively.

Table 294: LI ATI Initiative Energy Gross Realization Rates for Met-Ed

Stratum	PYRTD MWh/yr	Energy Realization Rate	CV	Relative Precision at 85% C.L.
Refrigerators	543	81.3%	0.5	12.9%
Freezers	125	85.9%	0.5	20.8%
Dehumidifiers	7	176.4%	0.5	72.0%
RACs	11	124.3%	0.5	22.8%
Program Total	**686**	**83.8%**	**0.5**	**9.0%**

Table 295: LI ATI Initiative Energy Gross Realization Rates for Penelec

Stratum	PYRTD MWh/yr	Energy Realization Rate	CV	Relative Precision at 85% C.L.
Refrigerators	765	94.6%	0.5	12.0%
Freezers	111	63.4%	0.5	14.7%
Dehumidifiers	9	310.4%	0.5	27.2%
RACs	10	78.5%	0.5	36.0%
Program Total	**895**	**92.8%**	**0.5**	**9.8%**

Table 296: LI ATI Initiative Energy Gross Realization Rates for Penn Power

Stratum	PYRTD MWh/yr	Energy Realization Rate	CV	Relative Precision at 85% C.L.
Refrigerators	243	84.2%	0.5	13.4%
Freezers	31	66.8%	0.5	50.9%
Dehumidifiers	4	63.1%	0.5	36.0%
RACs	3	50.3%	0.5	36.0%
Program Total	**281**	**81.7%**	**0.5**	**10.5%**

Table 297: LI ATI Initiative Energy Gross Realization Rates for WPP

Stratum	PYRTD MWh/yr	Energy Realization Rate	CV	Relative Precision at 85% C.L.
Refrigerators	663	94.8%	0.5	11.2%
Freezers	122	77.4%	0.5	20.8%
Dehumidifiers	7	317.6%	0.5	36.0%
RACs	8	68.3%	0.5	20.0%
Program Total	**801**	**93.7%**	**0.5**	**9.2%**

M.1.4 Results for Demand

The gross realization rates for demand, along with relative precisions, are shown in Table 298, Table 299, Table 300, and Table 301 for Met-Ed, Penelec, Penn Power, and WPP respectively.

Table 298: LI ATI Initiative Demand Gross Realization Rates for Met-Ed

Stratum	PYRTD MW/yr	Demand Realization Rate	CV	Relative Precision at 85% C.L.
Refrigerators	0.06	81.3%	0.5	12.9%
Freezers	0.01	86.0%	0.5	20.8%
Dehumidifiers	0.00	90.8%	0.5	72.0%
RACs	0.03	100.0%	0.5	22.8%
Program Total	**0.10**	**86.8%**	**0.5**	**8.9%**

Table 299: LI ATI Initiative Demand Gross Realization Rates for Penelec

Stratum	PYRTD MW/yr	Demand Realization Rate	CV	Relative Precision at 85% C.L.
Refrigerators	0.09	94.6%	0.5	12.0%
Freezers	0.01	63.4%	0.5	14.7%
Dehumidifiers	0.00	181.7%	0.5	27.2%
RACs	0.02	80.0%	0.5	36.0%
Program Total	**0.12**	**91.4%**	**0.5**	**9.6%**

Table 300: LI ATI Initiative Gross Realization Rates for Penn Power

Stratum	PYRTD MW/yr	Demand Realization Rate	CV	Relative Precision at 85% C.L.
Refrigerators	0.03	84.2%	0.5	13.4%
Freezers	0.00	66.8%	0.5	50.9%
Dehumidifiers	0.00	36.3%	0.5	36.0%
RACs	0.01	50.0%	0.5	36.0%
Program Total	**0.04**	**75.5%**	**0.5**	**9.1%**

Table 301: LI ATI Initiative Demand Gross Realization Rates for WPP

Stratum	PYRTD MW/yr	Demand Realization Rate	CV	Relative Precision at 85% C.L.
Refrigerators	0.07	94.8%	0.5	11.2%
Freezers	0.01	77.4%	0.5	20.8%
Dehumidifiers	0.00	181.7%	0.5	36.0%
RACs	0.02	66.7%	0.5	20.0%
Program Total	**0.11**	**89.8%**	**0.5**	**8.0%**

M.2 NET IMPACT EVALUATION

M.2.1 Net Impact Evaluation Methodology

A net impact evaluation is not planned for the Low-Income ATI initiative. An NTG ratio of 100% is used for calculation of portfolio-level net verified impacts and for net-level TRC calculations.

Appendix N – Residential Low-Income Direct Install Initiative

The Low-Income direct install initiative is comprised of the WARM program. The WARM program has three subprograms: WARM – Plus, WARM – Extra Measure, and WARM Multifamily. Each subprogram is implemented by FirstEnergy. Each sub program offers similar measures to its participants.

Participants are defined as the number of unique project numbers in the program. In PY8, project numbers have a one-to-one correspondence with account numbers for this program. Participants can receive numerous measures installed over the course of the program year. Participants must have a gross household income at or below 150% of the 2017 Federal Poverty Guideline.

To join this program, new participants must submit their most recent Household Income Tax Return and pay stubs for the last 30 days to FirstEnergy to verify their income. FirstEnergy also maintains a list of known Low-Income customers to verify customer's income.

N.1 Gross Impact Evaluation

N.1.1 Gross Impact Evaluation Methodology

Gross impact evaluation for the LI DI Initiative involved using TRM calculations for measures installed throughout the program. Unique measure calculations were performed in accordance with the 2016 PA TRM for each measure type. The impact evaluation process is described below.

N.1.1.1 Determination of In-Service Rates

In-service rates are calculated by using QA/QC forms created by a third-party inspector. Inspectors verified measure installations during a site visit after the project was completed. The verified installed quantities were compared to reported quantities to develop the in-service rates.

In PY8, ADM performed ride along site visits with three different QA/QC contractors to ensure that the contractors were performing the QA/QC visit properly. It was found that the QA/QC contractors were indeed looking for the right measures and measure quantities. ADM verified the same quantity of measures as the QA/QC contractors. ADM continues to rely on QA/QC contractors' inspections to determine in-service rates for measures.

In-service rates were used in all savings calculations except air sealing and attic insulation measures.

N.1.1.2 TRM Calculations

For lighting measures, the efficient wattage ranges and bulb type are stated in equipment name columns of the customer tracking data. ADM used data from the upstream lighting program to determine average baseline watts and average energy efficient watts for each unique equipment name. The hours of use are assumed to be the TRM default of 3 hours because the

bulb installation location is not known. TRM defaults were used for other portions of the calculation.

TRM defaults were used for the LED Nights Lights.

For refrigerator and freezer measures, each installation was assigned a category number using the equipment name and equipment description fields in the customer tracking data. If the name and description fields contradicted each other, the description field was used because the description column is more accurate and detailed. The implementer stated that the newly installed appliances are required to have the same size and configuration as the replaced appliance. Portions of the recycling part of the savings calculation come from the appliance turn-in program, other portions come from the determined category number. All appliances were assumed to be primary use. The default part use factors were used in the calculation.

For domestic hot water measures, first the water heater type was verified. The housing type identified in the customer tracking data is used in showerhead and aerator measure savings calculations. The percentage of residences with a clothes washer stated in the 2014 SWE PA residential baseline study is used in the water heater temperature setback measure calculation. The heat pump water heater measure calculation uses the efficient energy factor rating and volume stated in the customer tracking data or found in the supporting documentation. TRM defaults are assumed when specific values are not known or found. The PA 2016 TRM does not have a measure for electric resistance water heaters, therefore this type of measure saves zero energy.

Billing analysis was used to verify heating and cooling equipment types for accounts which received attic insulation. Once the heating and cooling equipment type was verified, the attic insulation savings calculation was completed. Insulation area, Rbase, Ree were provided in the project documentation. The HDDs, CDDs, and EFLHcool were found using the zip code lookup table to the projects reference city.

Residential air sealing measures used CFM50post and CFM50pre values found in the project audit forms. The heating equipment type was found in the customer tracking data and the cooling equipment type was in project audit forms.

The default savings values were used for the smart strip plug outlets. All smart strips were assumed tier 1 smart strips. The equip name or description columns were used to find the quantity of the plugs on the smart strips. Projects which have multiple smart strips installed were assigned the savings values for the “Unspecified use or multiple purchased” smart strips. The description column indicates if the smart strip was installed on an entertainment center. Descriptions which included phrases such as “TV”, “Living room”, or “entertain” were considered entertainment center installations.

Room air conditioner measures were evaluated using section 2.2.4 of the 2016 PA TRM. The capacity of the RAC is given the measures equipment name. All RACs were assumed to have louvered sides. The CEERbase and CEERee were found using the louvered sided assumption. The hour of use for room air conditioners were found using the zip code lookup table in the TRM.

Duct sealing measures were not evaluated because no supporting documentation was given to support the saving calculations. This did not adversely affect the program realization rates because there were very few duct sealing jobs[17].

N.1.1.3 Billing Based Verification of Electric Space Heat

The customer tracking data often times misreported the heating and cooling equipment type for a given address which received attic insulation. To verify the heating and cooling equipment type, a billing analysis was performed on a sample of homes which received attic insulation measures. It was found that in many situations an address tracked as non-electric heat had an inoperable non-electric central furnace as the primary heat source and therefore uses electric resistance heaters to heat the residence. The billing analysis uses monthly billing data, actual weather data, house size, and energy intensity (btu/sqft for heating and tons/sqft for cooling) assumptions to predict the heating and cooling type. Once the heating and cooling equipment types are confirmed, insulation savings calculations were made. Attic insulation savings realization rates were developed and applied to the attic insulation measure population.

N.1.2 Sampling

The sampling strategy for gross impact evaluation is summarized in Table 302, Table 303, Table 304, and Table 305 for Met-Ed, Penelec, Penn Power, and WPP respectively.

Table 302: LI DI Initiative Gross Impact Sample Design for Met-Ed

Stratum	MWh Threshold	Population Size	Achieved Sample Size	Evaluation Activity
High Savings	1,830	257	16	TRM Analysis with On-Site Verification
Medium Savings	1,005	502	25	
Low Savings	0	1,522	28	
Program Total		**2,281**	**69**	

Table 303: LI DI Initiative Gross Impact Sample Design for Penelec

Stratum	MWh Threshold	Population Size	Achieved Sample Size	Evaluation Activity
High Savings	1,380	469	13	Survey (phone + online)
Medium Savings	840	782	16	
Low Savings	0	2,180	17	
Program Total		**3,431**	**46**	

[17] There are other measures with sparse implementation that are also not credited savings. One example is the installation of a clothes line. Although it is expected that this measure can reduce energy usage associated with clothes drying, it is difficult to quantify impacts to the level of certainty that would warrant a TRM addition or interim measure protocol.

Table 304: LI DI Initiative Gross Impact Sample Design for Penn Power

Stratum	MWh Threshold	Population Size	Achieved Sample Size	Evaluation Activity
High Savings	1,375	160	16	Survey (phone + online)
Medium Savings	870	275	15	
Low Savings	0	803	21	
Program Total		**1,238**	**52**	

Table 305: LI DI Initiative Gross Impact Sample Design for WPP

Stratum	MWh Threshold	Population Size	Achieved Sample Size	Evaluation Activity
High Savings	1,650	270	13	Survey (phone + online)
Medium Savings	980	499	15	
Low Savings	0	1,398	18	
Program Total		**2,167**	**46**	

N.1.3 Results for Energy

The gross realization rates for energy, along with relative precisions, are shown in Table 306, Table 307, Table 308, and Table 309 for Met-Ed, Penelec, Penn Power, and WPP respectively.

Table 306: LI DI Initiative Energy Gross Realization Rates for Met-Ed

Stratum	MWh Threshold	PYRTD MWh/yr	Energy Realization Rate	CV	Relative Precision at 85% C.L.
High Savings	1,830	648	82.2%	0.5	17%
Medium Savings	1,005	674	91.4%	0.5	14%
Low Savings	0	657	100.3%	0.5	13%
Program Total		**1,979**	**91.3%**	**0.5**	**8.6%**

Table 307: LI DI Initiative Energy Gross Realization Rates for Penelec

Stratum	MWh Threshold	PYRTD MWh/yr	Energy Realization Rate	CV	Relative Precision at 85% C.L.
High Savings	1,380	885	93.7%	0.5	20%
Medium Savings	840	860	95.9%	0.5	18%
Low Savings	0	871	106.3%	0.5	17%
Program Total		**2,616**	**98.6%**	**0.5**	**10.6%**

Table 308: LI DI Initiative Energy Gross Realization Rates for Penn Power

Stratum	MWh Threshold	PYRTD MWh/yr	Energy Realization Rate	CV	Relative Precision at 85% C.L.
High Savings	1,375	302	108.6%	0.5	17%
Medium Savings	870	316	94.6%	0.5	18%
Low Savings	0	311	104.4%	0.5	16%
Program Total		**929**	**102.4%**	**0.5**	**9.7%**

Table 309: Res DI Initiative Energy Gross Realization Rates for WPP

Stratum	MWh Threshold	PYRTD MWh/yr	Energy Realization Rate	CV	Relative Precision at 85% C.L.
High Savings	1,650	622	97.5%	0.5	19%
Medium Savings	980	650	100.1%	0.5	18%
Low Savings	0	649	109.5%	0.5	17%
Program Total		**1,921**	**102.4%**	**0.5**	**10.5%**

N.1.4 Results for Demand

The gross realization rates for demand, along with relative precisions, are shown Table 310, Table 311, Table 312, and Table 313 for Met-Ed, Penelec, Penn Power, and WPP respectively.

Table 310: LI DI Initiative Demand Gross Realization Rates for Met-Ed

Stratum	MWh Threshold	PYRTD MW/yr	Demand Realization Rate	CV	Relative Precision at 85% C.L.
High Savings	1,830	0.06	89.9%	0.5	17%
Medium Savings	1,005	0.07	93.0%	0.5	14%
Low Savings	0	0.07	100.3%	0.5	13%
Program Total		**0.20**	**94.8%**	**0.5**	**8.5%**

Table 311: LI DI Initiative Demand Gross Realization Rates for Penelec

Stratum	MWh Threshold	PYRTD MW/yr	Demand Realization Rate	CV	Relative Precision at 85% C.L.
High Savings	1,380	0.09	94.0%	0.5	20%
Medium Savings	840	0.09	93.8%	0.5	18%
Low Savings	0	0.08	106.2%	0.5	17%
Program Total		**0.25**	**97.8%**	**0.5**	**10.6%**

Table 312: LI DI Initiative Gross Realization Rates for Penn Power

Stratum	MWh Threshold	PYRTD MW/yr	Demand Realization Rate	CV	Relative Precision at 85% C.L.
High Savings	1,375	0.03	95.3%	0.5	17%
Medium Savings	870	0.03	95.2%	0.5	18%
Low Savings	0	0.03	109.4%	0.5	16%
Program Total		**0.10**	**99.9%**	**0.5**	**9.8%**

Table 313: LI DI Initiative Demand Gross Realization Rates for WPP

Stratum	MWh Threshold	PYRTD MW/yr	Demand Realization Rate	CV	Relative Precision at 85% C.L.
High Savings	1,650	0.07	98.6%	0.5	19%
Medium Savings	980	0.07	98.9%	0.5	18%
Low Savings	0	0.07	109.1%	0.5	17%
Program Total		**0.21**	**102.3%**	**0.5**	**10.5%**

N.2 Net Impact Evaluation

N.2.1 Net Impact Evaluation Methodology

An independent net impact evaluation was not conducted for this initiative.

Appendix O Evaluation Detail – LI EE Kits Initiative

O.1 Gross Impact Evaluation

The Low-Income EE Kits initiative has two sub-components. Low-income EE Kits, administered by PowerDirect, and the Low-Income School Education program, administered by (AMCG). Both program components are similar to their non-income-qualified counterparts described in Appendix E . Other than minor differences in kit contents, the low-income EE Kit program components differ from the general EE Kit program components in the way customers are targeted and enrolled. The Low-Income EE Kit program from PowerDirect targets customers that are income qualified in the Companies' customer information systems databases. The Low-Income Schools program targets schools in low-income areas.

O.1.1 Gross Impact Evaluation Methodology

ADM's gross impact evaluation methodology was identical to the process described for EE Kits in Appendix E. As with other residential surveys for gross impact evaluation, ADM prioritized online surveys and used telephone surveys to achieve sample quotas in cases where a few phone calls could avoid the launch of a new wave of online surveys.

O.1.2 Sampling

Each kit type was treated as a separate stratum within the sampling initiative. The sample designs for the four EDCs are shown in Table 314, Table 315, Table 316, and Table 317.

Table 314: LI EE Kits Initiative Gross Impact Sample Design for Met-Ed

Stratum	Population Size	Achieved Sample Size	Evaluation Activity
LI EE Kits - Electric	3,947	27	Survey (phone + online)
LI EE Kits - Standard	6,510	14	
LI School Education Kits	788	47	
Program Total	**11,245**	**88**	

Table 315: LI EE Kits Initiative Gross Impact Sample Design for Penelec

Stratum	Population Size	Achieved Sample Size	Evaluation Activity
LI EE Kits - Electric	3,802	15	Survey (phone + online)
LI EE Kits - Standard	6,269	20	
LI School Education Kits	0	0	
Program Total	**10,071**	**35**	

Table 316: LI EE Kits Initiative Gross Impact Sample Design for Penn Power

Stratum	Population Size	Achieved Sample Size	Evaluation Activity
LI EE Kits - Electric	1,060	16	Survey (phone + online)
LI EE Kits - Standard	1,765	19	
LI School Education Kits	291	8	
Program Total	**3,116**	**43**	

Table 317: LI EE Kits Initiative Gross Impact Sample Design for WPP

Stratum	Population Size	Achieved Sample Size	Evaluation Activity
LI EE Kits - Electric	3,264	12	Survey (phone + online)
LI EE Kits - Standard	5,323	26	
LI School Education Kits	623	35	
Program Total	**9,210**	**73**	

O.1.3 Determination of Low-Income Eligibility

The low-income EE Kits program component targets customers that are designated as income-qualified customers. The two programs, however, have different methods of identifying low-income customers. The Low-Income EE Kits are delivered to customers that are known to be low-income qualified in the Companies' customer information systems databases. Customers may be identified as low-income due to past or present participation in income-qualified programs offered by the Companies. Such programs include the Act 129 WARM programs, the Low-Income Home Energy Assistance Program, and Pennsylvania Customer Assistance Program. The School Education program component focuses on students in participating school within the Companies' service territories. Participation in the School Education program does not require the disclosure of account numbers. It is therefore not possible to match customers to Low-Income status "SAP tags" in the customer information systems databases. As a result, the program implementer assigned all students in schools that are known to be in low-income areas to the low-income program component, and all other students to the non-low-income component.

ADM included an income battery at the end of verification surveys for most residential measures. Survey results for the EE Kits and LI EE Kits are shown in Figure 28 below. According to the figure, the process of using income status SAP tags from the Companies' customer information system databases appears to separate low-income and non-low-income customers. There are a number of reasons to expect the first bin to lower than 100% for the low-income kits. For example, household income and the number of persons per household can change over time, and this may cause some shifting of customers both in and out of the income qualified group. Furthermore, we have noted lower response rates in low-income customers. Therefore, the survey may have overrepresented customers in the upper range of the qualified incomes. The SAP tag method of identifying low-income customers appears to result in a relatively pure set of income-qualified customers. However, it is noteworthy to consider the efficiency of identifying low-income customers. For example, the number of non-LI EE Kits is approximately five-fold larger than the number of LI EE kits. Therefore, the first histogram bin for the non-LI EE kits represents almost as many actual customers as the first bin for the LI EE

kits. This suggests that the low-income benefits are actually greater than reported by the Companies, and an ex-post rather than ex-ante reporting methodology may help to increase the efficiency of identifying low-income customers.

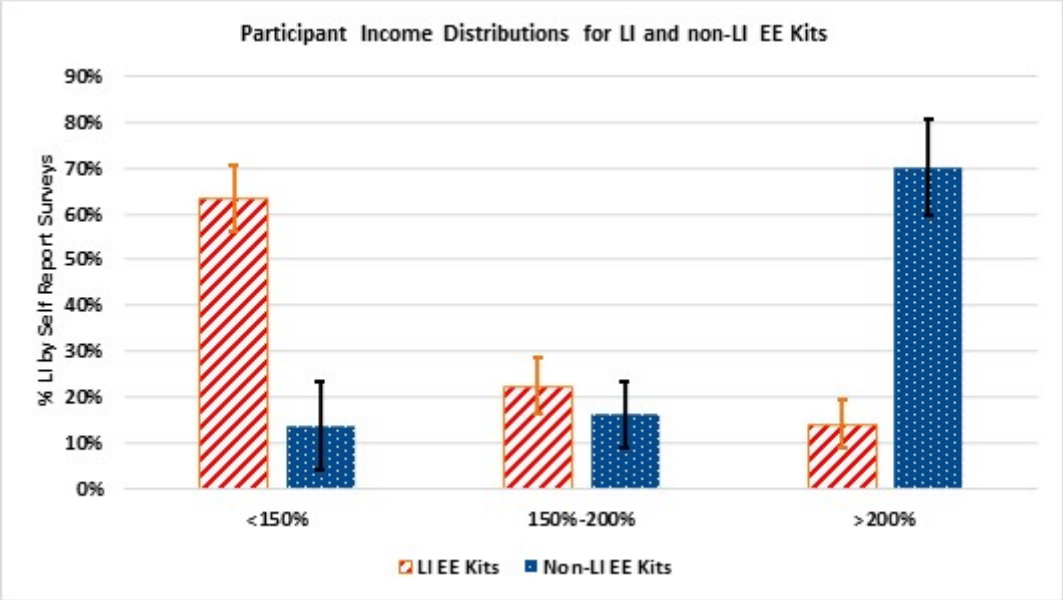

Figure 28: Reported income brackets for LI and Non-LI EE Kit Recipients

The school kits program does not have customer account numbers to cross reference against the Companies' customer information systems databases. As a result, the method for identification of LI School Kit participants is indirect, as described above. Survey results for the School Kits and LI School Kits are shown in Figure 29 below. According to the figure, the indirect process of assigning an "all or none" low-income status to students at schools does not seem to differentiate between income qualified and non-income qualified customers.

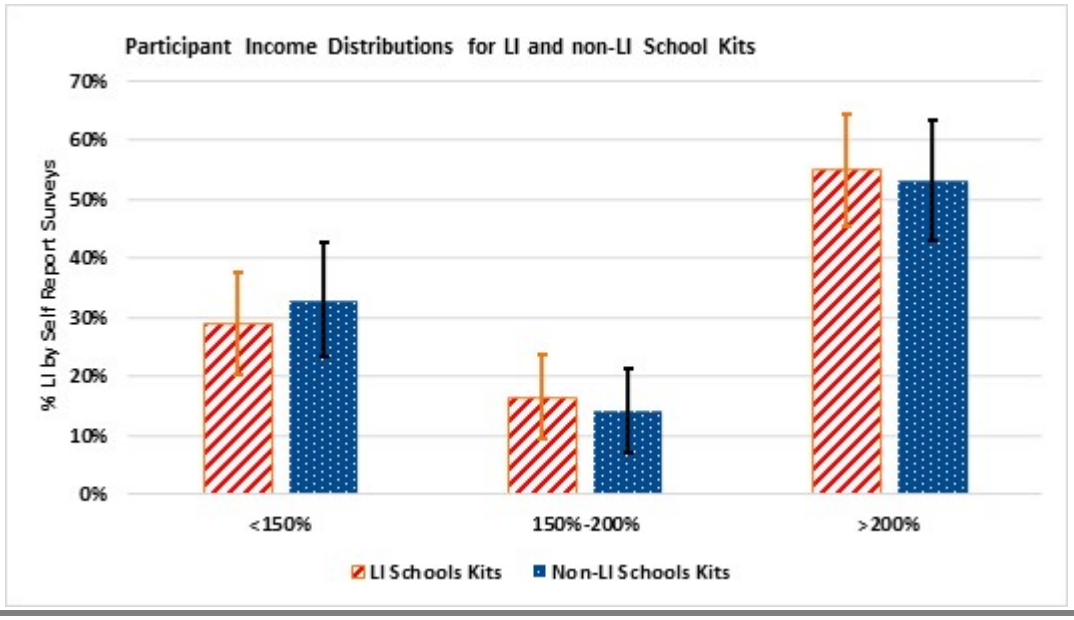

Figure 29: Reported income brackets for LI and Non-LI School Kit Recipients

According to the survey results it is clear that 100% of the LI School Kits customers are not low-income. On the other hand, a significant number of low-income customers are classified as non-income-qualified. ADM decided that robust reporting of the low-income contribution of the School Kits program requires an independent assessment of the number of low-income customers served by the School Education Program Component. Instead of using an all-or-none approach, we estimated the low-income fraction from the percentages of students at each school that are eligible for free or reduced priced lunches, according to the Pennsylvania Department of Education[18]. The Department of Education reports the percent of students at each school that are eligible for free or reduced-price lunches. Students from families with incomes below 130% of the Federal Poverty line are eligible for free lunches, while students from families with incomes below 185% of the Federal Poverty line are eligible for reduced price lunches. ADM interpolated between these two points by taking half of the number students that qualify for reduced price lunches (but not free lunches) and adding this value to the number of students that qualify for free lunches at each school. The results are shown below. Accordingly, the School Education Kit program's verified contribution to the low-income sector is taken to be a portion of the verified savings for the low-income component, and a portion of the verified savings for the non-low-income component.

Table 318 – Low-Income fractions determined from PA Dept. of Education data

EDC	Income Classification	% Low Income
Met-Ed	Res LI	40.74%
Met-Ed	Res	39.19%
Penelec	Res LI	0.00%
Penelec	Res	44.77%
Penn Power	Res LI	54.93%
Penn Power	Res	85.12%
WPP	Res LI	66.97%
WPP	Res	50.94%

A detailed breakdown of reported and verified impacts for the School Education Kits program component is provided in Table 319below.

[18] The report can be found on the Pennsylvania Department of Education web site: http://www.education.pa.gov/_layouts/download.aspx?SourceUrl=http://www.education.pa.gov/Documents/Teachers-Administrators/Food%20and%20Nutrition/Reports/2015-2016%20Building%20Data%20Report.xls

Table 319 – Detailed Comparison of Reported and Verified Impacts for the School Education Kits Program

EDC	Reported Low-Income Status	Low-Income Status Assigned by ADM	Participants	Repored kWh	Reported kW	Verified kWh	Verified kW
Met-Ed	1	0	467	171,707	19.9	174,047	20.8
Met-Ed	1	1	321	118,026	13.7	119,634	14.3
Met-Ed	0	0	1,455	510,010	59.0	517,406	66.8
Met-Ed	0	1	937	328,626	38.0	333,392	43.0
Penelec	1	0	0	0	0.0	0	0.0
Penelec	1	1	0	0	0.0	0	0.0
Penelec	0	0	934	352,348	36.1	340,959	37.3
Penelec	0	1	757	285,600	29.3	276,369	30.2
Penn Power	1	0	131	51,643	5.9	59,183	7.1
Penn Power	1	1	160	62,940	7.1	72,130	8.6
Penn Power	0	0	51	19,321	2.2	20,011	2.6
Penn Power	0	1	295	110,494	12.5	114,438	14.9
WPP	1	0	206	79,673	9.9	81,415	10.5
WPP	1	1	417	161,558	20.0	165,092	21.3
WPP	0	0	1,543	569,394	70.3	589,105	74.2
WPP	0	1	1,602	591,154	73.0	611,618	77.1

O.1.4 Results for Energy

The gross realization rates for energy, along with relative precisions, are shown in Table 320, Table 321, Table 322, and Table 323 for Met-Ed, Penelec, Penn Power, and WPP respectively.

Table 320: EE Kits Initiative Energy Gross Realization Rates for Met-Ed

Stratum	PYRTD MWh/yr	Energy Realization Rate	CV	Relative Precision at 85% C.L.
LI EE Kits - Electric	1,669	115.9%	0.5	14%
LI EE Kits - Standard	1,999	127.3%	0.5	19%
LI School Education Kits	290	101.4%	0.5	10%
Program Total	**3,957**	**120.6%**	**0.5**	**11.7%**

Table 321: EE Kits Initiative Energy Gross Realization Rates for Penelec

Stratum	PYRTD MWh/yr	Energy Realization Rate	CV	Relative Precision at 85% C.L.
LI EE Kits - Electric	1,705	133.8%	0.5	19%
LI EE Kits - Standard	2,089	118.1%	0.5	16%
LI School Education Kits	0	0.0%	0.5	0%
Program Total	**3,793**	**125.2%**	**0.5**	**12.2%**

Table 322: EE Kits Initiative Energy Gross Realization Rates for Penn Power

Stratum	PYRTD MWh/yr	Energy Realization Rate	CV	Relative Precision at 85% C.L.
LI EE Kits - Electric	474	133.3%	0.5	18%
LI EE Kits - Standard	584	116.4%	0.5	16%
LI School Education Kits	115	114.6%	0.5	25%
Program Total	**1,172**	**123.1%**	**0.5**	**11.2%**

Table 323: EE Kits Initiative Energy Gross Realization Rates for WPP

Stratum	PYRTD MWh/yr	Energy Realization Rate	CV	Relative Precision at 85% C.L.
LI EE Kits - Electric	1,438	121.4%	0.5	21%
LI EE Kits - Standard	1,729	109.7%	0.5	14%
LI School Education Kits	241	102.2%	0.5	12%
Program Total	**3,409**	**114.1%**	**0.5**	**11.6%**

O.1.5 Results for Demand

The gross realization rates for demand, along with relative precisions, are shown in Table 324, Table 325, Table 326, and Table 327 for Met-Ed, Penelec, Penn Power, and WPP respectively.

Table 324: EE Kits Initiative Demand Gross Realization Rates for Met-Ed

Stratum	PYRTD MW/yr	Demand Realization Rate	CV	Relative Precision at 85% C.L.
LI EE Kits - Electric	0.18	112.7%	0.5	14%
LI EE Kits - Standard	0.23	138.8%	0.5	19%
LI School Education Kits	0.03	104.4%	0.5	10%
Program Total	**0.44**	**125.4%**	**0.5**	**12.1%**

Table 325: EE Kits Initiative Demand Gross Realization Rates for Penelec

Stratum	PYRTD MW/yr	Demand Realization Rate	CV	Relative Precision at 85% C.L.
LI EE Kits - Electric	0.17	138.3%	0.5	19%
LI EE Kits - Standard	0.21	116.5%	0.5	16%
LI School Education Kits	0.00	0.0%	0.5	0%
Program Total	**0.37**	**126.3%**	**0.5**	**12.2%**

Table 326: EE Kits Initiative Gross Realization Rates for Penn Power

Stratum	PYRTD MW/yr	Demand Realization Rate	CV	Relative Precision at 85% C.L.
LI EE Kits - Electric	0.05	139.8%	0.5	18%
LI EE Kits - Standard	0.06	134.7%	0.5	16%
LI School Education Kits	0.01	120.2%	0.5	25%
Program Total	**0.13**	**135.3%**	**0.5**	**11.2%**

Table 327: EE Kits Initiative Demand Gross Realization Rates for WPP

Stratum	PYRTD MW/yr	Demand Realization Rate	CV	Relative Precision at 85% C.L.
LI EE Kits - Electric	0.17	118.8%	0.5	21%
LI EE Kits - Standard	0.21	124.4%	0.5	14%
LI School Education Kits	0.03	106.4%	0.5	12%
Program Total	**0.41**	**120.8%**	**0.5**	**11.3%**

O.2 NET IMPACT EVALUATION

A net impact evaluation was not conducted for the LI EE Kits Initiative.

Appendix P Evaluation Detail – Commercial and Industrial Lighting Initiative

P.1 Gross Impact Evaluation

Gross impact evaluation for the Commercial and Industrial Lighting (C&I Lighting) Initiative involved stratified sampling, on-site verifications, and TRM Appendix C calculations with primary data collection for lighting hours of use for medium savings and high savings projects, and application of TRM deemed hours of operation for low savings projects.

P.1.1 Gross Impact Evaluation Methodology

As a first step, projects are placed into one of four sampling strata as described in the next section. 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. One aspect of the desk review is to transfer the calculation data into the PA TRM's Appendix C calculator. Although Sodexo processes rebates with the TRM's Appendix C style calculator (augmented with worksheets to suit rebate application purposes), the transferring of the data to ADM's version of Appendix C is an evaluation step to ensure that all verified impacts for lighting projects are derived using the 2016 TRM's Appendix C.

Evaluation of all but the simplest of projects requires a site-specific M&V plan (SSMVP). 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.

The desk review and M&V plan inform the data acquisition activities needed to evaluate the sampled 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. However, all projects with ex ante savings under 25 MWh are evaluated with TRM hours of use, without exception. Although there can be considerable variation in project-specific impacts as calculated by the TRM and by primary data collection, the two methodologies produce compatible results at the aggregate level.

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. Where loggers are used, data analysis is finalized following their retrieval. Billing analysis is a viable option for certain projects, and in some cases the verified results are determined wholly or partially by billing analysis. Figure 30 shows the fraction of verified energy savings, as averaged over the four PA Companies, by primary

evaluation activities. Details regarding gross impact evaluation activities for each sampled project can be found in Appendix B.

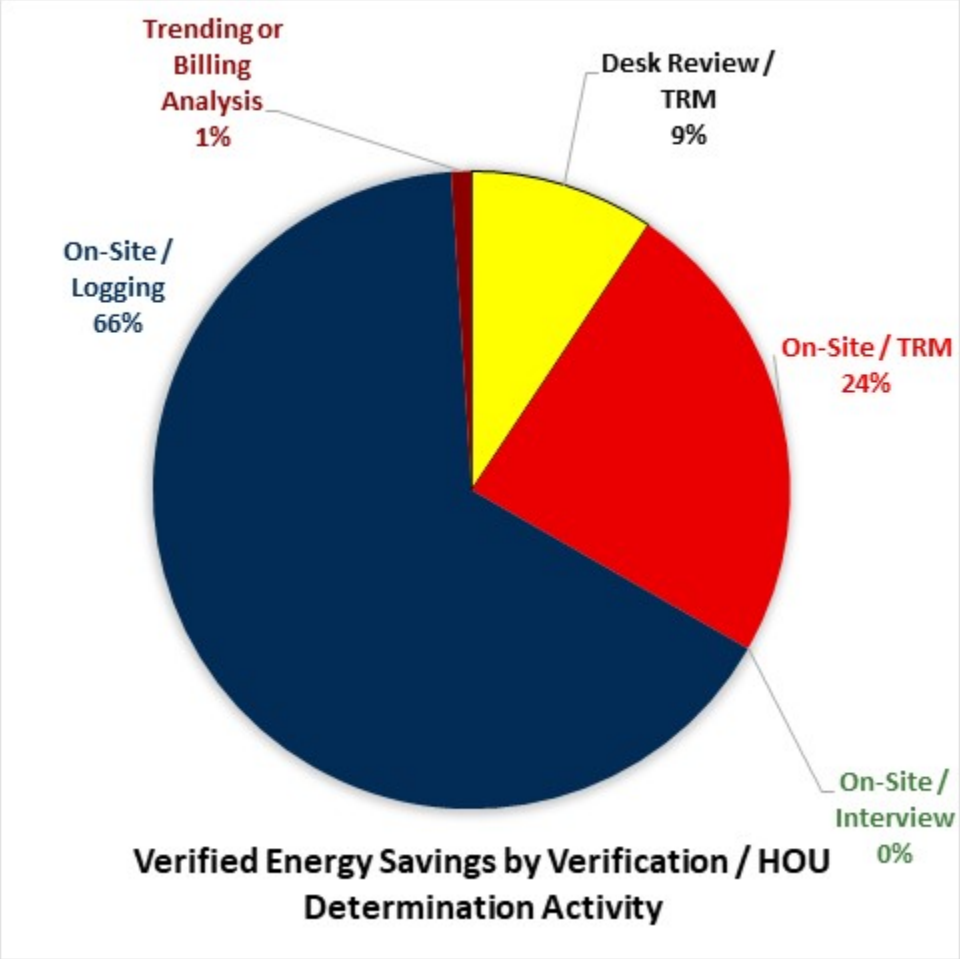

Figure 30 – Fraction of verified energy savings by evaluation activity.

As a final step in lighting project analysis, ADM analysts determine the incremental material and labor costs. 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 the costs used in the EDCs' EE&C plans.

P.1.2 Sampling

Projects are placed into four strata. The first stratum or "certainty" stratum consists of projects that are expected to result in energy savings in excess of 750 MWh. All these projects are sampled for evaluation, and nearly all of them are evaluated prior to rebate approval. Therefore, the gross realization rate for the certainty stratum is essentially 100% by design,

although reported impacts may at times be lower than the 750 MWh threshold, as the threshold is on ex ante MWh, while ex post MWh are reported for these projects. The remaining projects are placed into three sampling strata according to their reported energy impacts. The sample design is not optimized for efficiency in the sense of achieving the desired precision with the absolute minimum number of sample points. Rather, the sample is designed to facilitate specific evaluation protocols that are based on energy savings thresholds. For example, projects in the certainty stratum are evaluated with the highest level of rigor and evaluated in advance of rebate approval to ensure that customers' incentives are determined from verified energy savings. The smallest projects, those with expected impacts under 25 MWh, are placed in a separate stratum. For these projects, hours of use are determined by application of deemed hours in the PA TRM. The sample designs for the four EDCs are shown in Table 328, Table 329, Table 330, and Table 331.

Table 328: CI Lighting Initiative Gross Impact Sample Design for Met-Ed

Stratum	MWh Threshold	Population Size	Achieved Sample Size	Evaluation Activity
Lighting-Certainty	750	11	11	Desk Review, On-Site Verification, Logging HOU
Lighting-3	250	40	8	
Lighting-2	25	179	8	
Lighting-1	0	290	3	
Program Total	**n/a**	**520**	**30**	

Table 329: CI Lighting Initiative Gross Impact Sample Design for Penelec

Stratum	MWh Threshold	Population Size	Achieved Sample Size	Evaluation Activity
Lighting-Certainty	750	6	6	Desk Review, On-Site Verification, Logging HOU
Lighting-3	250	51	8	
Lighting-2	25	289	9	
Lighting-1	0	688	5	
Program Total	**n/a**	**1,034**	**28**	

Table 330: CI Lighting Initiative Gross Impact Sample Design for Penn Power

Stratum	MWh Threshold	Population Size	Achieved Sample Size	Evaluation Activity
Lighting-Certainty	750	3	3	Desk Review, On-Site Verification, Logging HOU
Lighting-3	250	14	7	
Lighting-2	25	123	9	
Lighting-1	0	278	6	
Program Total	**n/a**	**418**	**25**	

Table 331: CI Lighting Initiative Gross Impact Sample Design for WPP

Stratum	MWh Threshold	Population Size	Achieved Sample Size	Evaluation Activity
Lighting-Certainty	750	5	5	Desk Review, On-Site Verification, Logging HOU
Lighting-3	250	53	9	
Lighting-2	25	383	12	
Lighting-1	0	577	5	
Program Total	**n/a**	**1,018**	**31**	

P.1.3 Results for Energy

The gross realization rates for energy, along with relative precisions, are shown in Table 332, Table 333, Table 334, and Table 335 for Met-Ed, Penelec, Penn Power, and WPP respectively. Figure 31 plots the verified energy savings against the reported energy savings for all evaluated lighting projects for the program year. The figure includes data points from all four EDCs and is designed to show the reader the correspondence between reported and verified impacts. The relative precision values in the following tables are calculated with a coefficient of variation of 0.5, but the actual error ratios tend to be somewhat lower than 0.5.

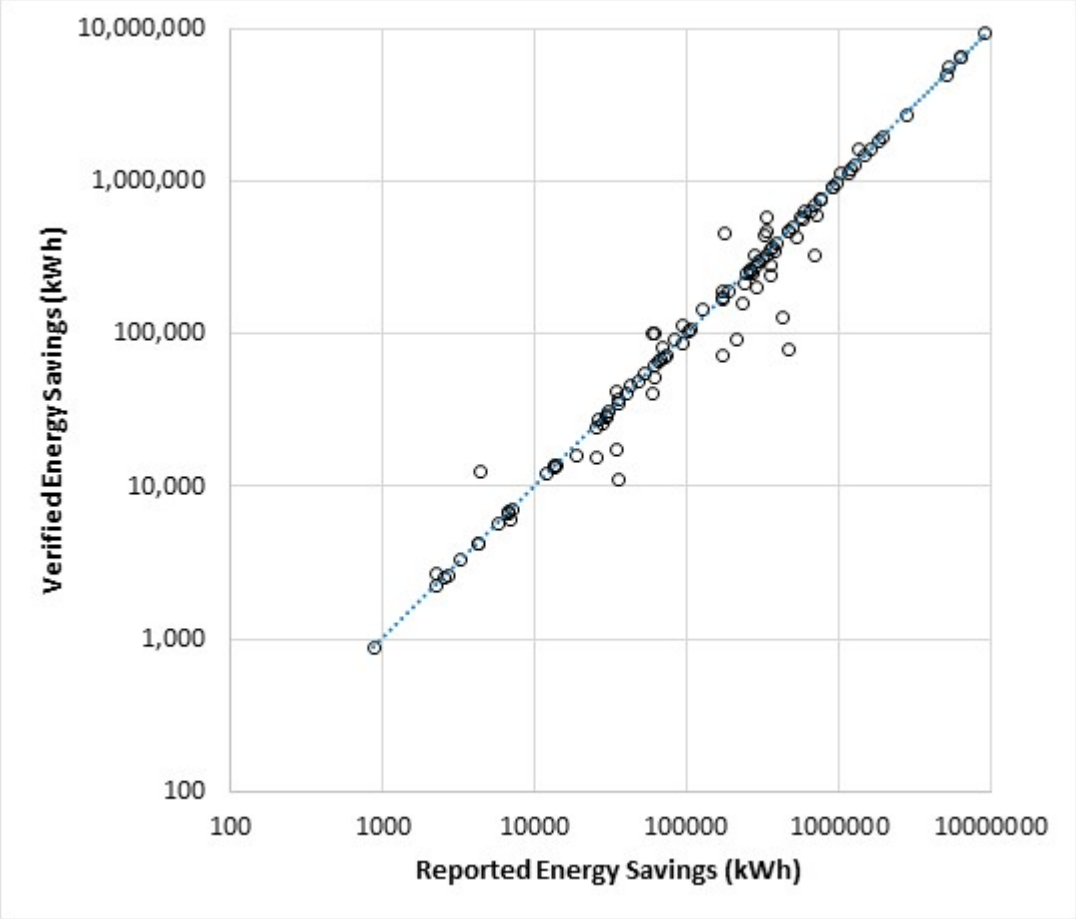

Figure 31: Verified vs. Reported Energy Savings for Sampled Lighting Projects.

Table 332: CI Lighting Initiative Energy Gross Realization Rates for Met-Ed

Stratum	MWh Threshold	PYRTD MWh/yr	Energy Realization Rate	CV	Relative Precision at 85% C.L.
Lighting-Certainty	750	26,008	102.1%	0.5	0%
Lighting-3	250	14,966	85.2%	0.5	23%
Lighting-2	25	12,741	114.4%	0.5	25%
Lighting-1	0	3,471	120.1%	0.5	41%
Program Total	**n/a**	**57,187**	**101.5%**	**0.5**	**8.7%**

Table 333: CI Lighting Initiative Energy Gross Realization Rates for Penelec

Stratum	MWh Threshold	PYRTD MWh/yr	Energy Realization Rate	CV	Relative Precision at 85% C.L.
Lighting-Certainty	750	19,352	102.4%	0.5	0%
Lighting-3	250	19,098	73.8%	0.5	23%
Lighting-2	25	20,670	78.2%	0.5	24%
Lighting-1	0	5,356	99.6%	0.5	32%
Program Total	**n/a**	**64,476**	**86.0%**	**0.5**	**8.3%**

Table 334: CI Lighting Initiative Energy Gross Realization Rates for Penn Power

Stratum	MWh Threshold	PYRTD MWh/yr	Energy Realization Rate	CV	Relative Precision at 85% C.L.
Lighting-Certainty	750	5,190	98.8%	0.5	0%
Lighting-3	250	4,968	88.8%	0.5	19%
Lighting-2	25	9,001	103.9%	0.5	23%
Lighting-1	0	2,479	100.7%	0.5	29%
Program Total	**n/a**	**21,639**	**98.8%**	**0.5**	**11.2%**

Table 335: CI Lighting Initiative Energy Gross Realization Rates for WPP

Stratum	MWh Threshold	PYRTD MWh/yr	Energy Realization Rate	CV	Relative Precision at 85% C.L.
Lighting-Certainty	750	4,893	99.2%	0.5	0%
Lighting-3	250	19,139	109.7%	0.5	22%
Lighting-2	25	25,893	127.5%	0.5	20%
Lighting-1	0	5,427	97.8%	0.5	32%
Program Total	**n/a**	**55,353**	**115.9%**	**0.5**	**15.1%**

P.1.4 Results for Demand

The gross realization rates for demand, along with relative precisions, are shown in Table 336, Table 337, Table 338, and Table 339 for Met-Ed, Penelec, Penn Power, and WPP respectively.

Table 336: CI Lighting Initiative Demand Gross Realization Rates for Met-Ed

Stratum	MWh Threshold	PYRTD MW/yr	Demand Realization Rate	CV	Relative Precision at 85% C.L.
Lighting-Certainty	750	3.70	100.4%	0.5	0%
Lighting-3	250	2.03	79.5%	0.5	23%
Lighting-2	25	2.05	118.4%	0.5	25%
Lighting-1	0	0.47	117.5%	0.5	41%
Program Total	**n/a**	**8.25**	**100.7%**	**0.5**	**9.0%**

Table 337: CI Lighting Initiative Demand Gross Realization Rates for Penelec

Stratum	MWh Threshold	PYRTD MW/yr	Demand Realization Rate	CV	Relative Precision at 85% C.L.
Lighting-Certainty	750	2.48	101.0%	0.5	0%
Lighting-3	250	2.54	92.8%	0.5	23%
Lighting-2	25	2.88	91.4%	0.5	24%
Lighting-1	0	0.70	100.0%	0.5	32%
Program Total	**n/a**	**8.60**	**95.3%**	**0.5**	**10.0%**

Table 338: CI Lighting Initiative Gross Realization Rates for Penn Power

Stratum	MWh Threshold	PYRTD MW/yr	Demand Realization Rate	CV	Relative Precision at 85% C.L.
Lighting-Certainty	750	0.62	91.8%	0.5	0%
Lighting-3	250	0.65	87.4%	0.5	19%
Lighting-2	25	1.18	101.6%	0.5	23%
Lighting-1	0	0.27	107.7%	0.5	29%
Program Total	**n/a**	**2.72**	**96.6%**	**0.5**	**11.4%**

Table 339: CI Lighting Initiative Demand Gross Realization Rates for WPP

Stratum	MWh Threshold	PYRTD MW/yr	Demand Realization Rate	CV	Relative Precision at 85% C.L.
Lighting-Certainty	750	0.64	100.5%	0.5	0%
Lighting-3	250	2.77	98.2%	0.5	22%
Lighting-2	25	2.90	120.8%	0.5	20%
Lighting-1	0	0.58	94.4%	0.5	32%
Program Total	**n/a**	**6.90**	**107.6%**	**0.5**	**13.7%**

P.2 NET IMPACT EVALUATION

P.2.1 Net Impact Evaluation Methodology

Tetra Tech conducted a net-to-gross (NTG) evaluation in PY8. The evaluation assessed free ridership and spillover through participant customer and vendor surveys following the Pennsylvania Evaluation Framework. NTG was assessed for each EDC at the major measure category level (i.e., custom, lighting, and other prescriptive), as custom and lighting qualified as high-impact measures in PY8.

Free ridership was assessed through the participant customer self-reports following the standardized self-report methodology for downstream programs, enhanced with influential vendor reports. Customer-identified influential vendors were asked a series of questions assessing the program's influence on their recommendations to the customer(s) who identified them as being influential in their decision-making process to support the free-ridership assessment. Similar to the participant customer self-report methodology, an "Influence Component" score was calculated for each influential vendor specific to each project. If the vendor's influence score is greater than the customer's score from the participant survey, the vendor score replaced the customer score in the self-report free-ridership scoring algorithm, under the rationale that the vendor's recommendation was a program-attributable factor.

In addition to free-ridership, the NTG evaluation also assessed both participant spillover and nonparticipant spillover. Participant spillover was assessed through participant customer self-reports. Nonparticipant spillover was estimated from vendor self-reports at the measure-category level (i.e., lighting, HVAC, and food service). Following the Evaluation Framework, total spillover was calculated by summing the participant and vendor-reported nonparticipant spillover rates, as vendors on average reported that their sales of program-qualifying equipment accounted for less than 90 percent of their total sales of high-efficiency products.

Individual free-ridership and spillover rates from the customer and vendor surveys were weighted to adjust for proportional sampling differences, non-response, and claimed energy savings to calculate overall estimates.

P.2.2 Sampling

Net impact evaluation used the same sampling scheme as gross impact evaluation. Stratification by MWh was necessary because commercial and industrial programs tend to concentrate impacts among a relatively small number of high-savings projects. The high fraction of program verified impacts in the certainty strata means that attainment of relative precision targets hinges on achieving a census or near-census of those strata Tetra Tech attempted to reach all customers in the "Certainty" strata, but not all decision makers for these customers responded to the survey. Despite relatively high response rates and large sample sizes, attainment of the 85/15 sampling targets was difficult – particularly for Met-Ed. On the other hand, the FirstEnergy implementation team has the benefit of obtaining one independent net-to-gross estimate for each of their EDCs. The sample designs for the four EDCs are shown in Table 340, Table 341, Table 342, and Table 343 for Met-Ed, Penelec, Penn Power, and WPP respectively. Note that these tables reflect the PY8 population.

Table 340: CI Lighting Initiative Net-to-Gross Sampling for Met-Ed

Stratum	Population Size	Achieved Sample Size	Response Rate
Lighting-Certainty	6	2	33.3%
Lighting-3	23	4	n/a
Lighting-2	121	23	n/a
Lighting-1	199	34	n/a
Program Total	**349**	**63**	**42.0%**

Table 341: CI Lighting Initiative Net-to-Gross Sampling for Penelec

Stratum	Population Size	Achieved Sample Size	Response Rate
Lighting-Certainty	1	0	0.0%
Lighting-3	30	9	n/a
Lighting-2	200	33	n/a
Lighting-1	561	61	n/a
Program Total	**792**	**103**	**44.0%**

Table 342: CI Lighting Initiative Net-to-Gross Sampling for Penn Power

Stratum	Population Size	Achieved Sample Size	Response Rate
Lighting-Certainty	1	1	100.0%
Lighting-3	5	2	n/a
Lighting-2	57	12	n/a
Lighting-1	353	30	n/a
Program Total	**416**	**45**	**38.0%**

Table 343: CI Lighting Initiative Net-to-Gross Sampling for WPP

Stratum	Population Size	Achieved Sample Size	Response Rate
Lighting-Certainty	0	0	n/a
Lighting-3	30	7	23.3%
Lighting-2	225	22	9.8%
Lighting-1	384	41	10.7%
Program Total	**639**	**70**	**41.0%**

P.2.3 Net Impact Evaluation Results

The PYTD verified gross energy impacts, free ridership, spillover, net-to-gross ratios, and relative precisions for net-to-gross are shown in Table 344, Table 345, Table 346, and Table 347 for Met-Ed, Penelec, Penn Power, and WPP respectively. The net-to-gross results show that overall net-to-gross for the commercial lighting is relatively high, with an average of 77% across the four EDCs. We apply PY8 NTG values from the same stratum. In cases where a stratum had no rebates in PY8 (e.g., the Lighting-Certainty stratum for WPP), the EDC's average NTG for the Initiative is used for the stratum.

Table 344: CI Lighting Initiative Net-to-Gro ss Results for Met-Ed

Stratum	PYVTD MWh	Free Ridership (%)	Spillover (%)	NTG Ratio	Relative Precision (@ 85% CL)
Lighting-Certainty	26,562	62.5%	1.5%	39.0%	37.6%
Lighting-3	12,754	5.8%	2.4%	96.6%	29.6%
Lighting-2	14,573	28.6%	1.9%	73.3%	12.2%
Lighting-1	4,168	24.9%	3.5%	78.6%	10.2%
Program Total	**58,058**	**38.8%**	**1.9%**	**63.1%**	**15.0%**

Table 345: CI Lighting Initiative Net-to-Gross Results for Penelec

Stratum	PYVTD MWh	Free Ridership (%)	Spillover (%)	NTG Ratio	Relative Precision (@ 85% CL)
Lighting-Certainty	19,820	20.1%	1.5%	81.4%	100.0%
Lighting-3	14,094	20.1%	1.5%	81.4%	18.2%
Lighting-2	16,172	18.3%	3.7%	85.5%	10.4%
Lighting-1	5,335	23.6%	16.1%	92.4%	7.9%
Program Total	**55,421**	**19.9%**	**3.6%**	**83.7%**	**35.2%**

Table 346 CI Lighting Initiative Net-to-Gross Results for Penn Power

Stratum	PYVTD MWh	Free Ridership (%)	Spillover (%)	NTG Ratio
Lighting-Certainty	5,130	37.5%	1.5%	64.0%
Lighting-3	4,410	12.5%	1.5%	89.0%
Lighting-2	9,352	28.9%	3.7%	74.8%
Lighting-1	2,496	32.0%	5.9%	74.0%
Program Total	**21,388**	**27.9%**	**3.0%**	**75.1%**

Table 347 CI Lighting Initiative Net-to-Gross Results for WPP

Stratum	PYVTD MWh	Free Ridership (%)	Spillover (%)	NTG Ratio	Relative Precision (@ 85% CL)
Lighting-Certainty	4,853	22.1%	5.0%	82.9%	0.0%
Lighting-3	20,986	27.1%	2.5%	75.4%	21.6%
Lighting-2	33,014	17.1%	5.6%	88.5%	13.2%
Lighting-1	5,309	26.3%	9.0%	82.7%	9.6%
Program Total	**64,163**	**21.5%**	**4.8%**	**83.3%**	**9.7%**

Appendix Q Evaluation Detail – Commercial and Industrial Custom Initiative

Q.1 Gross Impact Evaluation

Gross impact evaluation for the Commercial and Industrial Custom (C&I Custom) Initiative involved stratified sampling, on-site verifications, and project-specific data collection and calculations.

Q.1.1 Gross Impact Evaluation Methodology

As a first step, projects are spaced into one of three sampling strata as described in the next section. 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. 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 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.

Combined Heat and Power (CHP): CHP projects are typically evaluated trending data analysis. The generator output is typically modeled as a function of explanatory variables that may include weather-related information, calendar day types (especially for universities), and availability of biofuels, if applicable. Parasitic loads are estimated through inspection of trending data, monitoring, or an inspection equipment specifications and operating schedules.

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.

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.

In some cases, the desk review process may indicate that an on-site visit would not add sufficient value to the evaluation effort. For example, billing analysis or trending data analysis is a viable option for certain projects. Figure 32 shows the fraction of verified energy savings, as averaged over the four PA Companies, by primary evaluation activities. Details regarding gross impact evaluation activities for each sampled project can be found in Appendix B.

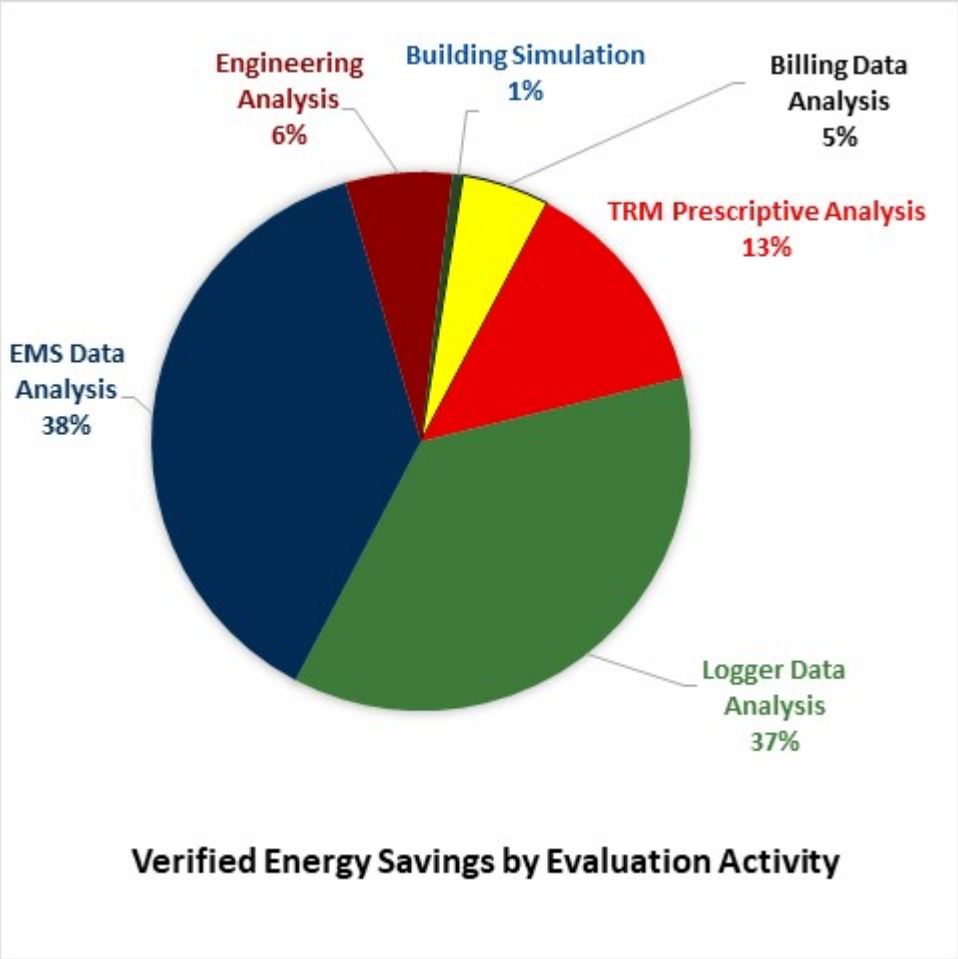

Figure 32 – Fraction of verified energy savings by evaluation activity.

As a final step in custom project analysis, ADM analysts determine the incremental material and labor costs. 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 the costs used in the EDCs' EE&C plans.

Q.1.2 Sampling

Projects are placed into three strata. The first stratum or "certainty" stratum consists of projects that are expected to result in energy savings more than 500 MWh. All these projects are sampled for evaluation, and nearly all of them are evaluated prior to rebate approval. Therefore, the gross realization rate for the certainty stratum is essentially 100% by design, although reported impacts may at times be lower than the 750 MWh threshold, as the threshold is on ex ante MWh, while ex post MWh are reported for these projects. The remaining projects are placed into two sampling strata according to their reported energy impacts. The sample design is not optimized for efficiency in the sense of achieving the desired precision with the absolute minimum number of sample points. Rather, the sample is designed to facilitate specific evaluation protocols that are based on energy savings thresholds. For example, the certainty stratum is evaluated with the highest level of rigor and are evaluated in advance of rebate approval to ensure that customers' incentives are determined from verified energy savings. The next largest projects, those with expected impacts above 250 MWh, are placed in a separate stratum and evaluated with primary data collection and a high level of rigor. Projects with impacts below 250 MWh are assigned a level of rigor assigned on a case by case basis. In this stratum, if the weighted MWh uncertainty (as determined from the sample scheme and a review of project documentation) is low, then basic rigor is preferred. The sample designs for the four EDCs are shown in Table 348, Table 349, Table 350, and Table 351.

Table 348: CI Custom Initiative Gross Impact Sample Design for Met-Ed

Stratum	MWh Threshold	Population Size	Achieved Sample Size	Evaluation Activity
Custom-Certainty	500	5	5	On-Site Verification, Metering
Custom-2	250	3	3	
Custom-1	0	56	11	
Program Total	**n/a**	**64**	**19**	

Table 349: CI Custom Initiative Gross Impact Sample Design for Penelec

Stratum	MWh Threshold	Population Size	Achieved Sample Size	Evaluation Activity
Custom-Certainty	500	2	2	On-Site Verification, Metering
Custom-2	250	5	5	
Custom-1	0	63	11	
Program Total	**n/a**	**70**	**18**	

Table 350: CI Custom Initiative Gross Impact Sample Design for Penn Power

Stratum	MWh Threshold	Population Size	Achieved Sample Size	Evaluation Activity
Custom-Certainty	500	1	1	On-Site Verification, Metering
Custom-2	250	5	5	
Custom-1	0	21	11	
Program Total	**n/a**	**27**	**17**	

Table 351: CI Custom Initiative Gross Impact Sample Design for WPP

Stratum	MWh Threshold	Population Size	Achieved Sample Size	Evaluation Activity
Custom-Certainty	500	5	5	On-Site Verification, Metering
Custom-2	250	7	6	
Custom-1	0	44	7	
Program Total	**n/a**	**56**	**18**	

Q.1.3 Results for Energy

The gross realization rates for energy, along with relative precisions, are shown in Table 352, Table 353, Table 354, and Table 355 for Met-Ed, Penelec, Penn Power, and WPP respectively. Figure 33 plots the verified energy savings against the reported energy savings for all evaluated lighting projects for all in for the program year. The figure includes data points from all four EDCs and is designed to show the reader the correspondence between reported and verified impacts. The relative precision values in the following tables are calculated with a coefficient of variation of 0.5 for larger projects and 0.7 for smaller projects. Realization rates tended to be close to 1.0 for larger projects, but more volatile for smaller projects.

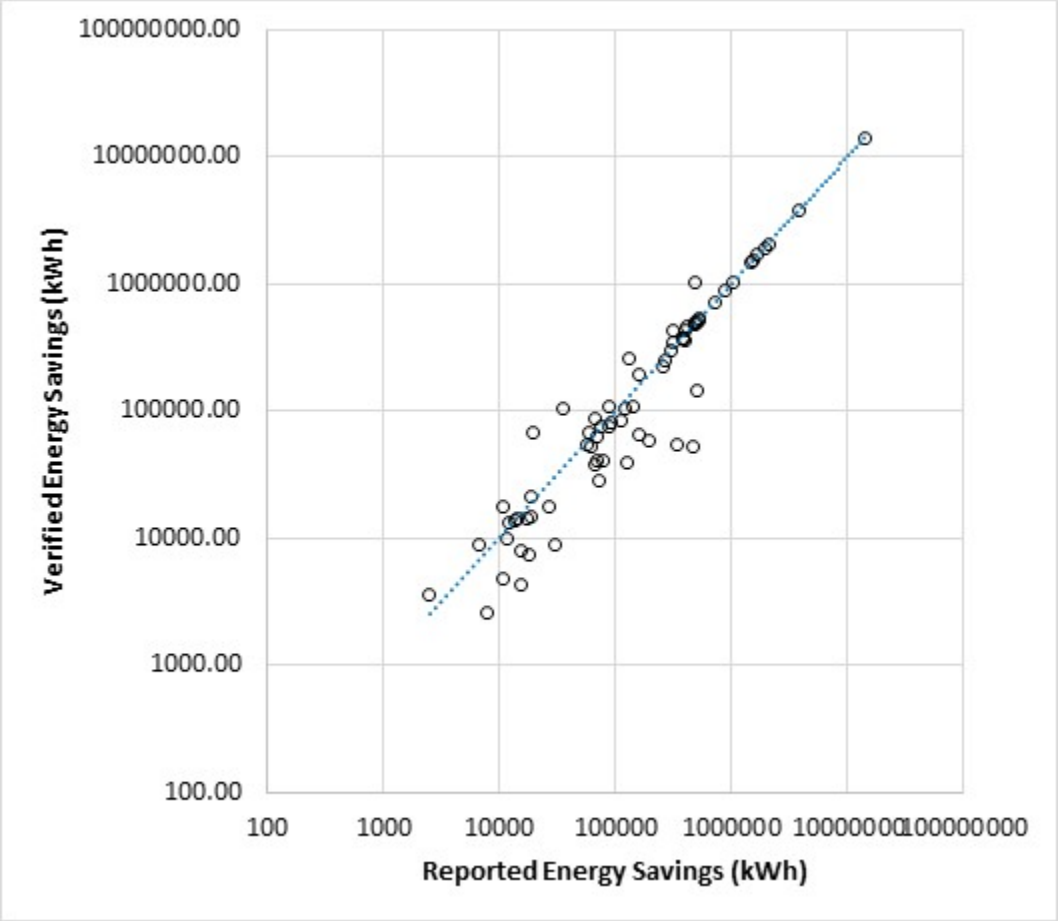

Figure 33: Verified vs. Reported Energy Savings for Sampled Custom Projects.

Table 352: CI Custom Initiative Energy Gross Realization Rates for Met-Ed

Stratum	MWh Threshold	PYRTD MWh/yr	Energy Realization Rate	CV	Relative Precision at 85% C.L.
Custom-Certainty	500	6,010	100.0%	0.5	0%
Custom-2	250	1,230	83.8%	0.5	0%
Custom-1	0	4,131	103.9%	0.7	27%
Program Total	**n/a**	**11,370**	**99.7%**		**10.3%**

Table 353: CI Custom Initiative Energy Gross Realization Rates for Penelec

Stratum	MWh Threshold	PYRTD MWh/yr	Energy Realization Rate	CV	Relative Precision at 85% C.L.
Custom-Certainty	500	3,387	100.0%	0.5	0%
Custom-2	250	2,074	127.8%	0.5	0%
Custom-1	0	4,491	74.3%	0.7	28%
Program Total	**n/a**	**9,952**	**94.2%**		**9.3%**

Table 354: CI Custom Initiative Energy Gross Realization Rates for Penn Power

Stratum	MWh Threshold	PYRTD MWh/yr	Energy Realization Rate	CV	Relative Precision at 85% C.L.
Custom-Certainty	500	533	100.0%	0.5	0%
Custom-2	250	1,891	99.9%	0.5	0%
Custom-1	0	1,538	97.0%	0.7	21%
Program Total	**n/a**	**3,962**	**98.8%**		**7.9%**

Table 355: CI Custom Initiative Energy Gross Realization Rates for WPP

Stratum	MWh Threshold	PYRTD MWh/yr	Energy Realization Rate	CV	Relative Precision at 85% C.L.
Custom-Certainty	500	20,697	100.0%	0.5	0%
Custom-2	250	2,459	64.5%	0.5	11%
Custom-1	0	3,310	80.1%	0.7	35%
Program Total	**n/a**	**26,466**	**94.2%**		**3.6%**

Q.1.4 Results for Demand

The gross realization rates for demand, along with relative precisions, are shown in Table 356, Table 357, Table 358, and Table 359 for Met-Ed, Penelec, Penn Power, and WPP respectively.

Table 356: CI Custom Initiative Demand Gross Realization Rates for Met-Ed

Stratum	MWh Threshold	PYRTD MW/yr	Demand Realization Rate	CV	Relative Precision at 85% C.L.
Custom-Certainty	500	1.01	100.0%	0.5	0%
Custom-2	250	0.14	85.2%	0.5	0%
Custom-1	0	0.65	64.7%	0.7	27%
Program Total	**n/a**	**1.81**	**86.1%**		**6.4%**

Table 357: CI Custom Initiative Demand Gross Realization Rates for Penelec

Stratum	MWh Threshold	PYRTD MW/yr	Demand Realization Rate	CV	Relative Precision at 85% C.L.
Custom-Certainty	500	0.40	100.0%	0.5	0%
Custom-2	250	0.31	82.7%	0.5	0%
Custom-1	0	0.54	57.5%	0.7	28%
Program Total	**n/a**	**1.25**	**77.4%**		**6.9%**

Table 358: CI Custom Initiative Gross Realization Rates for Penn Power

Stratum	MWh Threshold	PYRTD MW/yr	Demand Realization Rate	CV	Relative Precision at 85% C.L.
Custom-Certainty	500	0.06	100.0%	0.5	0%
Custom-2	250	0.23	97.7%	0.5	0%
Custom-1	0	0.23	55.0%	0.7	21%
Program Total	**n/a**	**0.53**	**79.2%**		**5.1%**

Table 359: CI Custom Initiative Demand Gross Realization Rates for WPP

Stratum	MWh Threshold	PYRTD MW/yr	Demand Realization Rate	CV	Relative Precision at 85% C.L.
Custom-Certainty	500	1.32	100.0%	0.5	0%
Custom-2	250	0.41	44.8%	0.5	11%
Custom-1	0	0.65	36.6%	0.7	35%
Program Total	**n/a**	**2.37**	**73.3%**		**3.6%**

Q.2 NET IMPACT EVALUATION

Q.2.1 Net Impact Evaluation Methodology

Tetra Tech conducted a net-to-gross (NTG) evaluation in PY8. The evaluation assessed free ridership and spillover through participant customer and vendor surveys following the Pennsylvania Evaluation Framework. NTG was assessed for each EDC at the major measure category level (i.e., custom, lighting, and other prescriptive), as custom and lighting qualified as high-impact measures in PY8.

Free ridership was assessed through the participant customer self-reports following the standardized self-report methodology for downstream programs, enhanced with influential vendor reports. Customer-identified influential vendors were asked a series of questions assessing the program's influence on their recommendations to the customer(s) who identified them as being influential in their decision-making process to support the free-ridership assessment. Similar to the participant customer self-report methodology, an "Influence Component" score was calculated for each influential vendor specific to each project. If the vendor's influence score is greater than the customer's score from the participant survey, the vendor score replaced the customer score in the self-report free-ridership scoring algorithm, under the rationale that the vendor's recommendation was a program-attributable factor.

In addition to free-ridership, the NTG evaluation also assessed both participant spillover and nonparticipant spillover. Participant spillover was assessed through participant customer self-reports. Nonparticipant spillover was estimated from vendor self-reports at the measure-category level (i.e., lighting, HVAC, and food service). Following the Evaluation Framework, total spillover was calculated by summing the participant and vendor-reported nonparticipant spillover rates, as vendors on average reported that their sales of program-qualifying equipment accounted for less than 90 percent of their total sales of high-efficiency products.

Individual free-ridership and spillover rates from the customer and vendor surveys were weighted to adjust for proportional sampling differences, non-response, and claimed energy savings to calculate overall estimates.

Q.2.2 Sampling

The net impact evaluation used the same sampling scheme as gross impact evaluation in PY8. For the custom initiative, the concentration of savings in the largest projects is even more pronounced. For example, 75% of the verified savings in Penelec' s custom initiative was attributable to the four largest projects. Although Tetra tech managed to interview three of these four customers, and 15 of the remaining 54 customers, the relative precision on net verified impacts was still nearly 32%. For custom projects, we have noticed that some large customers hire energy services companies (ESCOs) to act as a proxy for Act 129. While the ESCOs are generally knowledgeable about project details and are generally very effective at providing M&V access for gross impact evaluation, we do not find it appropriate to field the NTG surveys to ESCOs. For PY8, custom projects are a mid-impact measure: they account for 21% of sector-level verified impacts. We will conduct a net impact evaluation of the custom initiative again in

PY10, possibly as a high impact measure. In PY10, we will attempt to field NTGR surveys as part of the rebate application package.

At the sector level, the relative precisions on the C/I program tended to be at the 85/15 level or better because most of the impacts were attributable to lighting measures. However, both NTG results and precision for custom projects can be volatile in any given year due to the high positive skew in the savings distribution. As with lighting, the FirstEnergy implementation team has the benefit of obtaining one independent net-to-gross estimate for each of their EDCs, and this can help to balance out cases where the NTG is driven up or down by one dominantly large customer.

The sample designs for the four EDCs are shown in Table 360, Table 361, Table 362, and Table 363 for Met-Ed, Penelec, Penn Power, and WPP respectively. Note that these tables reflect the PY8 populations.

Table 360: CI Custom Initiative Net-to-Gross Sampling for Met-Ed

Stratum	Population Size	Achieved Sample Size	Response Rate
Custom-Certainty	4	2	50.0%
Custom-2	2	1	n/a
Custom-1	34	14	n/a
Program Total	**40**	**17**	**57.0%**

Table 361: CI Custom Initiative Net-to-Gross Sampling for Penelec

Stratum	Population Size	Achieved Sample Size	Response Rate
Custom-Certainty	2	2	100.0%
Custom-2	2	1	n/a
Custom-1	54	15	n/a
Program Total	**58**	**18**	**51.0%**

Table 362: CI Custom Initiative Net-to-Gross Sampling for Penn Power

Stratum	Population Size	Achieved Sample Size	Response Rate
Custom-Certainty	2	2	100.0%
Custom-2	2	1	n/a
Custom-1	16	4	n/a
Program Total	**20**	**7**	**47.0%**

Table 363: CI Custom Initiative Net-to-Gross Sampling for WPP

Stratum	Population Size	Achieved Sample Size	Response Rate
Custom-Certainty	2	0	0.0%
Custom-2	2	2	n/a
Custom-1	43	12	n/a
Program Total	**47**	**14**	**48.0%**

Q.2.3 Net Impact Evaluation Results

The PYTD verified gross energy impacts, free ridership, spillover, net-to-gross ratios, and relative precisions for net-to-gross are shown in Table 364, Table 365, Table 366, and Table 367 for Met-Ed, Penelec, Penn Power, and WPP respectively. Despite the difficulty of achieving a census of the largest customers, overall net-to-gross ratios for the custom initiatives were in a reasonably tight range around 50%. Inspection of stratum-level NTG ratios for all four EDCs suggests that NTG ratios are lower for custom projects than for lighting projects, and this is particularly true for large custom projects. We apply PY8 NTG values from the same EDC stratum.

Table 364: CI Custom Initiative Net-to-Gross Results for Met-Ed

Stratum	PYVTD MWh	Free Ridership (%)	Spillover (%)	NTG Ratio	Relative Precision (@ 85% CL)
Custom-Certainty	6,010	62.5%	0.0%	37.5%	32.6%
Custom-2	1,030	12.5%	0.0%	87.5%	46.1%
Custom-1	4,292	71.3%	0.1%	28.8%	13.4%
Program Total	**11,332**	**61.3%**	**0.0%**	**38.8%**	**19.6%**

Table 365: CI Custom Initiative Net-to-Gross Results for Penelec

Stratum	PYVTD MWh	Free Ridership (%)	Spillover (%)	NTG Ratio	Relative Precision (@ 85% CL)
Custom-Certainty	3,387	88.9%	0.0%	11.1%	0.0%
Custom-2	2,651	0.0%	0.0%	100.0%	46.1%
Custom-1	3,334	47.3%	1.6%	54.3%	14.3%
Program Total	**9,373**	**49.0%**	**0.6%**	**51.6%**	**25.8%**

Table 366: CI Custom Initiative Net-to-Gross Results for Penn Power

Stratum	PYVTD MWh	Free Ridership (%)	Spillover (%)	NTG Ratio	Relative Precision (@ 85% CL)
Custom-Certainty	533	62.5%	0.0%	37.5%	0.0%
Custom-2	1,888	62.5%	0.0%	37.5%	46.1%
Custom-1	1,492	39.9%	0.0%	60.1%	28.2%
Program Total	**3,913**	**53.9%**	**0.0%**	**46.1%**	**22.9%**

Table 367: CI Custom Initiative Net-to-Gross Results for WPP

Stratum	PYVTD MWh	Free Ridership (%)	Spillover (%)	NTG Ratio	Relative Precision (@ 85% CL)
Custom-Certainty	20,697	55.3%	0.0%	44.7%	100.0%
Custom-2	1,586	55.3%	0.0%	44.7%	0.0%
Custom-1	2,653	31.7%	0.0%	68.3%	16.0%
Program Total	**24,936**	**52.8%**	**0.0%**	**47.2%**	**78.6%**

Appendix R Evaluation Detail – Commercial and Industrial Prescriptive Initiative

R.1 Gross Impact Evaluation

Gross impact evaluation for the Commercial and Industrial Prescriptive (C&I Prescriptive) Initiative involved stratified sampling, on-site verifications, and project-specific data collection and calculations.

R.1.1 Gross Impact Evaluation Methodology

As a first step, projects are spaced into one of three sampling strata as described in the next section. As with lighting projects, each sampled prescriptive project undergoes a desk review prior to M&V activities. The desk review includes a full documentation review and if needed, additional topical research. Some projects may require M&V plans, but most projects can be evaluated with a combination of verification of measure installation and a TRM-based calculation. The first step in the M&V planning process is to check that the project is sufficiently documented, and that sufficient data exist to identify the proper TRM protocol (or IMP) and the values of key input parameters as required by the protocol. Details regarding gross impact evaluation activities for each sampled project can be found in Appendix B.

As a final step in custom project analysis, ADM analysts determine the incremental material and labor costs. 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 the costs used in the EDCs' EE&C plans.

R.1.2 Sampling

Projects are placed into two strata. The impact evaluation activities are similar for both strata. The sample designs for the four EDCs are shown in Table 368, Table 369, Table 370, and Table 371.

Table 368: CI Prescriptive Initiative Gross Impact Sample Design for Met-Ed

Stratum	MWh Threshold	Population Size	Achieved Sample Size	Evaluation Activity
Prescriptive-2	20	2	2	Desk Review, On-Site Verification
Prescriptive-1	0	26	26	
Program Total	**n/a**	**28**	**28**	

Table 369: CI Prescriptive Initiative Gross Impact Sample Design for Penelec

Stratum	MWh Threshold	Population Size	Achieved Sample Size	Evaluation Activity
Prescriptive-2	20	3	3	Desk Review, On-Site Verification
Prescriptive-1	0	41	27	
Program Total	**n/a**	**44**	**30**	

Table 370: CI Prescriptive Initiative Gross Impact Sample Design for Penn Power

Stratum	MWh Threshold	Population Size	Achieved Sample Size	Evaluation Activity
Prescriptive-2	20	1	1	Desk Review, On-Site Verification
Prescriptive-1	0	17	17	
Program Total	**n/a**	**18**	**18**	

Table 371: CI Prescriptive Initiative Gross Impact Sample Design for WPP

Stratum	MWh Threshold	Population Size	Achieved Sample Size	Evaluation Activity
Prescriptive-2	20	8	4	Desk Review, On-Site Verification
Prescriptive-1	0	58	26	
Program Total	**n/a**	**66**	**30**	

R.1.3 Results for Energy

The gross realization rates for energy, along with relative precisions, are shown in Table 372, Table 373, Table 374, and Table 375 for Met-Ed, Penelec, Penn Power, and WPP respectively. Figure 34 plots the verified energy savings against the reported energy savings for all evaluated lighting projects for the program year. The figure includes data points from all four EDCs and is designed to show the reader the correspondence between reported and verified impacts. The relative precision values in the following tables are calculated with a coefficient of variation of 0.5 for larger projects and 1.0 for smaller projects. Realization rates tended to be more volatile for smaller projects.

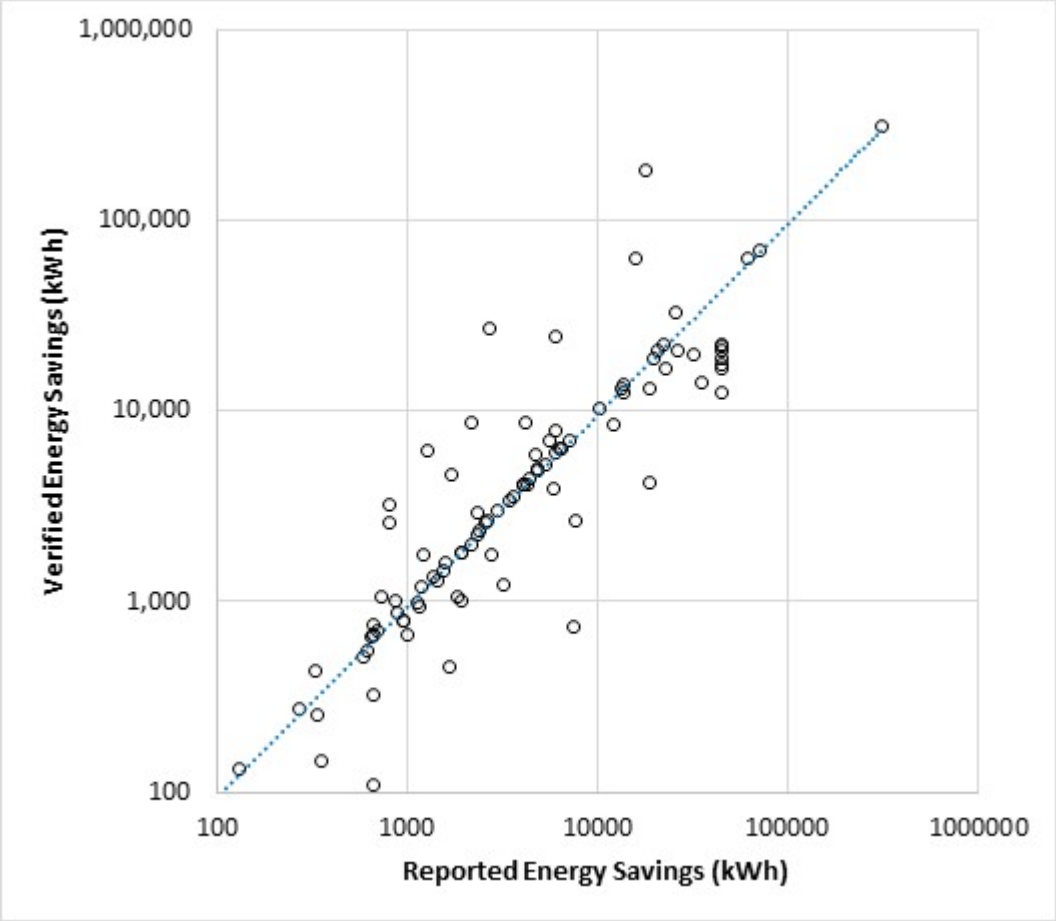

Figure 34: Verified vs. Reported Energy Savings for Sampled Prescriptive Projects.

Table 372: CI Prescriptive Initiative Energy Gross Realization Rates for Met-Ed

Stratum	MWh Threshold	PYRTD MWh/yr	Energy Realization Rate	CV	Relative Precision at 85% C.L.
Prescriptive-2	20	116	76.7%	0.5	0%
Prescriptive-1	0	128	95.3%	1	0%
Program Total	**n/a**	**244**	**86.5%**		**0.0%**

Table 373: CI Prescriptive Initiative Energy Gross Realization Rates for Penelec

Stratum	MWh Threshold	PYRTD MWh/yr	Energy Realization Rate	CV	Relative Precision at 85% C.L.
Prescriptive-2	20	420	94.6%	0.5	0%
Prescriptive-1	0	200	114.6%	1	16%
Program Total	**n/a**	**620**	**101.1%**		**6.0%**

Table 374: CI Prescriptive Initiative Energy Gross Realization Rates for Penn Power

Stratum	MWh Threshold	PYRTD MWh/yr	Energy Realization Rate	CV	Relative Precision at 85% C.L.
Prescriptive-2	20	45	37.0%	0.5	0%
Prescriptive-1	0	117	259.2%	1	0%
Program Total	**n/a**	**162**	**197.4%**		**0.0%**

Table 375: CI Prescriptive Initiative Energy Gross Realization Rates for WPP

Stratum	MWh Threshold	PYRTD MWh/yr	Energy Realization Rate	CV	Relative Precision at 85% C.L.
Prescriptive-2	20	447	40.4%	0.5	25%
Prescriptive-1	0	413	92.9%	1	21%
Program Total	**n/a**	**860**	**65.6%**		**10.8%**

R.1.4 Results for Demand

The gross realization rates for demand, along with relative precisions, are shown in Table 376, Table 377, Table 378, and Table 379 for Met-Ed, Penelec, Penn Power, and WPP respectively.

Table 376: CI Prescriptive Initiative Demand Gross Realization Rates for Met-Ed

Stratum	MWh Threshold	PYRTD MW/yr	Demand Realization Rate	CV	Relative Precision at 85% C.L.
Prescriptive-2	20	0.02	96.0%	0.5	0%
Prescriptive-1	0	0.03	82.4%	1	0%
Program Total	**n/a**	**0.05**	**88.5%**		**0.0%**

Table 377: CI Prescriptive Initiative Demand Gross Realization Rates for Penelec

Stratum	MWh Threshold	PYRTD MW/yr	Demand Realization Rate	CV	Relative Precision at 85% C.L.
Prescriptive-2	20	0.01	99.1%	0.5	0%
Prescriptive-1	0	0.03	68.9%	1	16%
Program Total	**n/a**	**0.05**	**78.3%**		**7.7%**

Table 378: CI Prescriptive Initiative Gross Realization Rates for Penn Power

Stratum	MWh Threshold	PYRTD MW/yr	Demand Realization Rate	CV	Relative Precision at 85% C.L.
Prescriptive-2	20	0.00	63.1%	0.5	0%
Prescriptive-1	0	0.02	178.7%	1	0%
Program Total	**n/a**	**0.02**	**170.2%**		**0.0%**

Table 379: CI Prescriptive Initiative Demand Gross Realization Rates for WPP

Stratum	MWh Threshold	PYRTD MW/yr	Demand Realization Rate	CV	Relative Precision at 85% C.L.
Prescriptive-2	20	0.04	66.1%	0.5	25%
Prescriptive-1	0	0.07	72.5%	1	21%
Program Total	**n/a**	**0.11**	**70.0%**		**11.4%**

R.2 NET IMPACT EVALUATION

R.2.1 Net Impact Evaluation Methodology

The Net-to-Gross evaluation methodology for the prescriptive measures performed for PY8 was identical to the methodology used for lighting and custom measures.

R.2.2 Sampling

Sample sizes for prescriptive measures were relatively small, as the initiative accounted for less than 1% of gross and net impacts. The sample designs for the four EDCs are shown in Table 380, Table 381, Table 382, and Table 383 for Met-Ed, Penelec, Penn Power, and WPP respectively.

Table 380: CI Prescriptive Initiative Net-to-Gross Sampling for Met-Ed

Stratum	Population Size	Achieved Sample Size	Response Rate
All	28	2	29.0%
Program Total	**28**	**2**	**29.0%**

Table 381: CI Prescriptive Initiative Net-to-Gross Sampling for Penelec

Stratum	PYVTD MWh	Free Ridership (%)	Spillover (%)	NTG Ratio	Relative Precision (@ 85% CL)
Prescriptive-2	627	57.0%	0.2%	43.2%	44.8%
Program Total	**627**	**57.0%**	**0.2%**	**43.2%**	**44.8%**

Table 382: CI Prescriptive Initiative Net-to-Gross Sampling for Penn Power

Stratum	Population Size	Achieved Sample Size	Response Rate
All	18	1	50.0%
Program Total	**18**	**1**	**50.0%**

Table 383: CI Prescriptive Initiative Net-to-Gross Sampling for WPP

Stratum	Population Size	Achieved Sample Size	Response Rate
All	66	1	17.0%
Program Total	**66**	**1**	**17.0%**

R.2.3 Net Impact Evaluation Results

The PYTD verified gross energy impacts, free ridership, spillover, net-to-gross ratios, and relative precisions for net-to-gross are shown in Table 364, Table 365, Table 366, and Table 367 for Met-Ed, Penelec, Penn Power, and WPP respectively.

Table 384: CI Prescriptive Initiative Net-to-Gross Results for Met-Ed

Stratum	PYVTD MWh	Free Ridership (%)	Spillover (%)	NTG Ratio	Relative Precision (@ 85% CL)
All	211	59.3%	0.2%	40.9%	44.4%
Program Total	**211**	**59.3%**	**0.2%**	**40.9%**	**44.4%**

Table 385: CI Prescriptive Initiative Net-to-Gross Results for Penelec

Stratum	MWh Threshold	PYRTD MW/yr	Demand Realization Rate	CV	Relative Precision at 85% C.L.
Prescriptive-2	20	0.15	104.3%	0.5	20%
Prescriptive-1	0	0.03	65.1%	0.5	16%
Program Total	**n/a**	**0.18**	**97.6%**	**0.5**	**17.2%**

Table 386 CI Prescriptive Initiative Net-to-Gross Results for Penn Power

Stratum	PYVTD MWh	Free Ridership (%)	Spillover (%)	NTG Ratio	Relative Precision (@ 85% CL)
Prescriptive-2	320	62.5%	0.2%	37.7%	59.5%
Program Total	**320**	**62.5%**	**0.2%**	**37.7%**	**59.5%**

Table 387 CI Prescriptive Initiative Net-to-Gross Results for WPP

Stratum	PYVTD MWh	Free Ridership (%)	Spillover (%)	NTG Ratio	Relative Precision (@ 85% CL)
Prescriptive-2	564	0.0%	0.2%	100.2%	64.3%
Program Total	**564**	**0.0%**	**0.2%**	**100.2%**	**64.3%**

Appendix S Evaluation Detail – C&I Appliance Turn-In Initiative

S.1 Gross Impact Evaluation

Gross impact evaluation for the Commercial Appliance Turn-In (ATI) Initiative involved customer verification surveys and TRM calculations of measure-level impacts. There are four distinct measures offered by the program: refrigerator recycling, freezer recycling, room AC (RAC) recycling, and dehumidifier recycling.

S.1.1 Gross Impact Evaluation Methodology

ADM's gross impact evaluation methodology was identical to the approach taken for residential ATI, as described in Appendix D.

S.1.2 Sampling

Each measure was treated as a separate stratum within the sampling initiative. The sample designs for the four EDCs are shown in Table 388, Table 389, Table 390, and Table 391.

Table 388: C&I ATI Initiative Gross Impact Sample Design for Met-Ed

Stratum	Population Size	Achieved Sample Size	Evaluation Activity
Refrigerators	80	25	Phone Surveys + Census Desk Review
Freezers	4	2	
Dehumidifiers	0	0	
RACs	20	9	
Program Total	**104**	**36**	

Table 389: C&I ATI Initiative Gross Impact Sample Design for Penelec

Stratum	Population Size	Achieved Sample Size	Evaluation Activity
Refrigerators	65	20	Phone Surveys + Census Desk Review
Freezers	18	5	
Dehumidifiers	0	0	
RACs	7	2	
Program Total	**90**	**27**	

Table 390: C&I ATI Initiative Gross Impact Sample Design for Penn Power

Stratum	Population Size	Achieved Sample Size	Evaluation Activity
Refrigerators	17	9	Phone Surveys + Census Desk Review
Freezers	2	2	
Dehumidifiers	0	0	
RACs	1	0	
Program Total	**20**	**11**	

Table 391: C&I ATI Initiative Gross Impact Sample Design for WPP

Stratum	Population Size	Achieved Sample Size	Evaluation Activity
Refrigerators	77	22	Phone Surveys + Census Desk Review
Freezers	7	1	
Dehumidifiers	0	0	
RACs	11	4	
Program Total	**95**	**27**	

S.1.3 Results for Energy

The gross realization rates for energy, along with relative precisions, are shown in Table 392, Table 393, Table 394, Table 395, and for Met-Ed, Penelec, Penn Power, and WPP respectively.

Table 392: C&I ATI Initiative Energy Gross Realization Rates for Met-Ed

Stratum	PYRTD MWh/yr	Energy Realization Rate	CV	Relative Precision at 85% C.L.
Refrigerators	76	97.4%	0.5	11.9%
Freezers	3	97.4%	0.5	36.0%
Dehumidifiers	0	0.0%	0.5	100.0%
RACs	2	97.4%	0.5	17.8%
Program Total	**81**	**97.4%**	**0.5**	**10.9%**

Table 393: C&I ATI Initiative Energy Gross Realization Rates for Penelec

Stratum	PYRTD MWh/yr	Energy Realization Rate	CV	Relative Precision at 85% C.L.
Refrigerators	69	92.6%	0.5	13.4%
Freezers	15	92.6%	0.5	27.4%
Dehumidifiers	0	0.0%	0.5	100.0%
RACs	1	92.6%	0.5	43.0%
Program Total	**85**	**92.6%**	**0.5**	**11.0%**

Table 394: C&I ATI Initiative Energy Gross Realization Rates for Penn Power

Stratum	PYRTD MWh/yr	Energy Realization Rate	CV	Relative Precision at 85% C.L.
Refrigerators	18	77.3%	0.5	16.5%
Freezers	2	77.3%	0.5	0.0%
Dehumidifiers	0	0.0%	0.5	100.0%
RACs	0	77.3%	0.5	100.0%
Program Total	**20**	**77.3%**	**0.5**	**11.6%**

Table 395: C&I ATI Initiative Energy Gross Realization Rates for WPP

Stratum	PYRTD MWh/yr	Energy Realization Rate	CV	Relative Precision at 85% C.L.
Refrigerators	79	84.5%	0.5	13.0%
Freezers	6	84.5%	0.5	66.7%
Dehumidifiers	0	0.0%	0.5	100.0%
RACs	1	84.5%	0.5	28.7%
Program Total	**86**	**84.5%**	**0.5**	**10.8%**

S.1.4 Results for Demand

The gross realization rates for demand, along with relative precisions, are shown in Table 396, Table 397, Table 398, and Table 399 for Met-Ed, Penelec, Penn Power, and WPP respectively.

Table 396: C&I ATI Initiative Demand Gross Realization Rates for Met-Ed

Stratum	PYRTD MW/yr	Demand Realization Rate	CV	Relative Precision at 85% C.L.
Refrigerators	0.01	63.1%	0.5	11.9%
Freezers	0.00	63.1%	0.5	36.0%
Dehumidifiers	0.00	0.0%	0.5	100.0%
RACs	0.01	63.1%	0.5	17.8%
Program Total	**0.01**	**63.1%**	**0.5**	**6.2%**

Table 397: C&I ATI Initiative Demand Gross Realization Rates for Penelec

Stratum	PYRTD MW/yr	Demand Realization Rate	CV	Relative Precision at 85% C.L.
Refrigerators	0.01	78.3%	0.5	13.4%
Freezers	0.00	78.3%	0.5	27.4%
Dehumidifiers	0.00	0.0%	0.5	100.0%
RACs	0.00	78.3%	0.5	43.0%
Program Total	**0.01**	**78.3%**	**0.5**	**9.6%**

Table 398: C&I ATI Initiative Gross Realization Rates for Penn Power

Stratum	PYRTD MW/yr	Demand Realization Rate	CV	Relative Precision at 85% C.L.
Refrigerators	0.00	69.6%	0.5	16.5%
Freezers	0.00	69.6%	0.5	0.0%
Dehumidifiers	0.00	0.0%	0.5	100.0%
RACs	0.00	69.6%	0.5	100.0%
Program Total	**0.00**	**69.6%**	**0.5**	**11.8%**

Table 399: C&I ATI Initiative Demand Gross Realization Rates for WPP

Stratum	PYRTD MW/yr	Demand Realization Rate	CV	Relative Precision at 85% C.L.
Refrigerators	0.01	65.9%	0.5	13.0%
Freezers	0.00	65.9%	0.5	66.7%
Dehumidifiers	0.00	0.0%	0.5	100.0%
RACs	0.00	65.9%	0.5	28.7%
Program Total	**0.01**	**65.9%**	**0.5**	**7.9%**

S.2 NET IMPACT EVALUATION

S.2.1 Net Impact Evaluation Methodology

An independent net impact evaluation was not conducted for this initiative because the initiative accounts for less than 0.1% of portfolio impacts, as averaged for the four PA Companies. The Net-to-Gross ratios for the C&I Appliance Turn-In program were taken to be the same as the Net-to-Gross ratios for the Residential Appliance Turn-In program.

Appendix T Evaluation Detail – Commercial and Industrial Direct Install Initiative

T.1 Gross Impact Evaluation

In PY9, there were only four projects approved in the Commercial and Industrial Direct Install (C&I Direct Install) initiative. Penelec had one project with 9 MWh savings and Met-Ed had three projects totaling 6 MWh. All projects were selected for evaluation and were found to be lighting upgrades. The projects were evaluated according to the lighting evaluation protocol described in Appendix P.

T.2 Net Impact Evaluation

An independent net impact evaluation was not conducted for this initiative because the initiative had only four projects and accounts for less than 0.1% of portfolio impacts, as averaged for the four PA Companies. The four projects were lighting projects, therefore the Net-to-Gross ratios for the C&I Lighting Initiative were applied as a proxy.

Appendix U Evaluation Detail – Behavioral Demand Response Initiative

U.1 Data Gathering

Interval meter data dating back to January of 2017 through August of 2017 was requested from FirstEnergy for all treatment and control group participants. A map of customer account numbers to treatment v. control group assignment was provided by Oracle. Furthermore, historical weather data for 2017 was obtained from DegreeDays.net for the Allegheny County Airport.

U.2 Data Preparation

Per the guidance set forth by the Act 129 Evaluation Framework and the 2016 TRM, ADM utilized a post-only model with lagged customer-specific control variables to conduct our analysis. We first isolated the data set into event and baseline data sets to reduce the computing resources necessary to conduct our analysis. Because the treatment effect is isolated at the hourly level per event day, limiting the post-only data to solely the hours of the events has no bearing on the result. The event day data was defined as 2 p.m. to 6 p.m. on the three event days

Advanced metering infrastructure was not fully implemented in the Penn Power residential service territory until early 2017, therefore control variables were generated based on data from May of 2017, being that May served as the closest proxy, temperature-wise before treatment onset. ADM isolated 2 p.m. to 6 p.m. on non-holiday weekdays in May of 2017 as the baseline period for the study.

A portion of customers had data that was captured at either a 30-minute or 15-minute interval, recorded in units of kWh/interval. We aggregated data to an hourly level by summing the sub-hourly meter reads per hour for all customers. Additionally, a small number of customer accounts were included in both the treatment group and control group. These customers were removed from the study.

Baseline control variables were created for all participants in a similar fashion to the three control variables used in the lagged seasonal model. ADM created three customer-specific control variables that represented average energy demand during typical periods of “no cooling,” “medium cooling,” and “high cooling.” Periods of “no cooling” were defined as non-holiday weekday hours between 2 p.m. and 6 p.m. in May of 2017 with a temperature above or equal to 60 degrees Fahrenheit and below 70 degrees. “Medium cooling” was defined similarly to “no cooling” except for referring to periods in which the temperature was equal to or above 70 degrees and below 80 degrees. “High cooling” was defined in the same with the exception to referring to temperatures above 80 degrees.

U.1 Regression Analysis

Similar to the evaluation of the Residential Behavioral Modification subprogram, ADM utilized a post-only model which made use of customer-specific baseline control variables generated in the month immediately prior to the first event day (i.e., May of 2017). ADM restricted the baseline period to the month immediately prior to the first event day as it is believed that most of the demand reduction is due to reductions in cooling load during the event period. Therefore, restricting the baseline period to May of 2017 provides the closest match in temperature available during the pre-treatment period. Furthermore, ADM generated three baseline variables for each customer ("no cooling," "medium cooling," and "high cooling") to capture the variability in each customer's energy demand during periods that can typically be attributed to different levels of cooling demand based on the temperature.

The post-only model is specified in the equation below:

$$kW_{ieh} = \beta_0 + \beta_1 * (NoCooling_i + MediumCooling_i + HighCooling_i) +$$

$$\beta_2 * \text{datetime}_{eh} + \tau_{eh} * \text{datetime}_{eh} * \text{treatment}_i + \varepsilon$$

The variables above are defined in Table 400 below. The regression coefficient of the interaction between the date/time of each event hour and the treatment indicator variable represents the average treatment effect per home for each hour of each event. A negative regression coefficient represents demand savings per household. Multiplying each coefficient by the number of treatment homes represents the total demand savings for each event-hour.

Table 400: Definition of variables in the lagged seasonal regression model.

Variable	Definition
kW_{ieh}	Customer i's energy demand during each event hour.
β_0	Intercept of the regression equation.
β_1	A matrix of regression coefficients representing the impact of the pre-treatment baseline variables on the regression equation.
β_1	A matrix of regression coefficients representing the main effect of time.
$NoCooling_i$	A customer's average baseline usage during periods of no cooling, as defined in the previous section.
$MediumCooling_i$	A customer's average baseline usage during periods of medium cooling, as defined in the previous section.
$HighCooling_i$	A customer's average baseline usage during periods of high cooling, as defined in the previous section.
treatment_i	The treatment indicator variable. Equal to one for the treatment group and zero for the control group.
datetime_{eh}	A matrix of indicator variables representing each hour of each event period.
τ_{eh}	A matrix of regression coefficients representing the treatment effect in each of hour of each event day.
ε	The error term.

Appendix V Report Validation

V.1 Linked Images

Most tables and charts in this report are images that are generated within an excel file. The last image should reflect the time and date of report compilation.

Table 401: Report Update Timestamp

Tables and Charts Updated on 11/07/18, at 19:00