Final Annual Report to the Pennsylvania Public Utility Commission

Phase III of Act 129

Program Year 8

(June 1, 2016 – May 31, 2017)

For Pennsylvania Act 129 of 2008

Energy Efficiency and Conservation Plan

Prepared by Navigant Consulting Inc.

For

Duquesne Light Company

November 15, 2017

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1. 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	Duquesne Light Company
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

2. 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.

Section 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 2013 and concluded in 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 for Duquesne Light Company (Duquesne Light, DLC) in Program Year 8 (PY8), 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 PY8. Compliance with Act 129 savings goals are ultimately based on verified gross savings. This report also includes estimates of cost-effectiveness accorded to the Total Resource Cost test (TRC).[1] Duquesne Light has retained Navigant Consulting Inc. (Navigant) as an independent evaluation contractor for Phase III of Act 129. Navigant is responsible for the measurement and verification of the savings and calculation of gross verified and net verified savings.

Navigant also performed a process evaluation 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 Duquesne Light. 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. Duquesne Light did not run a Demand Response program in PY8. Consequently, verified gross savings results from the EDC's first demand response season, which ran from June through September 2017, will be reported in the PY9 Semi-Annual Report to be submitted in January 2018.

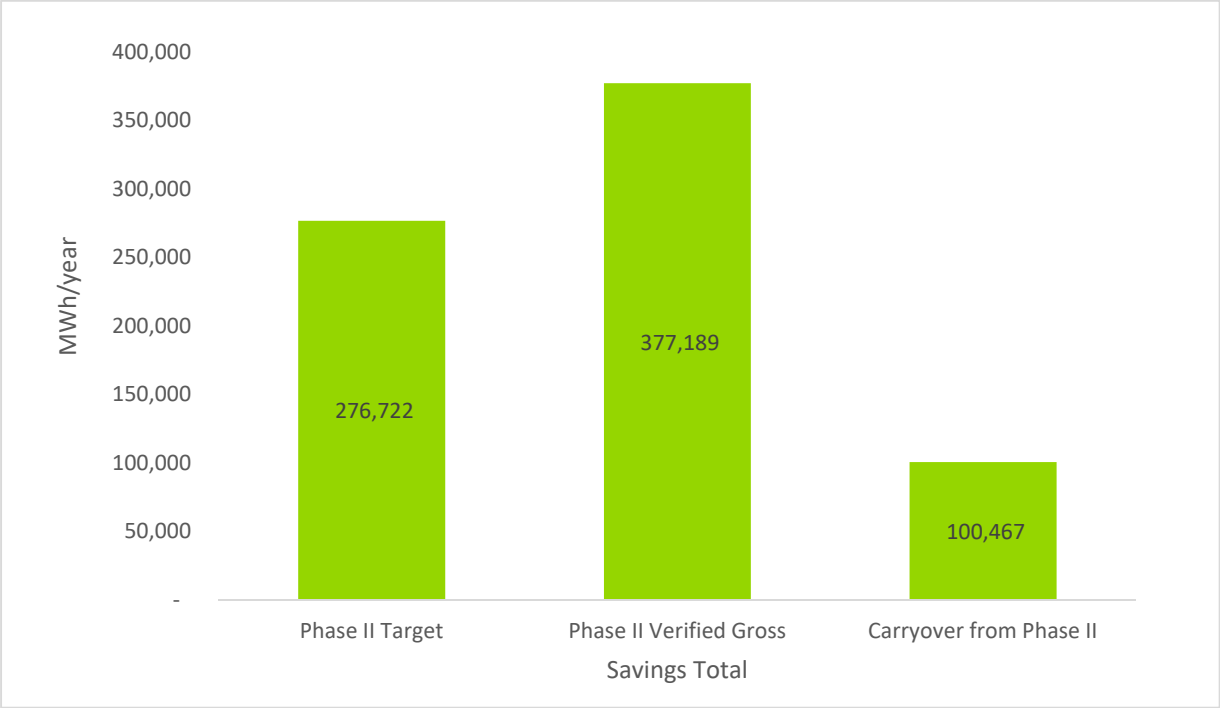
[1] The Pennsylvania TRC Test for Phase I was adopted by PUC order at Docket No. M-2009-2108601 on June 23, 2009 (*2009 PA TRC Test Order*). The TRC Test Order for Phase I later was refined in the same docket on August 2, 2011 (2011 PA TRC Test Order). The 2013 TRC Order for Phase II of Act 129 was issued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

Section 2 Summary of Achievements

2.1 Carryover Savings from Phase II of Act 129

Duquesne Light achieved a total of 100,467 MWh/year of portfolio-level carryover savings from Phase II. Figure 1 compares Duquesne Light's Phase II verified gross savings total to the Phase II compliance target to illustrate the carryover calculation.

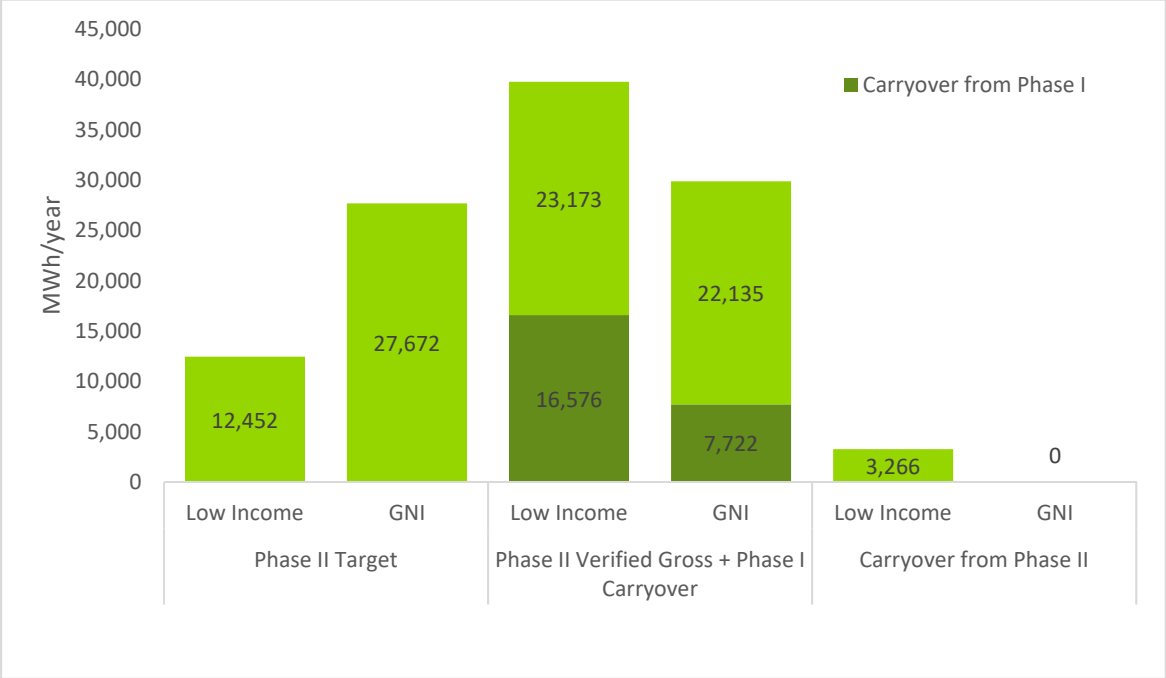
Figure 1: Carryover Savings from Phase II of Act 129



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 carryover savings for the low-income and GNI targets.

[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 II.

Figure 2: Customer Segment-Specific Carryover from Phase II



2.2 Phase III Energy Efficiency Achievements to Date

Since the beginning of Program Year 8 on June 1, 2016, Duquesne Light has claimed:

- 67,737 MWh/yr of reported gross electric energy savings (PYRTD)
- 10.62 MW/yr of reported gross peak demand savings (PYRTD) from energy efficiency programs
- 69,154 MWh/yr of verified gross electric energy savings (PYVTD)
- 10.96 MW/yr of verified gross peak demand savings (PYVTD) from energy efficiency programs

Since the beginning of Phase III of Act 129 on June 1, 2016, Duquesne Light has achieved:

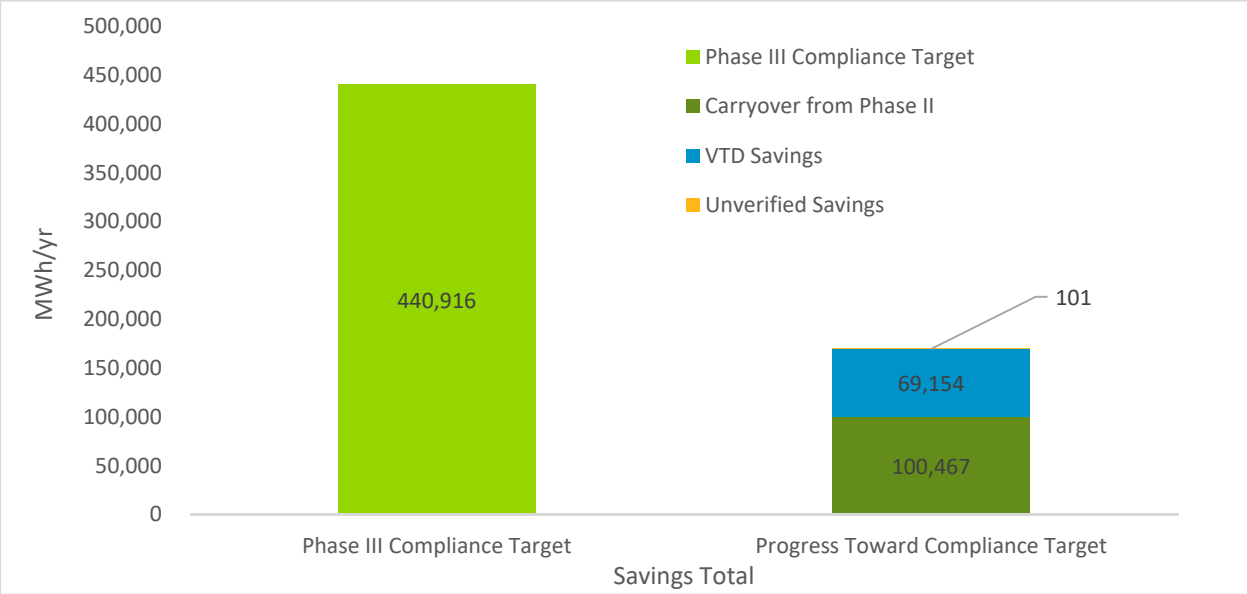
- 67,737 MWh/yr of reported gross electric energy savings (RTD)
- 10.62 MW/yr of reported gross peak demand savings (RTD) from energy efficiency programs
- 69,154 MWh/yr of verified gross electric energy savings (VTD)
- 10.96 MW/yr of verified gross peak demand savings (VTD) from energy efficiency programs

Including carryover savings from Phase II, Duquesne Light has achieved:

- 169,621 MWh/yr of VTD + portfolio-level CO energy savings.
    - This represents 38 percent of the May 31, 2021, energy savings compliance target of 440,916 MWh/yr.

Figure 3 summarizes Duquesne Light's progress towards the Phase III portfolio compliance target. Figure 3 includes the savings from two of the four PY8 Multifamily Retrofit Program projects which still were unverified at the time of the writing of this report. Those are captured under the "Unverified Savings" category. These savings will count toward the overall compliance target, and a percentage of them will count toward the low-income compliance target. Progress toward meeting compliance targets will be updated to include the verified savings from these two projects in the PY9 Semi-Annual Report, along with savings from the first two quarters of PY9.

Figure 3: EE&C Plan Performance Toward Phase III Portfolio Compliance Target

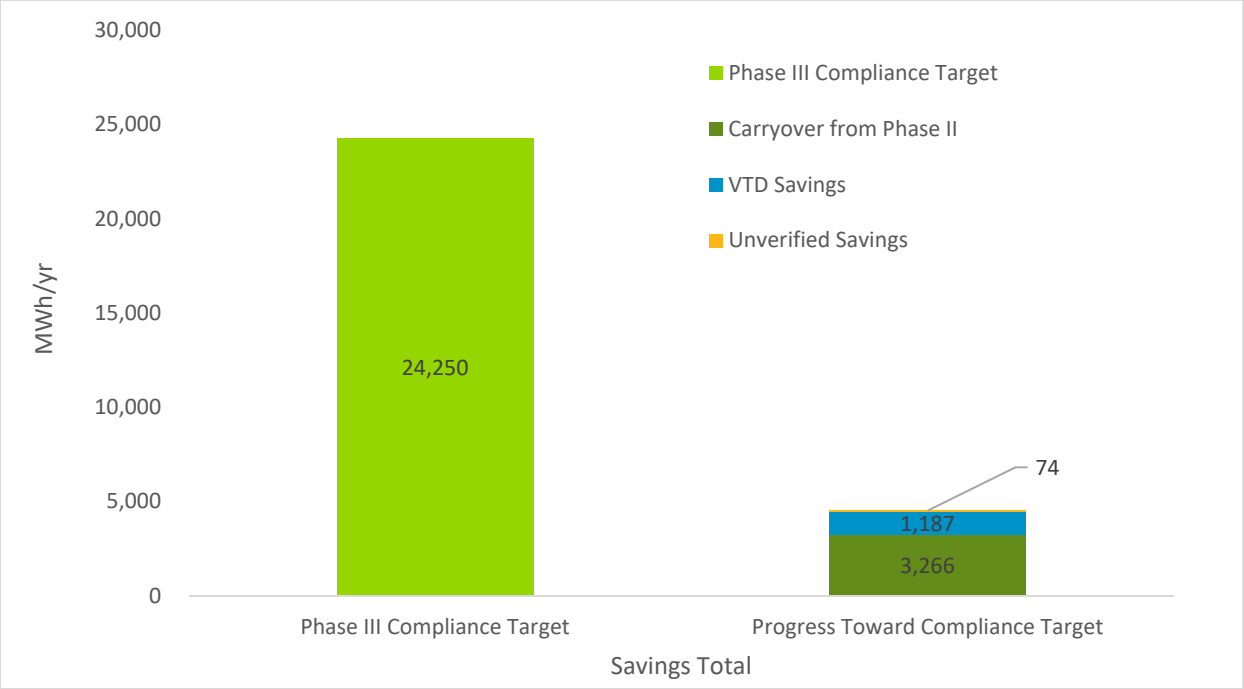


The Phase III Implementation Order directed EDCs to offer conservation measures to the low-income customer segment based on the proportion of electric sales attributable to low-income households. The proportionate number of measures target for Duquesne Light is 8.4 percent. Duquesne Light offers a total of 101 EE&C measures to its residential and non-residential customer classes. There are 20 measures available to the low-income customer segment at no cost to the customer. This represents 19.8 percent of the total measures offered in the EE&C plan and exceeds the proportionate number of measures target.

The PA PUC also established a low-income energy savings target of 5.5 percent of the portfolio savings goal. The low-income savings target for Duquesne Light is 24,250 MWh/yr and is based

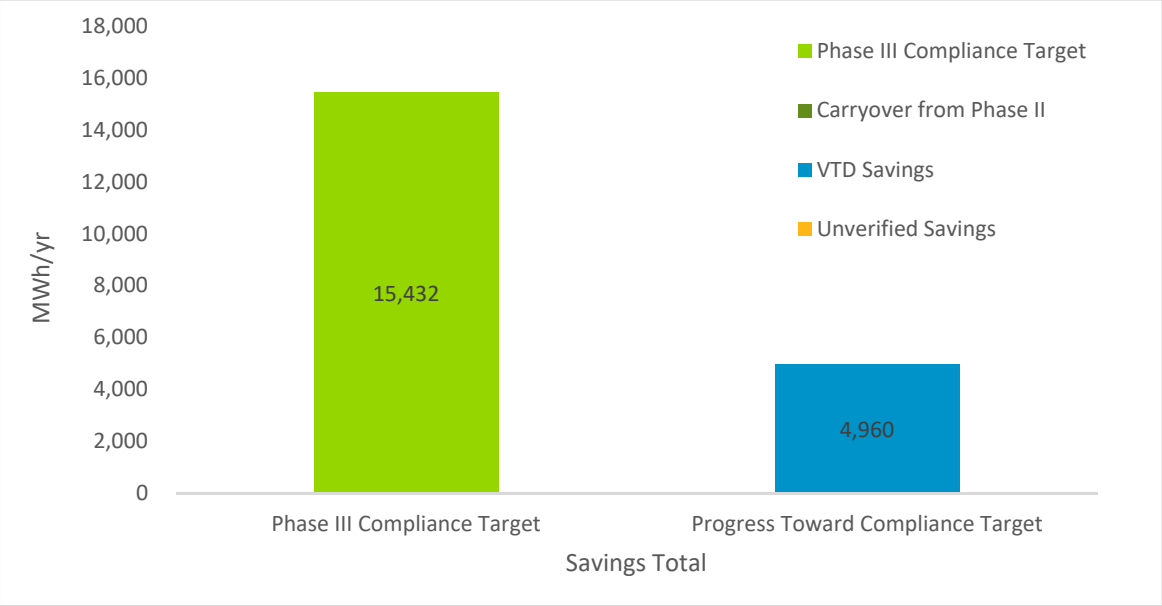
on verified gross savings. Figure 4 compares the VTD performance for the low-income customer segment to the Phase III savings target. Based on the latest available information, Duquesne Light has achieved 18.4 percent of the Phase III low-income energy savings target. Again, however, note that the VTD performance does not yet include the impact of two of the four Multifamily projects on progress toward meeting the Phase III low-income target. Those are captured within the "Unverified Savings" category of Figure 4.

Figure 4: 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 GNI savings target for Duquesne Light is 15,432 MWh/yr and is based on verified gross savings. Figure 5 compares the VTD performance for the GNI customer segment to the Phase III savings target. Based on the latest available information, Duquesne Light has achieved 32.1 percent of the Phase III GNI energy savings target.

Figure 5: 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 target for Duquesne Light is 42 MW. The demand response(DR) program will begin delivering demand reductions in PY9. No DR achievements are reported within this PY8 report.

2.4 Phase III Performance by Customer Segment

Table 1 presents the participation, savings, and spending by customer sector for PY8. 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 1.

Table 1: Program Year 8 Summary Statistics by Customer Segment

Parameter	Residential (Non-LI)	Residential LI	Small C&I (Non-GNI)	Large C&I (Non-GNI)	GNI	Total
Number of participants	67,064	19,206	214	64	54	86,602
PY8 Energy Realization Rate	101%	102%	104%	105%	102%	102%
PYVTD MWh/yr	45,043	1,155	8,382	9,613	4,960	69,154
PY8 Demand Realization Rate	102%	106%	111%	110%	91%	102%
PYVTD MW/yr (Energy Efficiency)	7.666	0.574	1.085	1.094	0.541	10.959
PYVTD MW (Demand Response)	0.00	0.00	0.00	0.00	0.00	0.00
Incentives ($1000)	$1,864	$0	$259	$444	$226	$2,793

Table 2 summarizes plan performance by sector since the beginning of Phase III.

Table 2: Phase III Summary Statistics by Customer Segment

Parameter	Residential (Non-LI)	Residential LI	Small C&I (Non-GNI)	Large C&I (Non-GNI)	GNI	Total
Number of Participants	67,064	19,206	214	64	54	86,602
P3TD Energy Realization Rate	101%	102%	104%	105%	102%	102%
VTD MWh/yr	45,043	1,155	8,382	9,613	4,960	69,154
P3TD Demand Realization Rate	102%	106%	111%	110%	91%	102%
VTD MW (Energy Efficiency)	7.666	0.574	1.085	1.094	0.541	10.959
VTD MW (Demand Response)	0.00	0.00	0.00	0.00	0.00	0.00
Incentives ($1000)	$1,864	$0	$259	$444	$226	$2,793

2.5 Summary of Participation by Program

Participation is defined differently for different 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 Table 3, and Table 4 provides the current participation totals for PY8 and Phase III.

Table 3: Program Participation Definitions

Programs	Component	Definition
REEP: Residential Energy Efficiency Residential Appliance Recycling Express Efficiency Small/Medium Midstream Lighting Small Commercial Direct Install Multifamily Housing Retrofits Commercial Efficiency Community Education Energy Efficiency Large Midstream Lighting Industrial Efficiency Public Agency Partnership	Downstream/ Midstream Rebates	A participant is a customer participating in the program within a given reporting year (e.g., Q1 through Q4 for PY8), represented by a unique participant account number within the tracking system. The counts appearing in Table 4, below, represent the summations of the unique customer participant account numbers in the tracking system for the given program in the year or cumulative years represented (i.e., PYRTD or P3TD). Customers participating in a program more than once within a reporting year (i.e., PYRTD) are counted once; customers participating more than once but in different years or programs are counted more than once (once in each year and/or program).
Residential Behavioral Savings Program	Home Energy Reports	A participant is a customer receiving a Home Energy report during the program year (i.e., PY8). The participant count represents the number of unique participants who received HERs during PY8.
REEP: Residential Energy Efficiency (Upstream Lighting)	Upstream rebates for lamp sales	Participation is not defined because reported program data tracks lamp sales activities and not individual participating customer activities.
REEP: Residential Energy Efficiency	Giveaways	A portion of REEP program savings results from efficiency kit giveaways during events in which the utility has participated (event giveaways). Although Duquesne Light tracks events and the measures given away, individual participants who receive the measures are not counted. Therefore, participation is not defined.
Low Income Energy Efficiency	Giveaways	All program savings reported to date stem from event efficiency kit giveaways. Duquesne Light tracks events and the measures given away and not the individual participants who receive the measures. Therefore, participation is not defined.

Participation for the following programs will be defined in subsequent compliance reports once activities are reported by Duquesne Light for Phase III.

- Whole House Energy Audit Program
- Large Curtailable Load Program

Table 4: EE&C Portfolio Participation by Program

Program	PYTD Participation	P3TD Participation
REEP: Residential Energy Efficiency	4,948	4,948
REEP: Residential Energy Efficiency (Upstream Lighting)	N/A	N/A
Residential Appliance Recycling	1,161	1,161
Residential Behavioral Savings	60,955	60,955
Residential Whole House Retrofit	0	0
Low Income Energy Efficiency	19,206	19,206
Express Efficiency	94	94
Small/Medium Midstream Lighting	78	78
Small Commercial Direct Install	38	38
Multifamily Housing Retrofit	4	4
Commercial Efficiency	10	10
Large Midstream Lighting	43	43
Industrial Efficiency	11	11
Public Agency Partnership	41	41
Community Education	13	13
Large C&I Demand Response Curtailable	0	0
Portfolio Total	**86,602**	**86,602**

2.6 Summary of Impact Evaluation Results

During PY8, Navigant completed impact evaluations for many of the energy efficiency programs in the portfolio. Table 5 summarizes the realization rates and net-to-gross ratios by program or evaluation initiative.

Table 5: Impact Evaluation Results Summary

Program\Initiative	Energy Realization Rate	Demand Realization Rate	Net to Gross Ratio
REEP: Residential Energy Efficiency	69%	80%	0.58
REEP: Residential Energy Efficiency (Upstream Lighting)	103%	103%	0.69
Residential Appliance Recycling	92%	92%	0.47
Residential Behavioral Savings	104%	104%	1.00
Residential Whole House Retrofit	N/A	N/A	N/A
Low Income Energy Efficiency	102%	106%	0.96
Express Efficiency	98%	102%	0.56
Small/Medium Midstream Lighting	156%	166%	0.88
Small Commercial Direct Install	98%	102%	0.99
Multifamily Housing Retrofit*	36%	27%	0.71
Commercial Efficiency	98%	102%	0.56
Large Midstream Lighting	156%	166%	0.88
Industrial Efficiency	99%	98%	0.68
Public Agency Partnership	101%	87%	0.80
Community Education	103%	98%	0.80
Large C&I Demand Response Curtailable	N/A	N/A	N/A

*Realization rates for the Multifamily Retrofit Program reflect the ratio of the verified projects to total PY8 reported savings. Savings from two of the four PY8 project are not yet verified and are not included in the verified projects total.

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. Table 6 presents net-to-gross findings for high impact measures (HIMs) studied in PY8. Two programs received net-to-gross research in PY8 – the Residential Appliance Recycling Program and the Nonresidential Midstream Lighting Program. Of these programs, only one had an HIM to be addressed – recycled refrigerators. The recycled refrigerator results are presented below.

Table 6: High Impact Measure Net-to-Gross

HIM	Free Ridership	Spillover	Net-to-Gross Ratio
Refrigerators	0.63	0.07	0.44

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 6 presents a summary of the PYTD energy savings by program for Program Year 8. 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 the energy recent realization rate and the verified net savings are adjusted by both the realization rate and the net-to-gross ratio.

Figure 6: PYTD Energy Savings by Program

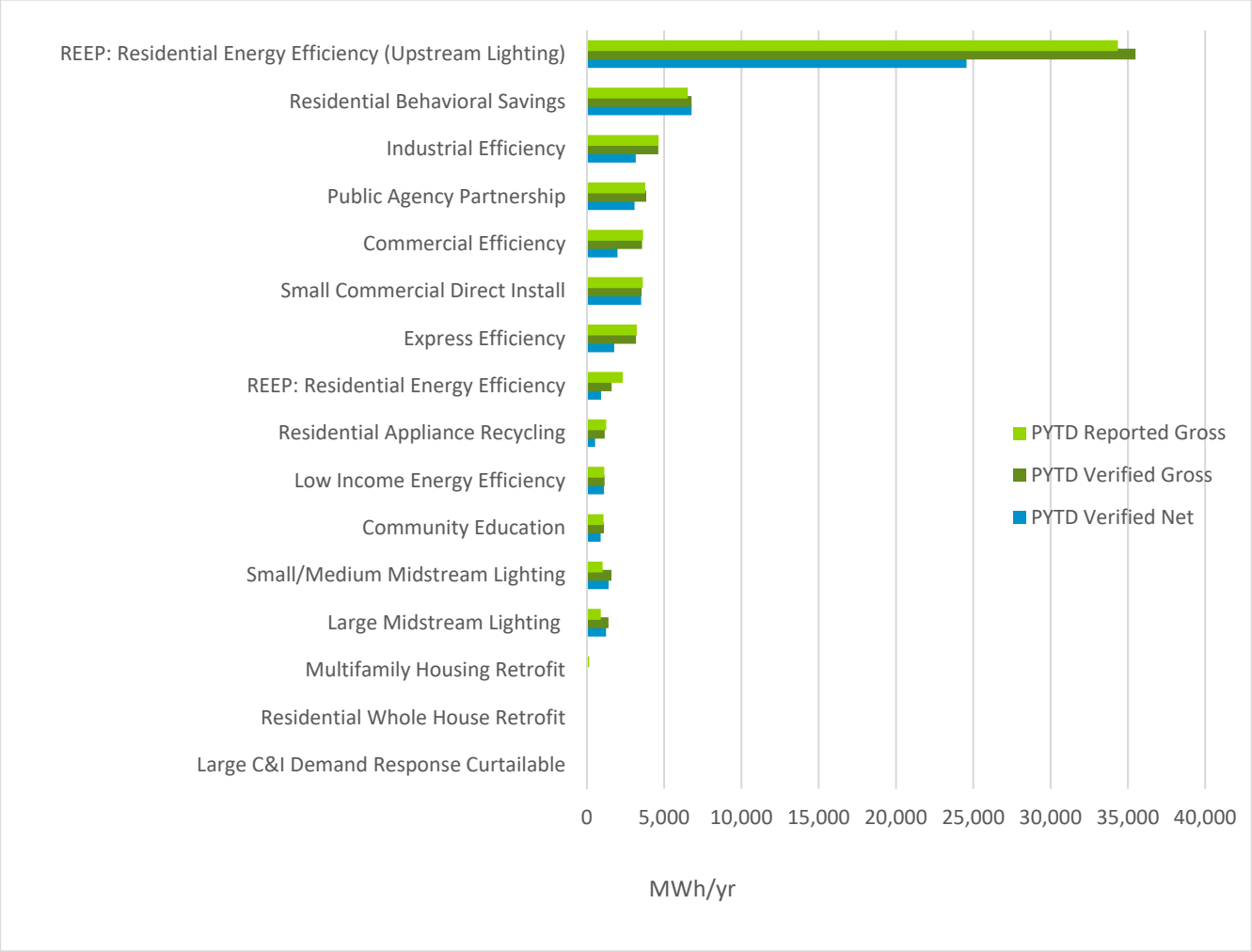
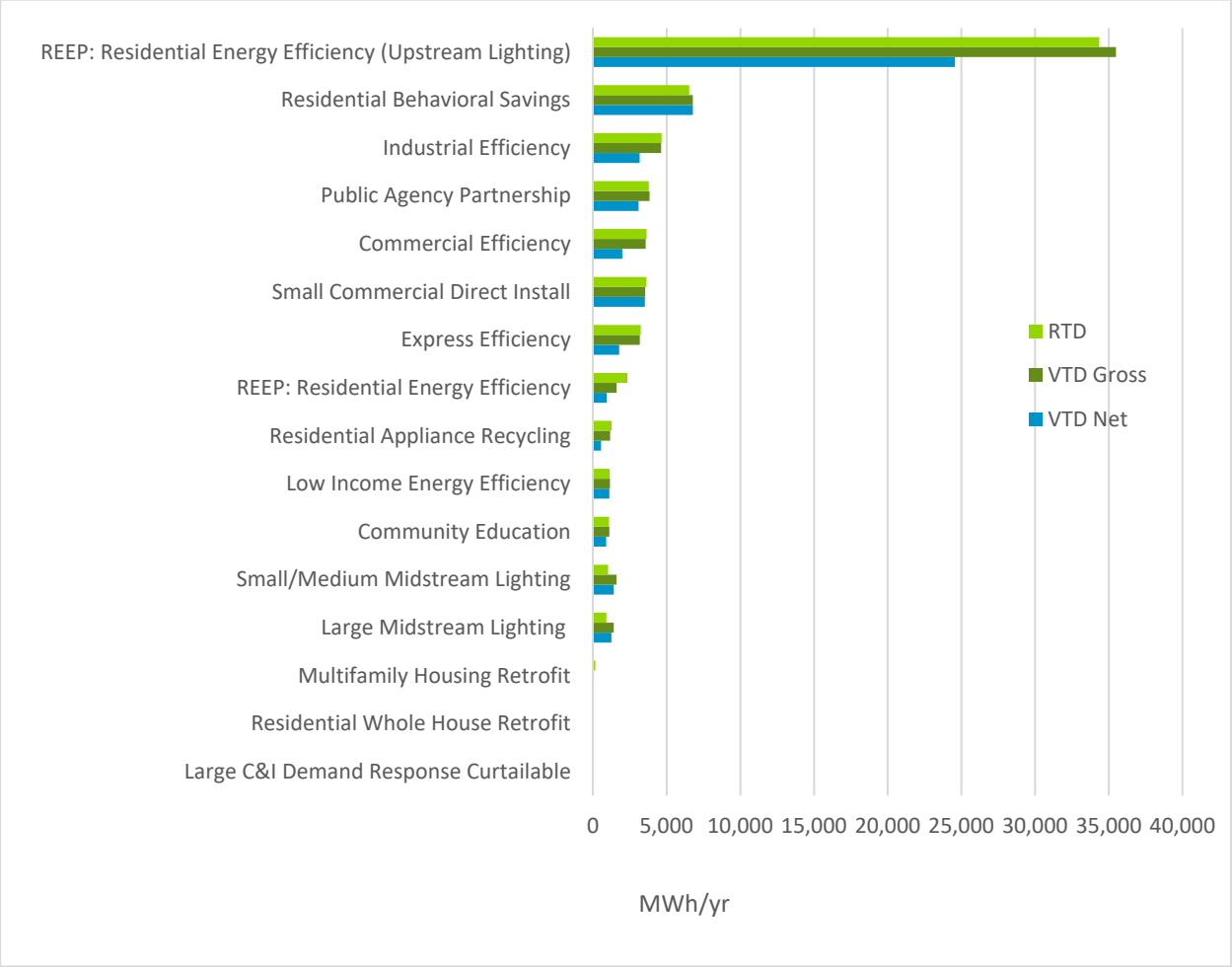


Figure 7 presents a summary of the energy savings by program for Phase III of Act 129.

Figure 7: P3TD Energy Savings by Program



A summary of energy impacts by program through PY8 is presented in Table 7.

Table 7: Incremental Annual Energy Savings by Program (MWh/Year)

Program	PYRTD (MWh/yr)	PYVTD Gross (MWh/yr)	PYVTD Net (MWh/yr)	RTD (MWh/yr)	VTD Gross (MWh/yr)	VTD Net (MWh/yr)
REEP: Residential Energy Efficiency	2,326	1,606	926	2,326	1,606	926
REEP: Residential Energy Efficiency (Upstream Lighting)	34,358	35,496	24,572	34,358	35,496	24,572
Residential Appliance Recycling	1,261	1,165	543	1,261	1,165	543
Residential Behavioral Savings	6,536	6,776	6,776	6,536	6,776	6,776
Residential Whole House Retrofit	0	0	0	0	0	0
Low Income Energy Efficiency	1,132	1,155	1,112	1,132	1,155	1,112
Express Efficiency	3,239	3,183	1,773	3,239	3,183	1,773
Small/Medium Midstream Lighting	1,025	1,595	1,412	1,025	1,595	1,412
Small Commercial Direct Install	3,626	3,546	3,521	3,626	3,546	3,521
Multifamily Housing Retrofit*	159	57	41	159	57	41
Commercial Efficiency	3,642	3,579	1,993	3,642	3,579	1,993
Large Midstream Lighting	904	1,407	1,245	904	1,407	1,245
Industrial Efficiency	4,651	4,627	3,166	4,651	4,627	3,166
Public Agency Partnership	3,793	3,845	3,093	3,793	3,845	3,093
Community Education	1,084	1,115	897	1,084	1,115	897
Large C&I Demand Response Curtailable	0	0	0	0	0	0
Portfolio Total	**67,737**	**69,154**	**51,071**	**67,737**	**69,154**	**51,071**

*Excludes verified savings for two of the four Multifamily Retrofit Program projects not yet verified.

2.7.2 Lifetime Energy Savings by Program

Table 8 presents the PYTD and P3TD lifetime energy savings by program. Lifetime energy savings are calculated by multiplying the annual energy savings by the efficient measure useful lifetime (EUL). Per the PA 2016 TRC Order, the measure EUL does not exceed 15 years for any measure in the portfolio. Additionally, early replacement measures are subject to a dual baseline calculation, leading to modified lifetime savings. For these measures, savings relative to the in-place baseline equipment are used for the remaining useful lifetime (RUL) of the base equipment. After the RUL, savings relative to code equipment are utilized for the remainder of the efficient measure's EUL.

Table 8: Lifetime Energy Savings by Program (MWh)

Program Name	PYVTD Gross Lifetime (MWh)	PYVTD Net (MWh)	VTD Gross Lifetime (MWh)	VTD Net Lifetime (MWh)
REEP: Residential Energy Efficiency	18,190	10,489	18,190	10,489
REEP: Residential Energy Efficiency (Upstream Lighting)	301,021	208,376	301,021	208,376
Residential Appliance Recycling	8,453	3,943	8,453	3,943
Residential Behavioral Savings	6,776	6,776	6,776	6,776
Residential Whole House Retrofit	0	0	0	0
Low Income Energy Efficiency	2,218	1,720	2,218	1,720
Express Efficiency	47,169	26,271	47,169	26,271
Small/Medium Midstream Lighting	15,380	13,610	15,380	13,610
Small Commercial Direct Install	47,625	47,290	47,625	47,290
Multifamily Housing Retrofit	859	611	859	611
Commercial Efficiency	49,093	27,342	49,093	27,342
Large Midstream Lighting	15,159	13,415	15,159	13,415
Industrial Efficiency	68,756	47,051	68,756	47,051
Public Agency Partnership	56,247	45,244	56,247	45,244
Community Education	15,932	12,816	15,932	12,816
Large C&I Demand Response Curtailable	0	0	0	0
Portfolio Total	**652,878**	**464,953**	**652,878**	**464,953**

*Excludes verified savings for two of the four Multifamily Retrofit Program projects not yet verified.

2.8 Summary of Demand Impacts by Program

Duquesne Light Company's 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 8 presents a summary of the PYTD demand savings by energy efficiency program for Program Year 8.

Figure 8: PYTD Demand Savings by Energy Efficiency Program

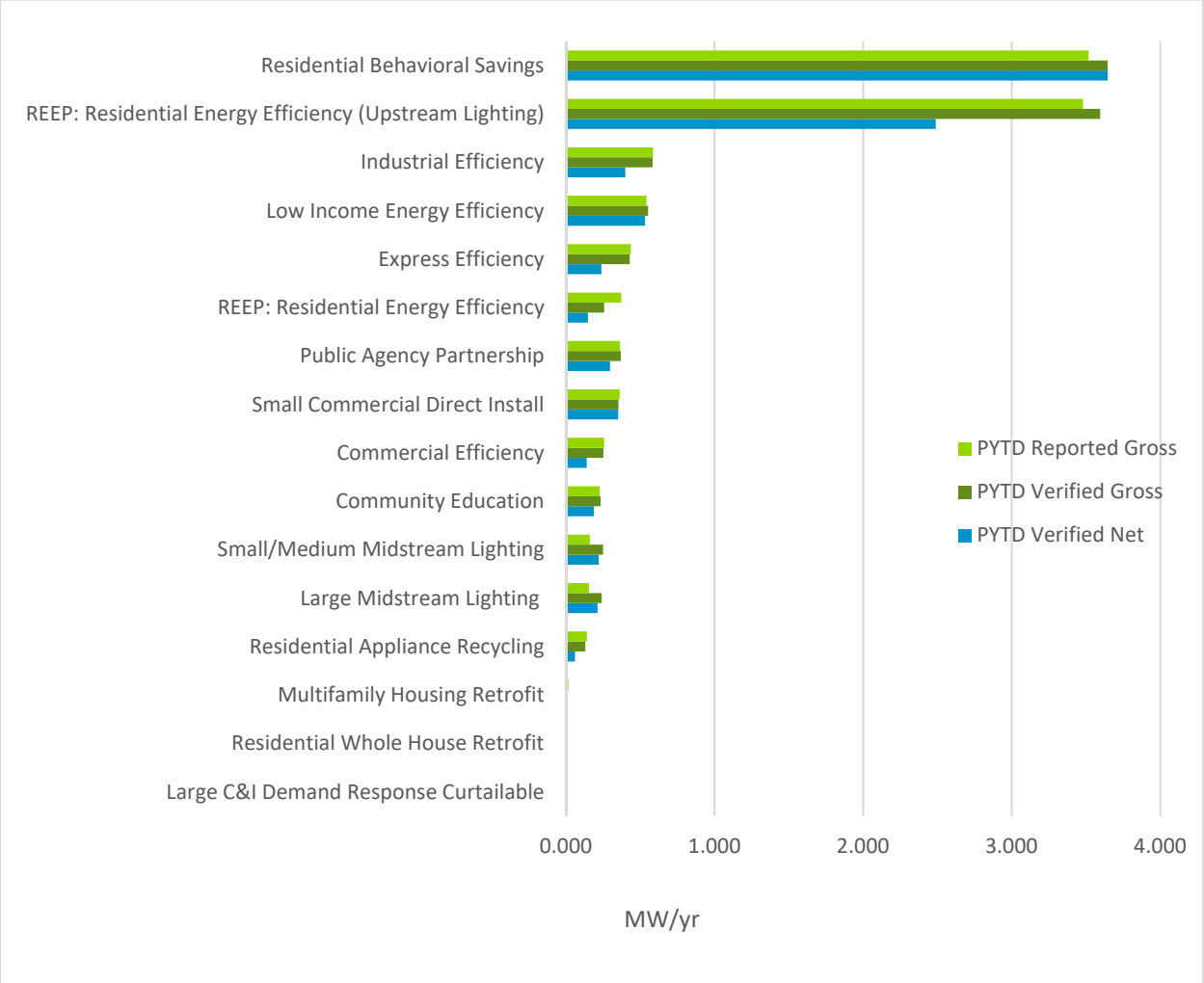
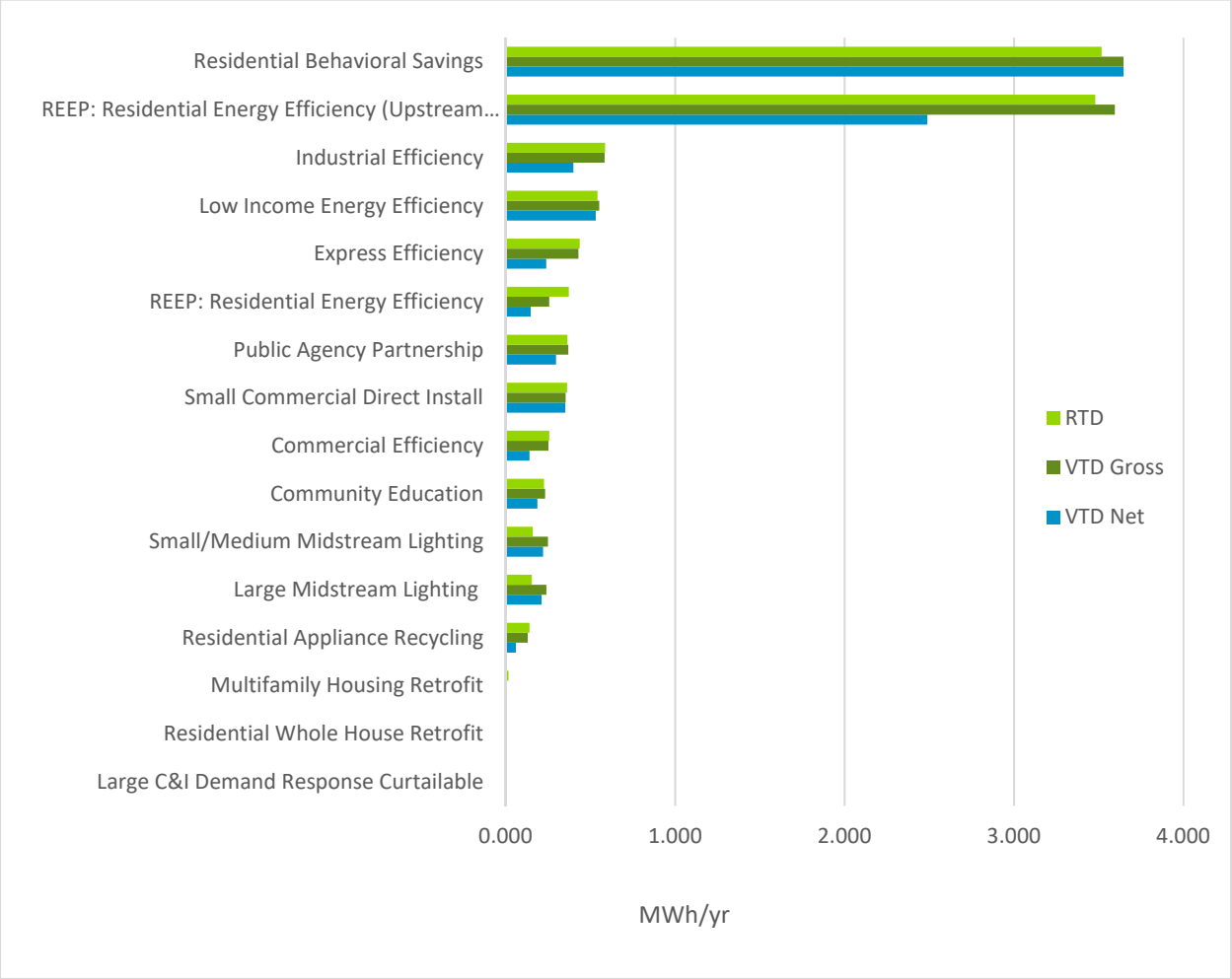


Figure 9 presents a summary of the P3TD demand savings by energy efficiency program for Phase III of Act 129.

Figure 9: P3TD Demand Savings by Energy Efficiency Program



A summary of the peak demand impacts by energy efficiency program through the current reporting period are presented in Table 9.

Table 9: Peak Demand Savings by Energy Efficiency Program (MW/Year)

Program Name	PYRTD (MW/yr)	PYVTD Gross (MW/yr)	PYVTD Net (MW/yr)	RTD (MW/yr)	VTD Gross (MW/yr)	VTD Net (MW/yr)
REEP: Residential Energy Efficiency	0.372	0.296	0.185	0.372	0.296	0.185
REEP: Residential Energy Efficiency (Upstream Lighting)	3.480	3.593	2.487	3.480	3.593	2.487
Residential Appliance Recycling	0.141	0.130	0.061	0.141	0.130	0.061
Residential Behavioral Savings	3.517	3.647	3.647	3.517	3.647	3.647
Residential Whole House Retrofit	0.000	0.000	0.000	0.000	0.000	0.000
Low Income Energy Efficiency	0.542	0.574	0.553	0.542	0.574	0.553
Express Efficiency	0.437	0.446	0.248	0.437	0.446	0.248
Small/Medium Midstream Lighting	0.161	0.266	0.236	0.161	0.266	0.236
Small Commercial Direct Install	0.362	0.368	0.366	0.362	0.368	0.366
Multifamily Housing Retrofit	0.016	0.004	0.003	0.016	0.004	0.003
Commercial Efficiency	0.257	0.262	0.146	0.257	0.262	0.146
Large Midstream Lighting	0.154	0.256	0.227	0.154	0.256	0.227
Industrial Efficiency	0.587	0.575	0.394	0.587	0.575	0.394
Public Agency Partnership	0.364	0.318	0.256	0.364	0.318	0.256
Community Education	0.227	0.223	0.179	0.227	0.223	0.179
Large C&I Demand Response Curtailable	0.000	0.000	0.000	0.000	0.000	0.000
Portfolio Total	**10.619**	**10.959**	**8.987**	**10.619**	**10.959**	**8.987**

*Excludes verified savings for two of the four Multifamily Retrofit Program projects not yet verified.

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. Duquesne Light uses the following line loss percentages/multipliers by sector:

- Residential = 1.074
- Small C&I = 1.074
- Large C&I = 1.074

As noted above, no DR achievements are reported within this PY8 report. There are no DR achievements to-date for Phase III.

2.9 Summary of Fuel Switching Impacts

No fuel switching measures are offered through Duquesne Light EE&C programs.

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. Table 10 shows the TRC ratios by program and for the portfolio. The benefits in Table 10 were calculated using gross verified impacts. Costs and benefits are expressed in 2016 dollars.

PY8 residential program gross TRC cost effectiveness generally was strong, except for the low-income program (LIEEP). LIEEP cost effectiveness was driven by significant costs being incurred in developing and ramping up the low-income component of the Whole House Retrofit program, which will produce savings starting in PY9. Except for the Multifamily Housing Retrofit Program (MFHR), which has long sales lead times and incurred program costs over the course of a slow ramp-up period (a total of only four completed projects in PY8), the non-residential programs had very positive gross TRC cost effectiveness results. MFHR cost effectiveness is expected to improve in PY9.

Table 10: PY8 Gross TRC Ratios by Program ($1,000)

Program	TRC NPV Benefits	TRC NPV Costs	TRC Ratio	TRC Net Benefits (Benefits – Costs)
REEP: Residential Energy Efficiency	$19,885	$7,717	2.58	$12,167
Residential Appliance Recycling	$364	$228	1.60	$136
Residential Behavioral Savings	$538	$143	3.76	$395
Residential Whole House Retrofit	$0	$68	0.00	($68)
Low Income Energy Efficiency	$132	$343	0.38	($211)
Residential Subtotal	**$20,918**	**$8,499**	**2.46**	**$12,419**
Express Efficiency	$1,993	$995	2.00	$999
Small/Medium Midstream Lighting	$908	$153	5.95	$755
Small Commercial Direct Install	$1,824	$983	1.86	$841
Multifamily Housing Retrofit	$32	$310	0.10	($278)
Commercial Efficiency	$1,839	$1,428	1.29	$411
Large Midstream Lighting	$962	$426	2.26	$535
Industrial Efficiency	$2,945	$988	2.98	$1,957
Public Agency Partnership	$2,179	$1,518	1.44	$662
Community Education	$926	$633	1.46	$293
Large C&I Demand Response Curtailable	$0	$485	0.00	($485)
Non-Residential Subtotal	**$13,609**	**$7,919**	**1.72**	**$5,690**
Portfolio Total	**$34,527**	**$16,418**	**2.10**	**$18,109**

Table 11 presents PY8 cost-effectiveness using net verified savings to calculate benefits. Net TRC cost effectiveness for the residential programs followed the pattern of gross TRC cost effectiveness, except for the Residential Appliance Recycling Program (RARP), which continues to show results below 1.0. Nonresidential net TRC cost effectiveness results were also generally positive (close to or greater than 1.0) for all programs.

Table 11: PY8 Net TRC Ratios by Program ($1,000)

Program	TRC NPV Benefits	TRC NPV Costs	TRC Ratio	TRC Net Benefits (Benefits – Costs)
REEP: Residential Energy Efficiency	$13,665	$6,171	2.21	$7,494
Residential Appliance Recycling	$170	$228	0.74	($58)
Residential Behavioral Savings	$538	$143	3.76	$395
Residential Whole House Retrofit	$0	$68	0.00	($68)
Low Income Energy Efficiency	$127	$343	0.37	($216)
Residential Subtotal	**$14,500**	**$6,953**	**2.09**	**$7,547**
Express Efficiency	$1,110	$826	1.34	$284
Small/Medium Midstream Lighting	$803	$147	5.48	$657
Small Commercial Direct Install	$1,811	$983	1.84	$828
Multifamily Housing Retrofit	$23	$290	0.08	($268)
Commercial Efficiency	$1,024	$1,068	0.96	($44)
Large Midstream Lighting	$851	$420	2.03	$431
Industrial Efficiency	$2,015	$919	2.19	$1,096
Public Agency Partnership	$1,753	$1,405	1.25	$348
Community Education	$745	$541	1.38	$204
Large C&I Demand Response Curtailable	$0	$485	0.00	($485)
Non-Residential Subtotal	**$10,136**	**$7,084**	**1.43**	**$3,052**
Portfolio Total	**$24,636**	**$14,037**	**1.76**	**$10,599**

Table 12 summarizes cost-effectiveness by program for Phase III of Act 129. Cost and benefits are expressed in 2016 dollars.

Table 12: P3TD Gross TRC Ratios by Program ($1,000)

Program	TRC NPV Benefits	TRC NPV Costs	TRC Ratio	TRC Net Benefits (Benefits – Costs)
REEP: Residential Energy Efficiency	$19,885	$7,717	2.58	$12,167
Residential Appliance Recycling	$364	$228	1.60	$136
Residential Behavioral Savings	$538	$143	3.76	$395
Residential Whole House Retrofit	$0	$68	0.00	($68)
Low Income Energy Efficiency	$132	$343	0.38	($211)
Residential Subtotal	**$20,918**	**$8,499**	**2.46**	**$12,419**
Express Efficiency	$1,993	$995	2.00	$999
Small/Medium Midstream Lighting	$908	$153	5.95	$755
Small Commercial Direct Install	$1,824	$983	1.86	$841
Multifamily Housing Retrofit	$32	$310	0.10	($278)
Commercial Efficiency	$1,839	$1,428	1.29	$411
Large Midstream Lighting	$962	$426	2.26	$535
Industrial Efficiency	$2,945	$988	2.98	$1,957
Public Agency Partnership	$2,179	$1,518	1.44	$662
Community Education	$926	$633	1.46	$293
Large C&I Demand Response Curtailable	$0	$485	0.00	($485)
Non-Residential Subtotal	**$13,609**	**$7,919**	**1.72**	**$5,690**
Portfolio Total	**$34,527**	**$16,418**	**2.10**	**$18,109**

Table 13 presents P3TD cost-effectiveness results using net verified savings to calculate benefits. Cost and benefits are expressed in 2016 dollars.

Table 13: P3TD Net TRC Ratios by Program ($1,000)

Program	TRC NPV Benefits	TRC NPV Costs	TRC Ratio	TRC Net Benefits (Benefits – Costs)
REEP: Residential Energy Efficiency	$13,665	$6,171	2.21	$7,494
Residential Appliance Recycling	$170	$228	0.74	($58)
Residential Behavioral Savings	$538	$143	3.76	$395
Residential Whole House Retrofit	$0	$68	0.00	($68)
Low Income Energy Efficiency	$127	$343	0.37	($216)
Residential Subtotal	**$14,500**	**$6,953**	**2.09**	**$7,547**
Express Efficiency	$1,110	$826	1.34	$284
Small/Medium Midstream Lighting	$803	$147	5.48	$657
Small Commercial Direct Install	$1,811	$983	1.84	$828
Multifamily Housing Retrofit	$23	$290	0.08	($268)
Commercial Efficiency	$1,024	$1,068	0.96	($44)
Large Midstream Lighting	$851	$420	2.03	$431
Industrial Efficiency	$2,015	$919	2.19	$1,096
Public Agency Partnership	$1,753	$1,405	1.25	$348
Community Education	$745	$541	1.38	$204
Large C&I Demand Response Curtailable	$0	$485	0.00	($485)
Non-Residential Subtotal	**$10,136**	**$7,084**	**1.43**	**$3,052**
Portfolio Total	**$24,636**	**$14,037**	**1.76**	**$10,599**

2.11 Comparison of Performance to Approved EE&C Plan

Table 14 presents P3TD expenditures, by program, compared to the budget estimates set forth in the EE&C plan through PY8. All of the dollars in Table 14 are presented in 2016 dollars.

Table 14: Comparison of P3TD Expenditures to Phase III EE&C Plan ($1,000)

Program	Phase III Budget from EE&C Plan through PY8	P3TD Actual Expenditures	Ratio (Actual/Plan)
REEP: Residential Energy Efficiency	$3,151	$4,600	1.46
Residential Appliance Recycling	$260	$266	1.02
Residential Behavioral Savings	$397	$143	0.36
Residential Whole House Retrofit	$245	$68	0.28
Low Income Energy Efficiency	$1,220	$343	0.28
Express Efficiency	$1,579	$753	0.48
Small/Medium Midstream Lighting	$559	$189	0.34
Small Commercial Direct Install	$934	$983	1.05
Multifamily Housing Retrofit	$851	$275	0.32
Commercial Efficiency	$1,836	$795	0.43
Large Midstream Lighting	$1,349	$477	0.35
Industrial Efficiency	$3,051	$925	0.30
Public Agency Partnership	$1,698	$1,090	0.64
Community Education	$407	$239	0.59
Large C&I Demand Response Curtailable	$697	$485	0.70
Portfolio Total	**$18,234**	**$11,631**	**0.64**

Table 15 compares Phase III verified gross program savings compare to the energy savings projections filed in the EE&C plan.

Table 15: Comparison of Phase III Actual Program Savings to EE&C Plan Projections for Phase III

Program	EE&C Plan Through PY8	VTD Gross MWh Savings	Ratio (Actual/Plan)
REEP: Residential Energy Efficiency	17,261	37,103	2.15
Residential Appliance Recycling	1,763	1,165	0.66
Residential Behavioral Savings	4,829	6,776	1.40
Residential Whole House Retrofit	350	0	0.00
Low Income Energy Efficiency	3,310	1,155	0.35
Express Efficiency	7,030	3,183	0.45
Small/Medium Midstream Lighting	3,893	1,595	0.41
Small Commercial Direct Install	2,187	3,546	1.62
Multifamily Housing Retrofit*	1,782	57	0.03
Commercial Efficiency	10,115	3,579	0.35
Large Midstream Lighting	9,393	1,407	0.15
Industrial Efficiency	16,804	4,627	0.28
Public Agency Partnership	9,354	3,845	0.41
Community Education	1,874	1,115	0.59
Large C&I Demand Response Curtailable	0	0	0.00
Portfolio Total	**89,947**	**69,154**	**0.77**

*Excludes verified savings for two of the four Multifamily Retrofit Program projects not yet verified.

- The residential program energy savings achieved by Duquesne Light in PY8 exceeded the PY8 residential sector savings goal for these programs as reflected in the EDC's EE&C Plan by 68%, and exceeded the PY8 spending target from that Plan by about 3%.

This phenomenon was driven largely by the Upstream Lighting program and the low-income portion of the Residential Behavioral Savings (Home Energy Reports) program. The Whole House Retrofit Program and its LIEEP counterpart generated no savings in PY8 due to a slow ramp up that will generate savings only starting in PY9. Similarly, the RARP ramp-up period slowed progress toward goals as the new CSP for this program was brought on board and developed the infrastructure for the program.

- The nonresidential program energy savings achieved by Duquesne Light in PY8 fell short of the utility's nonresidential program savings goal, as reflected in its EE&C Plan for the year, by 63%, and expenditures were also lower than budgeted by 51%. PY8 represented the first year of a new phase of program delivery, involving new CSPs and some new programs. As a result, there was a significant ramp period associated with activity in PY8, which resulted in lower than planned savings and expenditures.

2.12 Findings and Recommendations

Navigant found no overarching problems across programs in PY8 other than the fact that several programs had slow starts due to ramp-up activities. No recommendations are offered for these programs, now that the ramp-up period is over.

Table 16: Summary of Evaluation Recommendations

Evaluation Activity	Finding	Recommendation
Impact evaluation	No overarching findings	
Limited process evaluation	No overarching findings	

Section 3 Evaluation Results by Program

This section documents the gross impact, net impact, and process evaluation activities conducted in PY8 along with the outcomes of those activities. Not every program receives an evaluation every year. For example, in-depth research activities including participant process and net-to-gross surveys are not completed every year, including during PY8, for the Residential Energy Efficiency Program (REEP) and for most nonresidential programs. Instead, Navigant will use PY7 results for PY8. Evaluations during PY9 and PY11 often will inform updates to net to gross ratios and process related research to identify opportunities for program improvements. When certain types of research will not be conducted in a given year, the previous year's results typically will be used, per the approved Phase III Evaluation Plan.

Figure 10: Evaluation Activity Matrix

Program	PY8			PY9			PY10			PY11			PY12		
	Gross	Net	Process	Gross	Net	Process	Gross	Net	Process	Gross	Net	Process	Gross	Net	Process
REEP: Residential Energy Efficiency	*			X	X	X				X	X	X			
REEP: Upstream Lighting	X			X	X	X	X			X	X	X	X		
Residential Appliance Recycling	X	X	X							X	X	X			
Residential Behavioral Savings	X	**		X	**	X	X	**		X	**	X	X	**	
Residential Whole House Retrofit				X	X	X	X						X	X	X
Low Income Energy Efficiency***	X			X	X	X	X			X	X	X	X		
Express Efficiency	X				X	X	X				X	X	X		
Midstream Lighting	X	X	X	X				X	X	X					

Program	PY8			PY9			PY10			PY11			PY12		
	Gross	Net	Process	Gross	Net	Process	Gross	Net	Process	Gross	Net	Process	Gross	Net	Process
Small Commercial Direct Install	X				X	X	X				X	X			
Multifamily Housing Retrofit	X				X	X				X	X	X			
Commercial Efficiency	X				X	X	X				X	X	X		
Industrial Efficiency				X	X	X				X	X	X			
Public Agency Partnership	X				X	X	X				X	X	X		
Community Education	X				X	X	X				X	X	X		
Large C&I Demand Response Curtailable				X			X			X			X		

*While verification surveys were not performed for REEP, Navigant did conduct an application review for the program, which influenced the program's PY8 realization rate.
**The results of the impact evaluation for this program are net savings, such that no separate net savings assessment is necessary.
***At least one component of this program will receive impact evaluation each year.

3.1 Residential Energy Efficiency Program

The Residential Energy Efficiency Rebate Program (REEP) is designed to encourage customers to make an energy efficient choice when purchasing and installing household appliance and equipment measures by offering customers educational materials and financial incentives. Program educational materials include an online survey to help promote the availability of the REEP rebates. Duquesne Light also holds regular events within a number of retail stores to educate consumers on energy efficiency products, and to provide a platform for more broadly educating consumers on other programs falling under the EDC's Watt Choices brand.

REEP also provides energy efficiency measures in the form of energy efficiency kits free of charge to Duquesne Light customers who attend targeted community outreach events and who complete self-paced online home energy audits. In PY8, most energy efficiency kits contained compact fluorescent bulbs (CFLs) or light emitting diode bulbs (LEDs), two LED night lights, and a smart power strip. Smaller kits can contain simply 1 to 4 bulbs. During PY8, Duquesne Light expanded its use of LED bulbs in the kit offerings, and the majority of kits now offer LEDs

instead of CFLs. Overall during PY8, kit offerings included the following.

- LED EE Kit: four 9W LEDs, two 11W LEDs, two 15W LEDs, two LED nightlights (savings: 410 kWh)
- CFL EE Kit: two 13W CFLs, one 20W CFL, one 23W CFL, two electroluminescent nightlights, one smart power strip (savings: 288 kwh)
- Lamp Giveaways (i.e., single-lamp kits):
    - One 13W CFL
    - One 18W CFL

In addition to the equipment rebate and efficiency kit program components, a third REEP program component—upstream lighting—provides point of purchase discounts on CFLs and LEDs for customers. This is a more streamlined approach to discounting and is more readily engaged by customers since it does not require rebate forms. The elimination of rebate forms at the transaction level, in favor of bulk processing, significantly cuts processing costs.

Participation is counted differently for rebate, kit and upstream lighting participants. For rebates and kits tied to an individual customer, a participant is a customer participating in the given program within a given reporting year (e.g., Q1 through Q4 for PY8), represented by a unique participant account number within the tracking system. Customers participating in a program more than once within a reporting year (i.e., PYRTD) are counted once; customers participating more than once but in different years or in different programs are counted more than once (once in each year and/or program). A portion of REEP kit program savings result from giveaways during events in which the utility has participated (event giveaways). For these events, Duquesne Light tracks events and the measures given away and not the individual participants who receive the measures. Therefore, participation cannot be determined. Finally, participation in the upstream lighting program component is not defined, because reported program data tracks lamp sales activities and not individual participating customers/purchasers.

3.1.1 Participation and Reported Savings by Customer Segment

Table 17 presents the participation counts, reported energy and demand savings, and incentive payments for REEP in PY8 by customer segment.

Table 17: REEP Participation and Reported Impacts*

Parameter	Residential (Non-LI) REEP	Residential (Non-LI) REEP Upstream Lighting	Residential (Non-LI) Total
PYTD # Participants	4,948	N/A	4,948
PYRTD MWh/yr	2,326	34,358	36,684
PYRTD MW/yr	0.37	3.48	3.85
PY8 Incentives ($1000)**		$1,826	

*Excludes counts of customers who received efficiency kits during events giveaways and customers who purchased discounted bulbs via the upstream lighting component, neither of which is tracked at the customer level.
**Duquesne Light combines financial related information here for the two program components 1) REEP: Residential Energy Efficiency and 2) REEP: Residential Energy Efficiency (Upstream Lighting) under REEP: Residential Energy Efficiency. Otherwise, energy and demand impacts are reported separately for these two programs.

3.1.2 Gross Impact Evaluation

Navigant conducted limited PY8 gross impact evaluation activities for REEP for the three components – equipment rebates, efficiency kits, and upstream lighting. Generally, the PY8 evaluation relied on two data sources in estimating realization rates for energy and demand savings – an application file review and survey results from the PY7 evaluation effort. The evaluation team completed a rebate application file review for a random sample of equipment rebate measures to confirm measure specifications and savings, and corresponding participating customer information. Those findings were then combined with survey findings from the PY7 analysis that had verified installations.

The application file review consisted of the following process:

1. A simple random sample of participants was selected from the PMRS database.
2. Relevant documentation from PMRS or other hardcopy documentation was then obtained for the sample of participants to check against the PMRS records. The verification checklist for deemed or partially deemed savings measures included:
    a. Participant has valid utility account number.
    b. Measure(s) is on approved list and all parameters necessary for calculating savings are present.
    c. Rebate payment date is in the current program period being verified.
    d. Proof of purchase identifies qualifying measure and is dated within the period being verified.
    e. Unit kWh and kW are correct for each listed measure. For partially deemed measures this involves reviewing the additional inputs required by the TRM.

These data were not always provided in PMRS but rather sometimes obtained for the sample of participants by reviewing the application files, receipts indicating measure details, or through searches of secondary sources for a given make or model number.

Navigant selected a random sample consisting of 83 equipment rebate measures, and requested the associated applications from Duquesne Light. Duquesne Light then sent the team copies of the following:

- Filled out application forms
- Equipment and appliance receipts; work orders and invoices detailing the equipment installed and confirming the transactions and purchases
- Copies of Duquesne Light utility bills to confirm that the participant is a utility customer

In addition to the application review, savings for a census of the individual measures making up each kit were checked against the TRM for accuracy. The same was true for the Upstream Lighting program component, for which the evaluation team also checked the CSP's detailed records against what had been reported in the Duquesne Light program database (PMRS), both for savings and for bulb counts, for a census of the line items in the CSP's detailed participation data.

Table 18 shows the achieved sample size for the rebate equipment application file review along with the efficiency kit and upstream lighting components where a census of records was reviewed. The upstream lighting component does not specify a participant population size as previously described.

Table 19 and Table 20 show the gross energy and demand results for REEP.

Table 18: REEP Gross Impact Sample Design for PY8

Stratum	Population Size*	Achieved Sample Size	Evaluation Activity
Rebates	959	83	Comparison of application and related documentation to claimed counts and savings in PMRS, using TRM algorithms.
Kits	4,020	N/A	Apply PY7 findings, after confirmation that kit component savings match TRM values
Upstream Lighting	N/A	Census	Comparison of counts and values in a census of PMRS records with the detailed CSP records and the per-unit savings shown in the TRM.
Program Total	**4,979**	N/A	

*Counts differ from Table 17 that shows a unique count of participants. This table shows the unique count of participants in each stratum. For example, a customer participating in both Rebates and Kits is counted once in each.

Table 19: REEP Gross Impact Results for Energy

Stratum	PYRTD MWh/yr	Energy Realization Rate	Sample C_v or Error Ratio	Relative Precision at 85% C.L.
Rebates	358	99%	0.31	4.8%
Kits	1,968	64%	0.46	17.9%
Upstream Lighting	34,358	103%	Census	0.0%
Program Total	**36,684**	**101%**		**0.6%**

Table 20: REEP Gross Impact Results for Demand

Stratum	PYRTD MW/yr	Demand Realization Rate	Sample C_v or Error Ratio	Relative Precision at 85% C.L.
Rebates	0.20	93%	0.16	2.4%
Kits	0.17	63%	0.57	22.2%
Upstream Lighting	3.48	103%	Census	0.0%
Program Total	**3.85**	**101%**		**0.6%**

The following factors led to variations between the reported and verified savings and led to the observed realization rates for equipment rebates via the application file review activities.

- Savings adjusted for 21 of the 83 measures examined.
- Navigant found one instance where the application did not include a copy of the utility bill. However, Navigant was able to confirm that the participant was a Duquesne Light customer through program and customer tracking data. The review also identified seven applications with limited information (e.g., non-descriptive invoices). Specifically, Navigant had to research retailer websites to confirm that several rebated refrigerators and freezers were Energy Star rated. The team was able research details online to confirm savings for these applications, but the applications themselves were not sufficient to confirm measure eligibility.

- Navigant observed that for 16 of 25 central AC units, equipment sizes were rounded to the nearest ton. For example, many 2.5-ton units were rounded up in program tracking data to 3 tons. Navigant corrected for this rounding in its realization rate assessment, which overall was a negligible adjustment.
- Finally, Navigant's random sample drew three ductless mini-split measures. For each case, Navigant found that application details were limited, which required that online research be performed. The verified savings differed from reported savings for each case (i.e., yielding 261%, 62%, and 62% energy realization rates).

Additional details can be found in the accompanying Residential Process Evaluation report as this application file review informed impact and process evaluation activities.

The realization rates for efficiency kits and upstream lighting were informed by the results of the PY7 analysis.

3.1.3 Net Impact Evaluation

Per Navigant's Evaluation Plan, Navigant relied on PY7 results for the estimates of participant free ridership and spillover. Navigant plans to conduct net-to-gross research in PY9 to update these estimates.

In order to determine the total free ridership and spillover for REEP (all three program components combined), Navigant weighted the free ridership and spillover values of the individual components (equipment rebates, efficiency kits, and upstream lighting) by their PY8 verified savings achievements. The analysis relies on PY7 free ridership and spillover findings, but the total program net-to-gross factor relies on PY8 results for weighting.

Table 21 clarifies that there is no REEP net impacts sample given that the analysis relies on the PY7 evaluation findings. Table 22 shows the net impact evaluation results for REEP where PY7 component results are weighted by PY8 verified savings.

Table 21: REEP Net Impact Sample Design

Stratum	Stratum Boundaries	Population Size (PY8)*	Achieved Sample Size (from PY7)	Response Rate
Rebates	All	959	59	N/A
Kits	All	4,020	15	N/A
Upstream Lighting	N/A	N/A	N/A	N/A
Program Total		4,979		

*Counts differ from Table 17 that shows a unique count of participants. This table shows the unique count of participants in each stratum. For example, a customer participating in both Rebates and Kits are counted once in each.

Table 22: REEP Net Impact Evaluation Results

Target Group or Stratum (if appropriate)	PYVTD	Free Ridership (% from PY7)	Spillover (% from PY7)	NTG Ratio (from PY7)	Relative Precision (@ 85% CL, from PY7)
Rebates	355	0.59	0.18	0.59	8.5%
Kits	1,252	0.47	0.04	0.57	11.8%
Upstream Lighting	35,496	0.54	0.24	0.69	7.4%
Program Total	**37,103**	**0.54**	**0.23**	**0.69**	**4.9%**

Additional details on the net impacts evaluation can be found in the accompanying Residential Process Evaluation report.

The equipment rebate free ridership rate from the PY7 evaluation was 52 percent. Navigant examined annual ENERGY STAR® market penetration rates to understand how the availability of ENERGY STAR® as well as non-efficient equipment options might influence purchasing decisions, particularly as that mix of efficiency options changes with ENERGY STAR® criteria updates. For example, the penetration rate of ENERGY STAR® central air conditioners was 22 percent in 2016 while the penetration rate for ENERGY STAR® dehumidifiers was 63 percent.[4]

The efficiency kit free ridership rate from the PY7 evaluation was 47 percent. Navigant

[4] Energy Star Unit Shipment and Market Penetration Report Calendar Year 2016 Summary. https://www.energystar.gov/ia/partners/downloads/unit_shipment_data/2016_USD_Summary_Report.pdf?4228-28f5

examined individual kit components and found free ridership rates of 53 percent, 41 percent, and 39 percent for light bulbs, smart strips, and nightlights, respectively.

Navigant's previous analysis relied on three approaches for the upstream lighting component free ridership rate estimate. Those efforts included in-store intercept surveys, online surveys of CFL and LED bulb purchasers, and a Delphi Panel in which 13 industry experts reviewed the research data and then offered their own educated opinions regarding the free ridership rates for the various bulb types included in the program. The team estimated a free ridership rate of 54 percent from these efforts.

Finally, from the PY7 analysis, Navigant found spillover rates of 18 percent, 4 percent, and 24 percent for equipment rebates, efficiency kits, and upstream lighting, respectively.

High-Impact Measure Research

Because there was no net-to-gross analysis performed for this program in PY8, no high impact measure (HIM) analyses were conducted.

3.1.4 Verified Savings Estimates

In Table 23 the realization rates and net-to-gross ratios determined by Navigant are applied to the reported energy and demand savings estimates to calculate the verified savings estimates for REEP in PY8. These totals are added to the verified savings achieved in previous program years to calculate the P3TD program impacts.

Table 23: REEP PYTD and P3TD Savings Summary

Savings Type	Energy (MWh/yr)	Demand (MW/yr)
PYRTD	36,684	3.85
PYVTD Gross	37,103	3.89
PYVTD Net	25,498	2.67
RTD	36,684	3.85
VTD Gross	37,103	3.89
VTD Net	25,498	2.67

3.1.5 Process Evaluation

Participant process evaluation and net-to-gross (NTG) surveys will be conducted every other year (years PY9 and PY11). Such surveys were conducted of REEP program participants in PY7, and so were not completed in PY8.

Navigant spoke with the program manager in PY8 to gain a thorough understanding of the program and note any key changes from previous program years. For example, the program no longer offers rebates for dishwashers, televisions, whole house fans, faucet aerators, or CFLs.

Navigant also examined Duquesne Light's Program Management and Reporting System (PMRS) that tracks program activities at the measure level. This review examined data fidelity and the appropriate application of the TRM to measures to estimate reported savings. These are previously described for the REEP gross impacts evaluation. Further, additional details on the review can be found in the Residential Process Evaluation report.

The limited process evaluation activities yielded the following:

Measure Mix. Duquesne Light reduced the range of rebated measures in Phase III from the offerings of Phase II. For example, Duquesne Light no longer offers incentives for energy efficient dishwashers, televisions, whole house fans, faucet aerators, or CFLs. Navigant notes that these dropped measures either saw little savings activities in previous years or were susceptible to high free ridership rates. For example, Energy Star dishwashers and televisions had estimated market penetration rates in 2016 of 69 percent and 71 percent respectively.[5] The majority of the market offerings for these products are already efficient.

Applications. Navigant performed an in-depth application file review of 83 PY8 rebated measures and was able to confirm that the reported energy savings for the majority of that sample were accurate. Overall, Navigant calculated a realization rate of 99 percent for energy and 93 percent for demand. These activities confirmed that for the large majority of rebates, Duquesne Light is capturing information and reporting savings at a sufficient level of accuracy within its tracking databases.

Rounding. Central air conditioner savings are based on SEER and capacity ratings, and the tracking database currently reports and uses rounded values to generate reported savings, as noted above. However, manufacturers report SEER values to one decimal. Also, capacity values in program tracking databases are rounded to whole ton numbers (i.e., where 1 ton equals 12,000 Btu/hr), while most manufacturers report capacity ratings at the single Btu/hr level. However, as indicated above, the use of these rounded numbers is generally yielding relatively accurate estimates.

HVAC Application Form. The current HVAC rebate application form does not collect information on heating capacity for ductless mini-split systems. Further, the space on the form for reporting heating capacity for heat pumps is easily missed and the space for entering the information is cramped leading sometimes to problems reading the reported values when they are included in the application.[6]

Efficiency Kits. Duquesne Light offered PY8 participants kits with LED bulbs. During PY9 Navigant will plan to conduct evaluation activities for kits and those activities will include participant surveys. Among other investigations, the team will identify any changes in participant survey responses between evaluations in PY9 and previous years to determine if LEDs are influencing behaviors. For example, free ridership rates may have changed.

Upstream Lighting Savings Calculations. The evaluation team reviewed the lamp-level program details to confirm that Duquesne Light and its Upstream Lighting CSP are reporting savings

[5] Energy Star Unit Shipment and Market Penetration Report Calendar Year 2016 Summary. https://www.energystar.gov/ia/partners/downloads/unit_shipment_data/2016_USD_Summary_Report.pdf?4228-28f5
[6] Duquesne Light HVAC Rebate Application. https://www.rebate-zone.com/wattchoices/pdf/DBK.pdf

details correctly and in accordance with the 2016 TRM for each lamp-specific entry. Overall for PY8, Navigant found that data are tracked appropriately. Minor discrepancies resulted in realization rates of 103 percent for both energy and demand. Most often, these discrepancies could be traced to Navigant using different baseline bulb wattage assignments than those of the CSP.

Upstream Lighting Shift to LEDs. The first year of Phase III Upstream Lighting program component continued a multi-year shift toward LEDs and away from CFLs, with 71 percent of discounted bulbs being LEDs and the remainder being CFLs.

3.1.6 Cost-Effectiveness Reporting

A detailed breakdown of program finances and cost-effectiveness is presented in Table 24. TRC benefits in Table 24 were calculated using gross verified impacts. Net present value (NPV) PYTD costs and benefits are expressed in 2016 dollars. Net present value costs and benefits for P3TD financials are expressed in the 2016 dollars.

Table 24: Summary of REEP Finances – Gross Verified

Row #	Cost Category	PYTD ($1,000)		P3TD ($1,000)	
1	EDC Incentives to Participants [1]	$1,826		$1,826	
2	EDC Incentives to Trade Allies	$0		$0	
3	Participant Costs (net of incentives/rebates paid by utilities)	$3,117		$3,117	
4	**Incremental Measure Costs (Sum of rows 1 through 3)**	$4,943		$4,943	
		EDC	**CSP**	**EDC**	**CSP**
5	Design & Development [2]	$4	$71	$4	$71
6	Administration, Management, and Technical Assistance [3]	$46	$213	$46	$213
7	Marketing [4]	$69	$0	$69	$0
8	Program Delivery [5]	$0	$2,224	$0	$2,224
9	EDC Evaluation Costs	$34		$34	
10	SWE Audit Costs	$113		$113	
11*	**Program Overhead Costs (Sum of rows 5 through 10)**	$2,774		$2,774	
12	NPV of increases in costs of natural gas (or other fuels) for	**$0**		**$0**	

Row #	Cost Category	PYTD ($1,000)	P3TD ($1,000)
	fuel switching programs		
13	**Total NPV TRC Costs [6] (Net present value of sum of rows 4, 11, and 12)**	$7,717	$7,717
14	Total NPV Lifetime Electric Energy Benefits	$11,637	$11,637
15	Total NPV Lifetime Electric Capacity Benefits	$2,843	$2,843
16	Total NPV Lifetime Operation and Maintenance (O&M) Benefits	$5,405	$5,405
17	Total NPV Lifetime Non-Electric Benefits (Fossil Fuel, Water)	$0	$0
18	**Total NPV TRC Benefits [7] (Sum of rows 14 through 17)**	$19,885	$19,885
19	**TRC Benefit-Cost Ratio [8]**	**2.58**	**2.58**

[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. NOTE: Savings carried over from Phase II are not to be 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 25 presents program financials and cost-effectiveness on a net savings basis.

Table 25: Summary of REEP Finances – Net Verified

Row #	Cost Category	PYTD ($1,000)	P3TD ($1,000)
1	EDC Incentives to Participants [1]	$1,826	$1,826
2	EDC Incentives to Trade Allies	$0	$0

Row #	Cost Category	PYTD ($1,000)		P3TD ($1,000)	
3	Participant Costs (net of incentives/rebates paid by utilities)	$1,571		$1,571	
4	**Incremental Measure Costs (Sum of rows 1 through 3)**	$3,397		$3,397	
		EDC	**CSP**	**EDC**	**CSP**
5	Design & Development [2]	$4	$71	$4	$71
6	Administration, Management, and Technical Assistance [3]	$46	$213	$46	$213
7	Marketing [4]	$69	$0	$69	$0
8	Program Delivery [5]	$0	$2,224	$0	$2,224
9	EDC Evaluation Costs	$34		$34	
10	SWE Audit Costs	$113		$113	
11*	**Program Overhead Costs (Sum of rows 5 through 10)**	$2,774		$2,774	
12	NPV of increases in costs of natural gas (or other fuels) for fuel switching programs	**$0**		**$0**	
13	**Total NPV TRC Costs [6] (Net present value of sum of rows 4, 11, and 12)**	$6,171		$6,171	
14	Total NPV Lifetime Electric Energy Benefits	$7,997		$7,997	
15	Total NPV Lifetime Electric Capacity Benefits	$1,954		$1,954	
16	Total NPV Lifetime Operation and Maintenance (O&M) Benefits	$3,715		$3,715	
17	Total NPV Lifetime Non-Electric Benefits (Fossil Fuel, Water)	$0		$0	
18	**Total NPV TRC Benefits [7] (Sum of rows 14 through 17)**	$13,665		$13,665	
19	**TRC Benefit-Cost Ratio [8]**	**2.21**		**2.21**	

[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.

Row #	Cost Category	PYTD ($1,000)	P3TD ($1,000)

[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. NOTE: Savings carried over from Phase II are not to be 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 PY8 led to the following findings and recommendations from Navigant to Duquesne Light, along with a summary of how Duquesne Light plans to address the recommendation in program delivery.

Finding #1: The current HVAC rebate application does not collect information on heating capacity for ductless mini-split systems. Further, the space on the form for reporting heating capacity for heat pumps is easily missed and the space for entering the information is cramped leading sometimes to problems reading the reported values when they are included in the application. However, these issues are not resulting in an appreciable inaccuracy in savings estimation.

Recommendation #1: The next time the HVAC rebate application is updated, Duquesne Light should consider modifying the form to make it easier for participants/trade allies to report heating capacity.

EDC Status Report #1: Agreed.

3.2 Residential Appliance Recycling Program

The Residential Appliance Recycling Program (RARP) seeks to produce cost-effective, long-term, coincident peak demand reduction and annual energy savings in the residential market sector by removing operable, inefficient, primary and secondary refrigerators and freezers from the power grid in an environmentally safe manner.

To stimulate participation, RARP offers incentives to customers who allow the utility to remove and recycle eligible refrigerators ($35) and freezers ($35). The program implementation contractor in PY8 was ARCA. This is the first full year the program was delivered by ARCA, though the program delivery model remained essentially the same as it was in previous program years, when JACO was the CSP.

A participant in RARP is a customer participating within a given reporting year (e.g., Q1 through Q4 for PY8) represented by a unique participant account number within the tracking system. Customers participating in a program more than once within a reporting year (i.e., PYRTD) are

counted once; customers participating more than once but in different years or in different programs are counted more than once (once in each year and/or program).

Table 26 presents the participation counts, reported energy and demand savings, and incentive payments for RARP in PY8 by customer segment.

Table 26: RARP Participation and Reported Impacts

Parameter	Residential (Non-LI)
PYTD # Participants	1,161
PYRTD MWh/yr	1,261
PYRTD MW/yr	0.14
PY8 Incentives ($1000)	$38

3.2.1 Gross Impact Evaluation

The evaluation team used the basic level of verification rigor to confirm the gross energy and demand impacts for the appliances recycled through RARP during PY8. The specific verification tasks included the following:

- Review relevant documentation within PMRS and the CSP's detailed tracking data to confirm appropriate application of the TRM algorithms and assumptions, and to confirm that savings are associated with active Duquesne Light residential customers.
- Survey a random sample of participants to verify installations and estimate verification rates.
- For the sampled installations, calculate the verified savings that are dependent on deemed TRM inputs and the year of manufacture of the given appliance.
- Calculate a realization rate by dividing the verified energy and demand savings by their respective reported energy and demand savings.

The random sampling for RARP uses the simple ratio estimator. The reasons for using a simple ratio estimator were that measures for this program are mostly deemed within the TRM. The notable exception is that savings can vary somewhat based on the year of manufacturer. However, the year of manufacture is easily confirmed through a review of the CSP's tracking data details, and the survey of participants verifies that the recycling event occurred (i.e., the pickup of the appliance). Typically, the only changes expected to the estimated gross savings reported in PMRS would be due to clerical errors and installation (appliance removal) rates, which were expected to be minor. The resulting realization rate (the ratio of the ex-post savings to the ex-ante savings) was therefore expected to be very high with a very low variance.

In Duquesne Light's PY8 sampling plan, the team targeted 200 participants for RARP, with a targeted level of precision of 15 percent at 85 percent confidence. The sample design also targeted recycled refrigerators as a high impact measure, so that sampling plan was targeting survey completions with 150 refrigerator participants and 50 freezer participants. Table 27 shows the targeted and achieved sample sizes for the program by stratum. Surveys were completed with a total of 159 participants who recycled 170 appliances. Navigant exhausted the population of participants to achieve this sample. Within that group, 134 participants recycled 138 refrigerators, and 30 participants recycled 32 freezers. Some of those participants are counted within both groups given that participants can recycle up to two appliances per address per calendar year.

Table 27: RARP Gross Impact Sample Design for PY8

Stratum	Population Size*	Achieved Sample Size**	Evaluation Activity
Refrigerators	965	138	Phone survey
Freezers	234	32	Phone survey
Program Total	**1,199**	**170**	

*The 1,161 participants recycled 1,199 appliances.
**For the survey effort, 134 participants recycled 138 refrigerators and 30 participants recycled 32 freezers. The survey included 159 respondents overall. Some respondents recycled one refrigerator and one freezer.

The following describes the gross impact evaluation activities carried out by Navigant.

The evaluation team reviewed and confirmed relevant documentation using PMRS data and details from the CSP ARCA. This review occurred at the population level for all PY8 activities, beyond the sampled participants targeted for the survey. The team also determined that Duquesne Light's reported savings per appliance estimates a certain portion of units being manufactured before 1990. That is, when using the TRM savings parameter defaults, the reported savings of 1,037.5 kWh for refrigerators in the tracking system indicates that the EDC assumed 56 percent of recycled units were manufactured before 1990. Also, the 966.8 kWh value for freezers indicates that the EDC assumed 85 percent of recycled freezers were manufactured before 1990. Navigant's review of the CSP's data that captured date of manufacture from nameplates found that 26 percent of refrigerators and 47 percent of freezers were manufactured before 1990.

The team found that all sampled participants had active Duquesne Light account numbers (these were found to be validated in PMRS via linkage to the Customer Information System). The team also confirmed that rebate payment dates were in the current program period being verified, PY8. No exceptions were noted.

Next, the team completed telephone surveys for impact verification of the measures. RARP telephone interview surveys were performed with sampled customers to confirm participation in the program (i.e., that their refrigerator/freezer was recycled through the program).

The team then recalculated savings for the measures verified via the telephone surveys. As previously described, the team relied on the TRM savings algorithm and deemed inputs. The team also used the appliance date of manufacture to determine if it occurred before or after 1990. Following the TRM protocol, recycled units manufactured before 1990 are estimated to achieve greater savings.

The program realization rate was then calculated using the verified energy and demand savings from the telephone interviews. The survey effort confirmed the type and quantity of appliance that was recycled and the documentation review confirmed the year of manufacture. The reader should note that gross savings, reported or verified, do not reflect different savings for cases where participants replace units. All gross savings reflect full retirement savings. Induced replacements are accounted for only in the net savings analysis.

Finally, the team calculated a realization rate (or ratio estimate) for the entire sample in question by dividing the verified savings by the reported savings and extrapolated these findings to the program population. These results are shown in Table 28 and Table 29, for energy and demand savings, respectively.

Table 28: RARP Gross Impact Results for Energy

Stratum	PYRTD MWh/yr	Energy Realization Rate	Sample C_v or Error Ratio	Relative Precision at 85% C.L.
Refrigerators	1,027	92%	0.21	2.4%
Freezers	234	92%	0.11	2.8%
Program Total	**1,261**	**92%**		**2.0%**

Table 29: RARP Gross Impact Results for Demand

Stratum	PYRTD MW/yr	Demand Realization Rate	Sample C_v or Error Ratio	Relative Precision at 85% C.L.
Refrigerators	0.11	92%	0.21	2.4%
Freezers	0.03	92%	0.11	2.8%
Program Total	**0.14**	**92%**		**2.0%**

The following factors led to the variation between the reported and verified savings and led to the observed realization rates. Ultimately, the variations drove the realization rates below a value of 1.00.

- As previously stated, Navigant used the actual date of manufacture for the given appliance when applying the TRM algorithms. Navigant found that 26 percent of refrigerators were manufactured before 1990 and that 47 percent of freezers were manufactured before 1990. Those older units are expected to save more energy. Duquesne Light assumed a larger portion of units would be manufactured before 1990: 56 percent of refrigerators and 85 percent of freezers. Adjustments for this consideration drove the energy and demand realization rate to a value below 100 percent.
- Navigant found three instances where participants indicated that two units were recycled, but only one had been recorded by Duquesne Light. These three additional verified units contributed to an increase in the realization rate.

3.2.2 Net Impact Evaluation

Navigant's free ridership and spillover research aligned to the methodologies required by the SWE within the Framework's Appendix B section.[7]

Navigant investigated free ridership individually for refrigerators and freezers so that refrigerators could be analyzed individually as an HIM for the PY8 evaluation.

Free Ridership

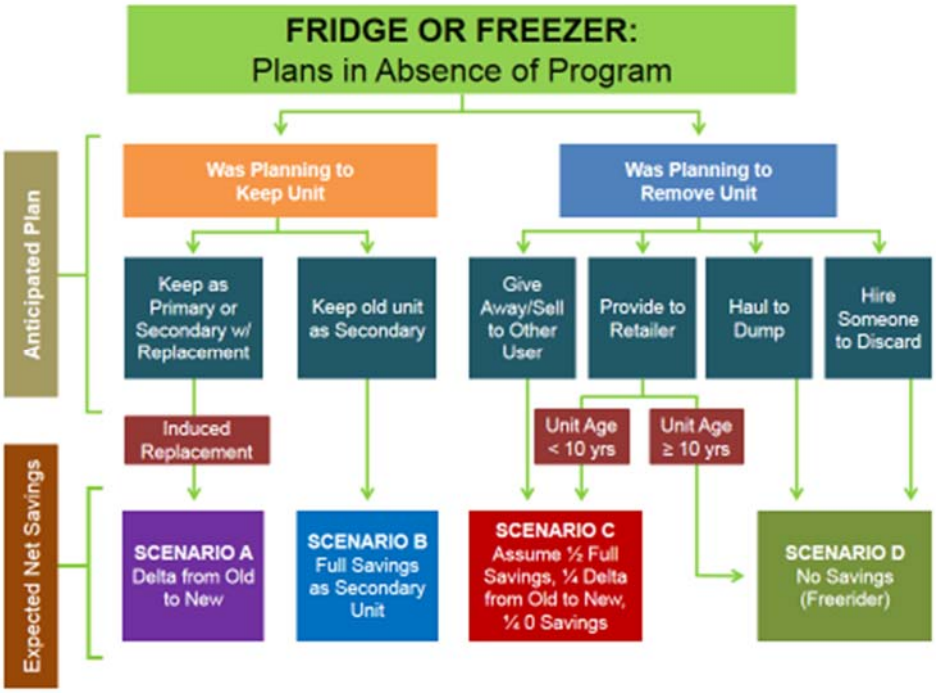
Navigant determined the free ridership for RARP by evaluating participants' responses to several questions relating to their motivation for program participation. Navigant based the methodology on the SWE guidance as summarized here:

1. The team estimated a free ridership percentage for each respondent who completed a survey, based on responses to the following key survey questions:
    a. If the Duquesne Light appliance recycling program had not been available, would the respondent have removed or kept the appliance?
    b. If the Duquesne Light appliance recycling program had not been available, what would the respondent most likely have done with the old appliance when disposing of it?
    c. Would the respondent have purchased a replacement appliance if the Duquesne Light program had not been available?
2. In estimating free ridership for this program, Navigant made the following assumptions regarding survey responses and participant actions:
    a. Participants were first classified into either keepers or removers.
    b. Removers were further classified into those who would have had their unit permanently removed from the electric grid and those whose units would have continued to be used.

[7] SWE Phase III Evaluation Framework. http://www.puc.pa.gov/Electric/pdf/Act129/SWE_PhaseIII-Evaluation_Framework102616.pdf

c. Each respondent was then assigned a net savings value based on what would have happened to the appliance in absence of the program (Figure 11).

Figure 11: RARP Free Ridership Scenario Diagram



Source: SWE Phase III Evaluation Framework

Navigant analyzed all feedback and determined the scenario to apply to each respondent. Each scenario has a net savings value associated with it. For example, full net savings are credited to respondents who fall into scenario B. Navigant relied on CSP detailed data to identify the year of manufacture because the TRM does not specify a default value associated with that regression equation dummy to use. The CSP found and reported within its detailed data the year of manufacture from the appliance nameplates.

As previously discussed, appliances manufactured before 1990 are estimated to use more energy than newer appliances (when all else is equal). The following shows the possible savings permutations when using the TRM default values.

- 1,200 kWh for recycled refrigerators manufactured before 1990
- 827 kWh for recycled refrigerators manufactured after 1990
- 996 kWh for recycled freezers manufactured before 1990
- 800 kWh for recycled freezers manufactured after 1990

Spillover

Navigant asked RARP customers whether they had taken any additional energy saving actions after participating in the Duquesne Light program. If the respondent had made additional energy efficiency improvements as a result of the program, the resulting energy savings would be considered spillover. Navigant applied the SWE methodology from the Framework[8] to RARP survey responses to determine spillover.

The Residential Process Evaluation report contains additional details on the methodology, analysis, and results of the free ridership and spillover estimation exercise. Table 30 shows the sample design and resulting achieved sample sizes, and Table 31 shows the results of the analysis.

Table 30: RARP Net Impact Sample Design

Stratum	Stratum Boundaries	Population Size*	Achieved Sample Size**	Response Rate
Refrigerators	All Refrigerators	965	138	14%
Freezers	All Freezers	234	32	13%
Program Total	All Units	**1,199**	**170**	

*The 1,161 participants recycled 1,199 appliances.
**For the survey effort, 134 participants recycled 138 refrigerators and 30 participants recycled 32 freezers. The survey included 159 respondents overall. Some respondents recycled one refrigerator and one freezer.

Table 31: RARP Net Impact Evaluation Results

Target Group or Stratum (if appropriate)	PYVTD	Free Ridership (%)	Spillover (%)	NTG Ratio	Relative Precision (@ 85% CL)
Refrigerators	949	0.63	0.07	0.44	15.8%
Freezers	216	0.42	0.01	0.59	8.4%
Program Total	**1,165**	**0.59**	**0.06**	0.47	5.8%

The RARP NTG ratio for PY8 is 47 percent, an increase from the 34 percent NTG ratio found in PY7. The following provides additional details about the NTG ratio estimate.

[8] SWE Framework. http://www.puc.pa.gov/Electric/pdf/Act129/SWE_PhaseIII-Evaluation_Framework102616.pdf

- The RARP free ridership rate for PY8 is 63 percent for refrigerators, 42 percent for freezers, and 59 percent combined for the program.
    - Twenty-five percent of appliances were categorized as scenario A or B indicating that without the program they would have been kept. Five percent of total appliances were categorized as scenario A indicating that the program induced the participants' decision to replace their appliance.
    - The remaining 75 percent of appliances were categorized as scenario C or D indicating that even without the program appliances would have been removed anyway.
        - Of those C and D units, 19 percent of units would have been removed by appliance dealers who were replacing appliances for the participants.
        - For the scenario D units that would have been disposed of in the absence of the program Navigant asked participants about how that would be accomplished:
            - Of the 33 appliances that respondents said would have been taken to the dump or recycling center, 79 percent of the corresponding respondents said they had access to a vehicle to haul it themselves.
            - For the 21 appliances that respondents said they would have hired someone else to haul away for them, only five respondents representing about a quarter of the appliances said they had a person in mind to hire when asked by the surveyor.
- The spillover rate is 6 percent for the RARP program participants. Navigant estimates that, on average, each program participant will achieve an additional 20 kWh in energy savings as a result of their participation.

High-Impact Measure Research

Navigant analyzed recycled refrigerators as a high-impact measure (HIM) as part of the PY8 study. This HIM evaluation was identical to the previously describe net impacts evaluation for RARP. Further, the majority of RARP measures in the program and the sample are recycled refrigerators, as described in Table 30.

The recycled refrigerator NTG ratio for PY8 is 44 percent. The following provides additional details about the NTG ratio estimate for the HIM.

- The free ridership rate for this PY8 HIM is 63 percent for refrigerators.
    - Twenty-two percent of appliances were categorized as scenario A or B indicating that without the program they would have been kept. Four percent of total appliances were categorized as scenario A indicating that the program induced the participants' decision to replace their appliance.

- The remaining 78 percent of appliances were categorized as scenario C or D indicating that even without the program appliances would have been removed anyway.
    - Of those C and D units, 22 percent of units would have been removed by appliance dealers who were replacing appliances for the participants.
    - For the scenario D units that would have been disposed of in the absence of the program Navigant asked participants about how that would be accomplished:
        - Of the 30 appliances that respondents said would have been taken to the dump or recycling center, 83 percent of the corresponding respondents said they had access to a vehicle to haul it themselves.
        - For the 17 appliances that respondents said they would have hired someone else to haul away for them, only three respondents representing about 18 percent of the appliances said they had a person in mind to hire when asked by the surveyor.
- The spillover rate is 7 percent for the program participants who recycled refrigerators. Navigant estimates that, on average, each program participant associated with this HIM will achieve an additional 23 kWh in energy savings as a result of their participation.

3.2.3 Verified Savings Estimates

In Table 32 the realization rates and net-to-gross ratios determined by Navigant are applied to the reported energy and demand savings estimates to calculate the verified savings estimates for RARP in PY8. These totals are added to the verified savings achieved in previous program years to calculate the P3TD program impacts. For this first year of Phase III, the program year and Phase III savings values are the same.

Table 32: RARP PYTD and P3TD Savings Summary

Savings Type	Energy (MWh/yr)	Demand (MW/yr)
PYRTD	1,261	0.14
PYVTD Gross	1,165	0.13
PYVTD Net	543	0.06
RTD	1,261	0.14
VTD Gross	1,165	0.13
VTD Net	543	0.06

3.2.4 Process Evaluation

The process evaluation for the RARP program in PY8 included the following activities:

- Interviews with the Duquesne Light program manager and the program CSP
- Review of the 2016 Pennsylvania TRM and program materials.
- Surveys with 159 RARP participants sampled as discussed above from the entire PY8 population between August 14, 2017 and August 31, 2017. These surveys included questions to inform the previously described gross and net impacts evaluations as well as this process evaluation.

The activities examined the program design, program administration, program implementation and delivery, and market response.

The process evaluation findings and details can be found in the PY8 Residential Process Evaluation report that accompanies this report. Highlights of the process evaluation are summarized here:

Progress Toward Goals. The PY8 RARP did not achieve its savings target for PY8. But rather only 66% of that goal.

Sources of Awareness. Navigant asked participants to list all sources from which they learned or became aware of RARP (i.e., beyond just their first source). Responses varied and the most common included family or friends (61 mentions, or 38% of all mentions), bill insert (53 mentions, or 33% of mentions), and online/website sources (36 mentions, or 23% of participants). These findings are similar to findings from PY7 with the notable exception of television that was mentioned 23 percent of the time in PY7 but only 8 percent of the time in PY8. Interestingly, Navigant notes that Duquesne Light does not advertise RARP on television. Rather, Duquesne Light customers viewed other EDC television promotions for their recycling programs, but customers did not differentiate between the EDCs.

Satisfaction. Navigant asked RARP participants about their satisfaction with various program aspects as well as with the program overall, using a scale of 1 to 10 with 10 being “very satisfied.” Note that Navigant redesigned its survey from a 5-point scale to a 10-point scale for Phase III in order to allow for more granularity in responses and to be consistent with other surveys Duquesne Light administers to its customers.

- For PY8, respondents reported the highest satisfaction with the courtesy of the team that picked up the appliance (mean 9.5), with the program overall (9.5), and with the program sign-up process (9.2). These aspects were also rated the highest during PY7. Navigant also found that the time it took for respondents to receive the rebate received a high score of 9.1. This was a significant improvement over PY7 where this aspect was scored the lowest satisfaction, at a 3.6 out of 5. However, that score was in the context of the loss of the program CSP mid-year and the associated delays in appliance removal and rebate payments.

Net-to-Gross. Free ridership decreased from significantly high levels in PY7 (72%) to 59 percent in PY8. This year's free ridership levels are more in line with previous estimates of 65 and 51 percent for PY5 and PY6, respectively. Similar to previous program years, Navigant found that when applying the SWE methodology for net savings, the majority of units fell into Scenario D: participants planned or indicated that units would have been disposed of anyway in the absence of the program. Also, Scenario D is applied if units would have been provided to a retailer (presumably a retailer who replaces a recycled appliance) and the unit is over 10 years old.

Recycled Refrigerator HIM. Navigant completed NTG research for recycled refrigerators and found a free ridership rate of 63 percent, a spillover rate of 7 percent, and a NTG ratio of 44 percent. Navigant notes that the NTG ratio for RARP overall (i.e., when also considering freezers) in PY8 was 47 percent.

Average Age. The average age of all recycled refrigerators within the program for PY8 was 22 years, and the average age of freezers was 27 years. Duquesne Light's reported savings assumes that 56 percent of recycled refrigerators and 85 percent of freezers were manufactured before 1990. However, Navigant's review of the CSP's detailed tracking data found that that only 26 percent of refrigerators and 47 percent of freezers were manufactured before 1990.

3.2.5 Cost-Effectiveness Reporting

A detailed breakdown of program finances and cost-effectiveness is presented in Table 33. TRC benefits in Table 33 were calculated using gross verified impacts. Net present value (NPV) PYTD costs and benefits are expressed in 2016 dollars. Net present value costs and benefits for P3TD financials are expressed in the 2016 dollars.

Table 33: Summary of RARP Finances – Gross Verified

Row #	Cost Category	PYTD ($1,000)		P3TD ($1,000)	
1	EDC Incentives to Participants [1]	$38		$38	
2	EDC Incentives to Trade Allies	$0		$0	
3	Participant Costs (net of incentives/rebates paid by utilities)	-$38		-$38	
4	**Incremental Measure Costs (Sum of rows 1 through 3)**	$0		$0	
		EDC	**CSP**	**EDC**	**CSP**
5	Design & Development [2]	$3	$6	$3	$6
6	Administration, Management, and Technical Assistance [3]	$22	$18	$22	$18
7	Marketing [4]	$0	$20	$0	$20
8	Program Delivery [5]	$0	$147	$0	$147

9	EDC Evaluation Costs	$3	$3
10	SWE Audit Costs	$9	$9
11*	**Program Overhead Costs (Sum of rows 5 through 10)**	$228	$228
12	NPV of increases in costs of natural gas (or other fuels) for fuel switching programs	**$0**	**$0**
13	**Total NPV TRC Costs [6] (Net present value of sum of rows 4, 11, and 12)**	$228	$228
14	Total NPV Lifetime Electric Energy Benefits	$283	$283
15	Total NPV Lifetime Electric Capacity Benefits	$81	$81
16	Total NPV Lifetime Operation and Maintenance (O&M) Benefits	$0	$0
17	Total NPV Lifetime Non-Electric Benefits (Fossil Fuel, Water)	$0	$0
18	**Total NPV TRC Benefits [7] (Sum of rows 14 through 17)**	$364	$364
19	**TRC Benefit-Cost Ratio [8]**	**1.60**	**1.60**

[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. NOTE: Savings carried over from Phase II are not to be 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 34 presents program financials and cost-effectiveness on a net savings basis.

Table 34: Summary of RARP Finances – Net Verified

Row #	Cost Category	PYTD ($1,000)		P3TD ($1,000)	
1	EDC Incentives to Participants [1]	$38		$38	
2	EDC Incentives to Trade Allies	$0		$0	
3	Participant Costs (net of incentives/rebates paid by utilities)	-$38		-$38	
4	**Incremental Measure Costs (Sum of rows 1 through 3)**	$0		$0	
		EDC	**CSP**	**EDC**	**CSP**
5	Design & Development [2]	$3	$6	$3	$6
6	Administration, Management, and Technical Assistance [3]	$22	$18	$22	$18
7	Marketing [4]	$0	$20	$0	$20
8	Program Delivery [5]	$0	$147	$0	$147
9	EDC Evaluation Costs	$3		$3	
10	SWE Audit Costs	$9		$9	
11*	**Program Overhead Costs (Sum of rows 5 through 10)**	$228		$228	
12	NPV of increases in costs of natural gas (or other fuels) for fuel switching programs	**$0**		**$0**	
13	**Total NPV TRC Costs [6] (Net present value of sum of rows 4, 11, and 12)**	$228		$228	
14	Total NPV Lifetime Electric Energy Benefits	$132		$132	
15	Total NPV Lifetime Electric Capacity Benefits	$38		$38	
16	Total NPV Lifetime Operation and Maintenance (O&M) Benefits	$0		$0	
17	Total NPV Lifetime Non-Electric Benefits (Fossil Fuel, Water)	$0		$0	
18	**Total NPV TRC Benefits [7] (Sum of rows 14 through 17)**	$170		$170	

Row #	Cost Category	PYTD ($1,000)	P3TD ($1,000)
19	**TRC Benefit-Cost Ratio [8]**	**0.74**	**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. NOTE: Savings carried over from Phase II are not to be 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

3.2.6 Status of Recommendations

The impact and process evaluation activities in PY8 led to the following findings and recommendations from Navigant to Duquesne Light, along with a summary of how Duquesne Light plans to address the recommendation in program delivery.

Finding #1: The PY8 RARP did not achieve its savings target for PY8. But rather only 66% of that goal.

Recommendation #1: RARP fell short of its goals in PY8 in terms of achieved energy (MWh) savings (i.e., achieved 66% of its original PY8 goal). While this may be attributed to the program ramping up activities for Phase III, it may also reflect the results of limited marketing activities. Should the utility need to increase progress toward goals in the future, a number of options should be considered:

- Television advertising may be an effective, if expensive, means for achieving greater savings. Navigant notes that during PY7 Duquesne Light exceeded its annual savings target when television advertising was more often mentioned as a source of awareness by participants (even when Duquesne Light was not responsible for those commercials).
- Online and website sources may prove to be more cost-effective mass market outreach methods as consumers adopt more internet based activities. Future evaluations could attempt to identify preferred communication channels (e.g., mail, email, phone calls, internet advertisements, social media posts, etc.) of Duquesne Light customers so that mass market outreach efforts are optimized.

A referral program for RARP could be effective, given the frequency of respondent reports that

their source of awareness of the program was word of mouth from friends and family. A referral program could offer a cash incentive or an LED energy efficiency kit to participants who have friends or family enroll in RARP. However, as with each of these options, the associated costs of redesigning program materials, applications, and administration must also be considered. Those costs may be offset by additional savings if the reward for referrals were energy efficiency kits or other efficiency measures.

EDC Status Report #1: Duquesne Light will consider a more active online promotional effort for RARP, and possibly a referral program, should it have difficulty meeting its goals in PY9. Television advertising, however, is not cost effective.

3.3 Residential Behavioral Savings Program

The Residential Behavior Savings program (Home Energy Reports or HER program) influences behavior change in customers through the power of information, provided in the form of an energy report mailed to participants on a regular basis. These reports provide participants with information about their recent energy use and compare the usage to that of similar homes. The reports also provide participants with energy-saving tips, some of which are tailored to the participant's circumstances. Other studies have shown this set of information to stimulate participants to reduce their energy use, creating average energy savings in the one to two percent range.

Duquesne Light launched the HER program in PY4 and targets high-use residential customers. The current program participation levels include 15,748 customers from the 2012 wave and 47,751 participants from the 2015 wave. Duquesne Light also currently administers the program to 16,662 low income customers that are part of a wave initiated in 2015. The administration, implementation, and evaluation for those low-income participants are similar to their market rate participant counterparts described within this section. However, the low-income evaluation results are detailed in Section 3.5. Navigant also obtained new low-income classifications later in PY8 which were used to identify any market rate customers that had been reclassified as low income, and vice versa. Navigant identified 2,544 market rate participants reclassified as low income. The savings from these households, though not included in the low-income wave, contribute to the low income PY8 savings for LIEEP as shown in Section 3.5. Ultimately, the market rate wave's participant count is 60,955 and the low-income wave's participant count is 19,206.

A participant is a customer receiving Home Energy reports during the program year (i.e., PY8). The participant count represents the number of unique participants who received HERs during PY8. The program is an opt-out program in which the CSP, Oracle (OPower), enrolls participants in the program based on a randomized control trial (RCT) program design. Enrolled customers can opt out of the program by calling or emailing the program implementer.

In the RCT design, eligible customers are randomly assigned to treatment and control groups. Due to random assignment, any difference in usage between treatment participants (i.e., the program participants) and control customers is a result of participation in the program.

3.3.1 Participation and Reported Savings by Customer Segment

Table 35 presents the participation counts, reported energy and demand savings, and incentive payments for HER in PY8. As previously noted, low-income HER participant results are reflected in LIEEP as shown in Section 3.5.3

Table 35: HER Participation and Reported Impacts

Parameter	Residential (Non-LI)
PYTD # Participants	60,955
PYRTD MWh/yr	6,536
PYRTD MW/yr	3.65
PY8 Incentives ($1000)	$0

3.3.2 Gross Impact Evaluation

The main methodological issue for the impact evaluation is to estimate the counterfactual energy use by households participating in the HER program. Stated another way, the impact evaluation compares actual energy usage against the estimated energy that participating households would have used in the absence of the program. The program utilized an RCT experimental design, meaning that households were randomly allocated to the control and treatment groups. This eliminated the issue of selection bias that complicates the evaluation of many behavioral programs. The random assignment of households to the treatment and control groups means the control group should serve as a robust baseline against which the energy use of the treatment households can be compared to estimate savings from enrollment in the HER program.

Navigant estimated program savings with a linear fixed-effects regression (LFER) analysis. In the LFER model, average daily consumption (ADC) of kWh by participant and non-participant *k* in billing period *t*, denoted by ADC_{kt}, is a function of three terms:

- The binary variable Treatment, taking a value of 0 if household k is assigned to the control group, and 1 if household k is assigned to the participant group
- The binary variable Post, taking a value of 0 if bill t is before the household's program start date and 1 if the bill is received on or after the program start date
- The interaction between these variables, Post Treatment

This is referred to as a one-way fixed-effects model because it includes a household-specific

fixed-effects term. Equation 1 formally presents the equation for this model.[9]

Equation 1. One-Way Fixed-Effects Regression Model

$$ADC_{kt} = \alpha_{0k} + \alpha_1 Post_t + \alpha_2 Participant_k \cdot Post_t + \varepsilon_{kt}$$

where

ADC_{kt} =	The average daily use in kWh for participant or non-participant *k* during billing cycle *t*. This is the dependent variable in the model.
$Post_t$ =	A binary variable indicating whether bill cycle *t* is in the post-program period (taking a value of 1) or in the pre-program period (taking a value of 0).
$Participant_k$ =	A binary variable indicating whether household *k* is in the participant group (taking a value of 1) or in the non-participant group (taking a value of 0).
α_{0k} =	The household-specific fixed effect (constant term) for household *k*. The fixed-effect controls for all participant or non-participant-specific effects on energy consumption that do not change over time, such as the number of household members or the size of the dwelling.
α_1, α_2 =	Regression parameters corresponding to the independent variables.

The coefficient α_{0k} is the household-specific fixed-effect that implicitly captures all participant-specific and non-participant-specific effects on electricity use that do not change over time. The calculation of the fixed-effect term does not require knowledge of which characteristics at each household are unchanged; the regression model uses billing data to implicitly estimate the aggregate impact upon energy use of all characteristics that are unchanged over time. Second, α_1 captures the average effect among non-participants of being in the post-treatment period. In other words, it captures the effects of exogenous factors, such as economic conditions, that affect all non-participants in the program period but not in the pre-program period. Third, $\alpha_1 + \alpha_2$ captures the average effect among participants of being in the post-program period, and so the effect directly attributable to the HER program is captured by the coefficient α_2. In other words, this coefficient captures the difference-in-difference (DID) in average daily kWh use between the participants and non-participants across the pre-program and treatment periods. Consequently, the DID statistic is considered the best indicator of program effects in a program evaluation. The evaluation team generated average savings for PY8 by multiplying the estimate of household

[9] This equation corresponds to Formula 1.1 in Appendix C of Evaluation, Measurement, and Verification (EM&V) of Residential Behavior-Based Energy Efficiency Programs: Issues and Recommendations, published by the State and Local Energy Efficiency Action Network in May 2012.

average daily savings (α_2) by the average number of post days per participant.

The one-way fixed-effects model is the preferred model used for reporting savings. As a check on the robustness of the savings estimates, Navigant also modeled HER program savings utilizing a post-only model. Due to the experimental design of the program, the two models should generate similar results. The second model uses post-enrollment program observations only and replaces the household fixed effect with the household's energy use in the same calendar month of the pre-program year to account for household-level variation in energy use. Navigant refers to this model as the post-program regression (PPR) model. Formally, defining $Preconsumption_{kt}$ as household *k*'s energy use in month *t* and letting γ_t denote the fixed effect for month *t*, the model takes the form shown in Equation 2.

Equation 2. PPR Model with Monthly Fixed Effects

$$ADC_{kt} = \alpha_{ot} + \alpha_1 Preconsumption_{tk} + \alpha_2 Participant_k + \gamma_t + \varepsilon_{kt}$$

Participants and non-participants that moved out of Duquesne Light territory during the course of the program were omitted from the regression analysis to estimate program effects but were included in the estimate of total program savings for the time prior to when they moved away. Navigant assumed that until a participant moves out, their program savings are equal to savings over the same period for participants that remain in the program for the balance of the program duration.

Table 36 summarizes the sampling strategy for the PY8 evaluation. Both regression models utilize billing data from all treatment and control households that are enrolled in the HER program. Thus, the sampling strategy is considered to be a census approach where data from all households is utilized in the analysis, as shown in Table 36.

Table 36: HER Gross Impact Sample Design for PY8

Stratum	Population Size	Achieved Sample Size	Evaluation Activity
HER	60,955	60,955	Regression analysis
Program Total	**60,955**	**60,955**	

No onsite inspections were conducted for the PY8 HER program evaluation.

The verified ex-post energy savings for HER in PY8 were 6,776 MWh, after accounting for double-counted savings with other Duquesne Light energy efficiency programs. Navigant calculated the demand savings by multiplying the verified savings by the percent energy savings during summer peak hours (14.1%) and dividing by the number of summer peak hours (262 hours). Percent energy savings during peak hours comes from EDC's cost effectiveness TRC calculator. Summer peak hours are defined as non-holiday weekday afternoons from 2:00 pm to 6:00 pm during June1 to August 31 (see the Evaluation Framework section 3.3.2.2.8 Demand –

Basic Rigor). A summary of ex-ante HER program energy savings is shown in Table 37.

Table 37: HER Gross Impact Results for Energy

Stratum	PYRTD MWh/yr	Energy Realization Rate	Sample C_v or Error Ratio	Relative Precision at 85% C.L.
HER	6,536	104%	N/A	0.0%
Program Total	**6,536**	**104%**		**0.0%**

Table 38: HER Gross Impact Results for Demand

Stratum	PYRTD MW/yr	Demand Realization Rate	Sample C_v or Error Ratio	Relative Precision at 85% C.L.
HER	3.52	104%	N/A	0.0%
Program Total	**3.52**	**104%**		**0.0%**

The following factors led to variation between the reported and verified savings and led to the observed realization rates.

- Energy savings per participant home were verified at slightly higher than the CSP's reported estimate.

Behavioral Program and Component Absolute Precision

Navigant calculated the absolute precision results for the HER waves. The Phase III Evaluation Framework (at Section 6.1.1.1.1) requires the program-level verification for these behavioral programs to achieve an absolute precision of ±0.5 percent at the 95 percent confidence level (two-tailed), while individual waves may have a wider margin of error. That regression analysis estimation error is 0.47 percent for the 2012 wave and 0.41 percent for the 2015 wave- the two waves that comprise the HER program. Note that those errors are not reflected in Table 37. Instead, Table 37 reflects the uncertainty associated with the sampling (i.e., relative precision at the 85 percent confidence level). Navigant analyzed all HER program data via its census approach and did not use sampling. Therefore, there is no sampling uncertainty to report.

3.3.3 Net Impact Evaluation

Due to the RCT design of the HER program, free ridership and participant spillover are

incorporated in the results of the regression analysis. Section 2.2.2 of the SEE Action protocol states:

> *RCTs eliminate this free-rider concern during the study period because the treatment and control groups each contain the same number of free riders through the process of random assignment to the treatment or control groups. When the two groups are compared, the energy savings from the free riders in the control group cancel out the energy savings from the free riders in the treatment group, and the resulting estimate of program energy savings is an unbiased estimate of the savings caused by the program (the true program savings).*
>
> …
>
> [Participant spillover], *in which participants engage in additional energy efficiency actions outside of the program as a result of the program, is also automatically captured by an RCT design for energy use that is measured within a household.*

However, the RCT design does not account for non-participant spillover. Section 2.2.2 of the SEE Action protocol continues:

> [Non-participant spillover] *issues in which a program influences the energy use of non-program participants are not addressed by RCTs. In these cases in which non-participant spillover exists, an evaluation that relies on RCT design could underestimate the total program-influenced savings.*

Free ridership and spillover are incorporated into the results of the HER regression analysis based on customer billing records. Non-participant spillover is not included in the regression analysis, but the industry standard approach is to assume that non-participant spillover is small for this type of program. It would be primarily driven by conversations that participants may have with non-participant Duquesne Light customers, which are expected to have a relatively small impact on non-participant energy savings. The conservative approach used by Navigant is to assume that non-participant spillover is 0.00 and that the NTG ratio for the HER program is conservatively assumed to be 1.0. As a result, the net and gross savings estimates are the same for the HER program. As such, there is no NTG sample for the HER program.

Table 39 conveys that the team did not consider a sample for the net impact analysis per the pervious discussion. Table 40 reflects the net impacts equaling the gross impacts.

Table 39: HER Net Impact Sample Design

Stratum	Stratum Boundaries	Population Size	Achieved Sample Size	Response Rate
HER	N/A	60,955	N/A	N/A
Program Total	**N/A**	**60,955**		**N/A**

Table 40: HER Net Impact Evaluation Results

Target Group or Stratum (if appropriate)	PYVTD	Free Ridership (%)	Spillover (%)	NTG Ratio	Relative Precision (@ 85% CL)
HER	6,776	N/A	N/A	N/A	N/A
Program Total	**6,776**	**N/A**	**N/A**		**N/A**

As previously stated, the NTG ratio is assumed to be 1.00.

High-Impact Measure Research

Navigant identified no high impact measures (HIMs) for HER in PY8.

3.3.4 Verified Savings Estimates

In Table 41 the realization rates and net-to-gross ratios determined by Navigant are applied to the reported energy and demand savings estimates to calculate the verified savings estimates for HER in PY8. These totals are added to the verified savings achieved in previous program years to calculate the P3TD program impacts.

Table 41: HER PYTD and P3TD Savings Summary

Savings Type	Energy (MWh/yr)	Demand (MW/yr)
PYRTD	6,536	3.52
PYVTD Gross	6,776	3.65
PYVTD Net	6,776	3.65
RTD	6,536	3.52
VTD Gross	6,776	3.65
VTD Net	6,776	3.65

3.3.5 Process Evaluation

There are no process evaluation activities to report on for HER in PY8. Navigant will conduct process evaluation activities, including participant surveys, during future years of Phase III.

3.3.6 Cost-Effectiveness Reporting

A detailed breakdown of program finances and cost-effectiveness is presented in Table 42. TRC benefits in Table 42 were calculated using gross verified impacts. Net present value (NPV)

PYTD costs and benefits are expressed in 2016 dollars. Net present value costs and benefits for P3TD financials are expressed in the 2016 dollars.

Table 42: Summary of Program Finances – Gross Verified

Row #	Cost Category	PYTD ($1,000)		P3TD ($1,000)	
1	EDC Incentives to Participants [1]	$0		$0	
2	EDC Incentives to Trade Allies	$0		$0	
3	Participant Costs (net of incentives/rebates paid by utilities)	$0		$0	
4	**Incremental Measure Costs (Sum of rows 1 through 3)**	$0		$0	
		EDC	CSP	EDC	CSP
5	Design & Development [2]	$3	$9	$3	$9
6	Administration, Management, and Technical Assistance [3]	$24	$26	$24	$26
7	Marketing [4]	$0	$0	$0	$0
8	Program Delivery [5]	$0	$64	$0	$64
9	EDC Evaluation Costs	$4		$4	
10	SWE Audit Costs	$13		$13	
11*	**Program Overhead Costs (Sum of rows 5 through 10)**	$143		$143	
12	NPV of increases in costs of natural gas (or other fuels) for fuel switching programs	**$0**		**$0**	
13	**Total NPV TRC Costs [6] (Net present value of sum of rows 4, 11, and 12)**	$143		$143	
14	Total NPV Lifetime Electric Energy Benefits	$285		$285	
15	Total NPV Lifetime Electric Capacity Benefits	$253		$253	
16	Total NPV Lifetime Operation and Maintenance (O&M) Benefits	$0		$0	
17	Total NPV Lifetime Non-Electric Benefits (Fossil Fuel, Water)	$0		$0	

18	**Total NPV TRC Benefits [7] (Sum of rows 14 through 17)**	$538	$538
19	**TRC Benefit-Cost Ratio [8]**	**3.76**	**3.76**

[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. NOTE: Savings carried over from Phase II are not to be 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 43 presents program financials and cost-effectiveness on a net savings basis.

Table 43: Summary of HER Program Finances – Net Verified

Row #	Cost Category	PYTD ($1,000)		P3TD ($1,000)	
1	EDC Incentives to Participants [1]	$0		$0	
2	EDC Incentives to Trade Allies	$0		$0	
3	Participant Costs (net of incentives/rebates paid by utilities)	$0		$0	
4	**Incremental Measure Costs (Sum of rows 1 through 3)**	$0		$0	
		EDC	**CSP**	**EDC**	**CSP**
5	Design & Development [2]	$3	$9	$3	$9
6	Administration, Management, and Technical Assistance [3]	$24	$26	$24	$26
7	Marketing [4]	$0	$0	$0	$0
8	Program Delivery [5]	$0	$64	$0	$64
9	EDC Evaluation Costs	$4		$4	
10	SWE Audit Costs	$13		$13	

11*	**Program Overhead Costs (Sum of rows 5 through 10)**	$143	$143
12	NPV of increases in costs of natural gas (or other fuels) for fuel switching programs	**$0**	**$0**
13	**Total NPV TRC Costs [6] (Net present value of sum of rows 4, 11, and 12)**	$143	$143
14	Total NPV Lifetime Electric Energy Benefits	$285	$285
15	Total NPV Lifetime Electric Capacity Benefits	$253	$253
16	Total NPV Lifetime Operation and Maintenance (O&M) Benefits	$0	$0
17	Total NPV Lifetime Non-Electric Benefits (Fossil Fuel, Water)	$0	$0
18	**Total NPV TRC Benefits [7] (Sum of rows 14 through 17)**	$538	$538
19	**TRC Benefit-Cost Ratio [8]**	**3.76**	**3.76**

[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. NOTE: Savings carried over from Phase II are not to be 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

Based on its analysis of this program, Navigant has no findings leading to recommendations.

3.4 Residential Whole House Retrofit Program

The Residential Whole House Retrofit Program (WHRP) provides resources to residential customers to obtain a comprehensive residential home energy audit, installation of home audit conservation kit items, and rebates for the range of eligible measures included in the REEP program. The program services offered are different for low-income customers than they are for non-low-income customers. Non-low-income qualifying customers receive $250 toward the cost of the audit, while low-income qualified customers (households at or below 150% of the federal poverty income guidelines) receive the audit at no cost. Both groups receive direct install measures at no cost.

A participant is a customer participating in the program within a given reporting year (e.g., Q1 through Q4 for PY8), represented by a unique participant account number within the tracking system. No participation was recorded for the program in PY8. However, there were planning and ramp-up costs associated with the program.

3.4.1 Process Evaluation

Navigant had planned to complete a process evaluation for the Whole House program in PY8, but program participation did not occur until early PY9 as a result of program ramp up. A detailed evaluation will be completed as part of the PY9 evaluation activities.

3.4.2 Cost-Effectiveness Reporting

A detailed breakdown of program finances and cost-effectiveness is presented in Table 44. TRC benefits in Table 44 were calculated using gross verified impacts of 0. Net present value (NPV) PYTD costs and benefits are expressed in 2016 dollars. Net present value costs and benefits for P3TD financials are expressed in the 2016 dollars.

Table 44: Summary of WHRP Program Finances – Gross Verified

Row #	Cost Category	PYTD ($1,000)		P3TD ($1,000)	
1	EDC Incentives to Participants [1]	$0		$0	
2	EDC Incentives to Trade Allies	$0		$0	
3	Participant Costs (net of incentives/rebates paid by utilities)	$0		$0	
4	**Incremental Measure Costs (Sum of rows 1 through 3)**	$0		$0	
		EDC	**CSP**	**EDC**	**CSP**
5	Design & Development [2]	$3	$5	$3	$5
6	Administration, Management, and Technical Assistance [3]	$25	$16	$25	$16
7	Marketing [4]	$0	$0	$0	$0

8	Program Delivery [5]	$6	$1	$6	$1
9	EDC Evaluation Costs	$3		$3	
10	SWE Audit Costs	$9		$9	
11*	**Program Overhead Costs (Sum of rows 5 through 10)**	$68		$68	
12	NPV of increases in costs of natural gas (or other fuels) for fuel switching programs	**$0**		**$0**	
13	**Total NPV TRC Costs [6] (Net present value of sum of rows 4, 11, and 12)**	$68		$68	
14	Total NPV Lifetime Electric Energy Benefits	$0		$0	
15	Total NPV Lifetime Electric Capacity Benefits	$0		$0	
16	Total NPV Lifetime Operation and Maintenance (O&M) Benefits	$0		$0	
17	Total NPV Lifetime Non-Electric Benefits (Fossil Fuel, Water)	$0		$0	
18	**Total NPV TRC Benefits [7] (Sum of rows 14 through 17)**	$0		$0	
19	**TRC Benefit-Cost Ratio [8]**	**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. NOTE: Savings carried over from Phase II are not to be 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 45 presents program financials and cost-effectiveness on a net savings basis.

Table 45: Summary of WHRP Program Finances – Net Verified

Row #	Cost Category	PYTD ($1,000)		P3TD ($1,000)	
1	EDC Incentives to Participants [1]	$0		$0	
2	EDC Incentives to Trade Allies	$0		$0	
3	Participant Costs (net of incentives/rebates paid by utilities)	$0		$0	
4	**Incremental Measure Costs (Sum of rows 1 through 3)**	$0		$0	
		EDC	**CSP**	**EDC**	**CSP**
5	Design & Development [2]	$3	$5	$3	$5
6	Administration, Management, and Technical Assistance [3]	$25	$16	$25	$16
7	Marketing [4]	$0	$0	$0	$0
8	Program Delivery [5]	$6	$1	$6	$1
9	EDC Evaluation Costs	$3		$3	
10	SWE Audit Costs	$9		$9	
11*	**Program Overhead Costs (Sum of rows 5 through 10)**	$68		$68	
12	NPV of increases in costs of natural gas (or other fuels) for fuel switching programs	**$0**		**$0**	
13	**Total NPV TRC Costs [6] (Net present value of sum of rows 4, 11, and 12)**	$68		$68	
14	Total NPV Lifetime Electric Energy Benefits	$0		$0	
15	Total NPV Lifetime Electric Capacity Benefits	$0		$0	
16	Total NPV Lifetime Operation and Maintenance (O&M) Benefits	$0		$0	
17	Total NPV Lifetime Non-Electric Benefits (Fossil Fuel, Water)	$0		$0	
18	**Total NPV TRC Benefits [7] (Sum of rows 14 through 17)**	$0		$0	

19	**TRC Benefit-Cost Ratio [8]**	**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. NOTE: Savings carried over from Phase II are not to be 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 Low-Income Energy Efficiency Program

The Residential Low-Income Energy Efficiency Program (LIEEP) comprises participation by qualified low-income customers (households at or below 150% of federal poverty income guidelines) in two program components:

- Whole House Retrofit program (LI WHRP)
- Residential Behavioral Savings program (LI HER)

These market rate counterpart programs have been described in previous sections. The programs are additionally offered to low-income customers and referred to as components of the overall LIEEP program. No participation occurred for the Whole House Retrofit program in PY8 for either market rate or low-income customers.

Duquesne Light also engaged low income utility customers through a number low-income-specific community events where it handed out energy efficiency kits. These low-income kit (LI Kits) activities are captured and reported under LIEEP, and contribute to the low income carve-out goal. These LI Kits are equivalent to the kits distributed by Duquesne Light through REEP to market rate participants. For these community events, Duquesne Light tracks events and the measures given away and not the individual participants who receive the measures. Therefore, participation counts are not defined for these kits, but rather solely the number of kits.

For each of these components, LI WHRP, LI HER, and LI Kits, verified savings attributable to the low-income sector are reflected in LIEEP and in Duquesne Light's progress toward the Phase III low income carve-out goal. While not a part of LIEEP, a portion of savings from the Multifamily Housing Retrofits program also contributes to the low income carve-out goal.

Specifically, 67 percent[10] of that program's savings have been allocated to low income customers, based on the percentage of units in treated buildings in which qualified low-income households reside. However, all PY8 reported savings are reflected in the Multifamily Housing Retrofits program section of this report, section 3.9, and not here in the LIEEP section.

LI HER participation is counted similar to the market rate HER program. That is, a participant is a customer receiving Home Energy reports during the program year. A total of 16,662 participants were originally included in the low-income wave. However, as discussed in Section 3.3, Navigant identified 2,544 market rate participants reclassified as low income. The savings from these households, though not included in the low-income wave, contribute to the low income PY8 savings for LIEEP. Therefore, the final participant count for LI HER for PY8 is 19,206.

No participants are counted for LI WHRP during PY8. Participation is not counted for the LI Kits activities. Instead, Duquesne Light tracks events and the kit measures given away and not the individual participants who receive the kits.

3.5.1 Participation and Reported Savings by Customer Segment

Table 46 presents the participation counts, reported energy and demand savings, and incentive payments for LIEEP in PY8 by customer segment. Given the previously-described approach to counting participants, the counts in Table 46 relate to LI HER only.

Table 46: LIEEP Participation and Reported Impacts

Parameter	Residential LI Kits	Residential LI HER	Residential LI Total
PYTD # Participants	N/A	19,206	19,206
PYRTD MWh/yr	143	989	1,132
PYRTD MW/yr	0.01	0.53	0.54
PY8 Incentives ($1000)	$0	$0	$0

3.5.2 Gross Impact Evaluation

Gross impact evaluations occurred only for the LI HER component of LIEEP during PY8. Navigant completed those activities in concert with the market rate counterpart program, HER, and the methodologies for LI HER mirror the HER methodologies. Therefore, the reader should

[10] This value is subject to change and will be confirmed and reported in the PY9 Semi-Annual Report to be submitted in January 2018. Two of the four Multifamily Housing Retrofits program projects are currently unverified.

refer to Section 3.3 for details on the evaluation and how analysis methodologies inform the gross and net impact results.

Given that there are no participants reported for PY8, Navigant did not complete gross impact evaluations for LI WHRP.

Finally, the verification results for the LI Kits rely on the realization rates developed during PY7 for LIEEP kits to inform the PY8 gross impacts verified results. Table 47 shows the LIEEP sample design for PY8. Table 48 and Table 49 show the energy and demand gross impact results for LIEEP, respectively.

Table 47: LIEEP Gross Impact Sample Design for PY8

Stratum	Population Size	Achieved Sample Size	Evaluation Activity
LI Kits	N/A	N/A	Apply PY7 results
LI HER	19,206	19,206	Regression analysis
Program Total	**19,206**	**19,206**	

The verified ex-post energy savings for LI HER in PY8 were 1,054 MWh, after accounting for double-counted savings with other Duquesne Light energy efficiency programs. Navigant calculated the LI demand savings by multiplying the verified LI savings by the percent energy savings during summer peak hours (14.1%) and dividing by the number of summer peak hours (262 hours). Percent energy savings during peak hours comes from the EDC's cost effectiveness TRC calculator. Summer peak hours are defined as non-holiday weekday afternoons from 2:00 pm to 6:00 pm during June1 to August 31 (see the Evaluation Framework section 3.3.2.2.8 Demand – Basic Rigor). A summary of ex-ante LI HER program energy savings is shown in Table 49.

Table 48: LIEEP Gross Impact Results for Energy

Stratum	PYRTD MWh/yr	Energy Realization Rate	Sample C_v or Error Ratio	Relative Precision at 85% C.L.
LI Kits	143	71%	0.37	11.0%
LI HER	989	107%	N/A	0.0%
Program Total	**1,132**	**102%**		**1.0%**

Table 49: LIEEP Gross Impact Results for Demand

Stratum	PYRTD MW/yr	Demand Realization Rate	Sample C_v or Error Ratio	Relative Precision at 85% C.L.
LI Kits	0.01	72%	0.42	11.0%
LI HER	0.53	107%	N/A	0.0%
Program Total	**0.54**	**106%**		**0.1%**

The following factors led to variation between the reported and verified savings and led to the observed realization rates.

The realization rate for LI HER is 107 percent. Navigant found that energy savings per participant home were verified at slightly higher than the CSP's reported estimate. Additionally, the team reallocated a portion of savings (277 MWh) from the market rate HER wave (see Section 3.3) to the low income HER wave after 2,544 market rate participants were reclassified as low-income customers.

The realization rates for efficiency kits are informed by the PY7 analysis, which yielded realization rates of 71 percent for energy and 72 percent for demand. Further, given the small sample sizes observed in PY7, the survey of low income participants was combined with the survey of market rate participants. Findings from both efforts combined to estimate the verified gross energy and demand impacts realization rates.

Behavioral Program and Component Absolute Precision

Navigant calculated the absolute precision results for the LI HER wave. The Phase III Evaluation Framework (at Section 6.1.1.1.1) requires the program-level verification for these behavioral programs to achieve an absolute precision of ±0.5 percent at the 95 percent confidence level (two-tailed), while individual waves may have a wider margin of error. That regression analysis estimation error is 0.80 percent for LI HER. Note that this error is not reflected in Table 48, which instead reflects the uncertainty associated with the sampling (i.e., relative precision at the 85 percent confidence level). Navigant analyzed all LI HER program data via its census approach and did not use sampling. Therefore, there is no sampling uncertainty to report.

3.5.3 Net Impact Evaluation

LI HER net impacts equal gross impacts (see Section 3.3 for a detailed explanation). The LI Kits net impacts are informed by the PY7 evaluation that surveyed residential recipients of efficiency kits. Table 50 conveys that no net impact sampling occurred for PY8. Table 51 shows the resulting net-to-gross (NTG) ratios and conveys that LI HER gross impacts equal net impacts.

Table 50: LIEEP Net Impact Sample Design

Stratum	Stratum Boundaries	Population Size (PY8)	Achieved Sample Size (from PY7)	Response Rate
LI Kits	All measures	N/A	15	N/A
LI HER	All measures	19,206	N/A	N/A
Program Total	**All measures**	**N/A**		**N/A**

Table 51: LIEEP Net Impact Evaluation Results

Target Group or Stratum (if appropriate)	PYVTD	Free Ridership (%)	Spillover (%)	NTG Ratio	Relative Precision (@ 85% CL)
LI Kits	101	0.47	0.04	0.57	11.8%
LI HER	1,054	N/A	N/A	N/A	N/A
Program Total	**1,155**	**N/A**	**N/A**	**0.96***	**N/A**

*Assumes LI HER NTG ratio = 1.

As described in section 3.3.3, the RCT method for LI HER results in net impacts equaling gross impacts. The conservative approach used by Navigant is to assume that non-participant spillover is 0.00 and that the NTG ratio for the HER program is conservatively assumed to be 1.0. As a result, the net and gross savings estimates are the same for the LI HER component. As such, there is no NTG sample or results for the LI HER component.

Similar to the gross impacts results, the net impacts evaluation for LI Kits relied on the PY7 evaluation that combined evaluations of market rate and low-income kit activities. The efficiency kit free ridership rate from the PY7 evaluation was 47 percent. Navigant examined individual kit components and found free ridership rates of 53 percent, 41 percent, and 39 percent for light bulbs, smart strips, and nightlights, respectively. The spillover rate was 4 percent.

High-Impact Measure Research

Navigant identified no high impact measures (HIMs) for LIEEP in PY8.

3.5.4 Verified Savings Estimates

In Table 52 the realization rates and net-to-gross ratios determined by Navigant are applied to the reported energy and demand savings estimates to calculate the verified savings estimates for LIEEP in PY8. These totals are added to the verified savings achieved in previous program

years to calculate the P3TD program impacts.

Table 52: LIEEP PYTD and P3TD Savings Summary

Savings Type	Energy (MWh/yr)	Demand (MW/yr)
PYRTD	1,132	0.54
PYVTD Gross	1,155	0.57
PYVTD Net	1,112	0.55
RTD	1,132	0.54
VTD Gross	1,155	0.57
VTD Net	1,112	0.55

3.5.5 Process Evaluation

Navigant will conduct process evaluations during future years of Phase III. Activities will include participant surveys to inform NTG and process evaluation research. Research in PY9 will also focus on LIEEP WHEAP, when Navigant anticipates there will be reported savings.

3.5.6 Cost-Effectiveness Reporting

A detailed breakdown of program finances and cost-effectiveness is presented in Table 53. TRC benefits in Table 53 were calculated using gross verified impacts. Net present value (NPV) PYTD costs and benefits are expressed in 2016 dollars. Net present value costs and benefits for P3TD financials are expressed in the 2016 dollars.

Table 53: Summary of Program Finances – Gross Verified

Row #	Cost Category	PYTD ($1,000)		P3TD ($1,000)	
1	EDC Incentives to Participants [1]	$0		$0	
2	EDC Incentives to Trade Allies	$0		$0	
3	Participant Costs (net of incentives/rebates paid by utilities)	$0		$0	
4	**Incremental Measure Costs (Sum of rows 1 through 3)**	$0		$0	
		EDC	**CSP**	**EDC**	**CSP**
5	Design & Development [2]	$6	$27	$6	$27
6	Administration, Management, and Technical Assistance [3]	$27	$83	$27	$83

7	Marketing [4]	$0	$0	$0	$0
8	Program Delivery [5]	$5	$137	$5	$137
9	EDC Evaluation Costs	$13		$13	
10	SWE Audit Costs	$45		$45	
11*	**Program Overhead Costs (Sum of rows 5 through 10)**	$343		$343	
12	NPV of increases in costs of natural gas (or other fuels) for fuel switching programs	**$0**		**$0**	
13	**Total NPV TRC Costs [6] (Net present value of sum of rows 4, 11, and 12)**	$343		$343	
14	Total NPV Lifetime Electric Energy Benefits	$85		$85	
15	Total NPV Lifetime Electric Capacity Benefits	$46		$46	
16	Total NPV Lifetime Operation and Maintenance (O&M) Benefits	$0		$0	
17	Total NPV Lifetime Non-Electric Benefits (Fossil Fuel, Water)	$0		$0	
18	**Total NPV TRC Benefits [7] (Sum of rows 14 through 17)**	$132		$132	
19	**TRC Benefit-Cost Ratio [8]**	**0.38**		**0.38**	

[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. NOTE: Savings carried over from Phase II are not to be 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 54 presents program financials and cost-effectiveness on a net savings basis.

Table 54: Summary of LIEEP Program Finances – Net Verified

Row #	Cost Category	PYTD ($1,000)		P3TD ($1,000)	
1	EDC Incentives to Participants [1]	$0		$0	
2	EDC Incentives to Trade Allies	$0		$0	
3	Participant Costs (net of incentives/rebates paid by utilities)	$0		$0	
4	**Incremental Measure Costs (Sum of rows 1 through 3)**	$0		$0	
		EDC	CSP	EDC	CSP
5	Design & Development [2]	$6	$27	$6	$27
6	Administration, Management, and Technical Assistance [3]	$27	$83	$27	$83
7	Marketing [4]	$0	$0	$0	$0
8	Program Delivery [5]	$5	$137	$5	$137
9	EDC Evaluation Costs	$13		$13	
10	SWE Audit Costs	$45		$45	
11*	**Program Overhead Costs (Sum of rows 5 through 10)**	$343		$343	
12	NPV of increases in costs of natural gas (or other fuels) for fuel switching programs	**$0**		**$0**	
13	**Total NPV TRC Costs [6] (Net present value of sum of rows 4, 11, and 12)**	$343		$343	
14	Total NPV Lifetime Electric Energy Benefits	$82		$82	
15	Total NPV Lifetime Electric Capacity Benefits	$45		$45	
16	Total NPV Lifetime Operation and Maintenance (O&M) Benefits	$0		$0	
17	Total NPV Lifetime Non-Electric Benefits (Fossil Fuel, Water)	$0		$0	

18	**Total NPV TRC Benefits [7] (Sum of rows 14 through 17)**	$127	$127
19	**TRC Benefit-Cost Ratio [8]**	**0.37**	**0.37**

[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. NOTE: Savings carried over from Phase II are not to be 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

Navigant limited its impact and process evaluation activities for LIEEP in PY8. At this time, we make no recommendations for the program.

3.6 Commercial Efficiency/Express Efficiency programs

As noted in Duquesne Light's Phase III EE&C Plan filing,[11] "the Express Efficiency, Commercial Efficiency and Industrial Efficiency Programs provide common incentives for a full range of common measures to assist commercial and industrial customers of all sizes and in all key market segments to overcome barriers to adopt energy efficiency measures. These programs put in place a baseline program design, with set incentive levels and measure content. The design provides an overarching programmatic structure with calculated incentives for customized projects or itemized incentives for standard measures." While all three programs share these characteristics, as a group they represent a very significant percentage of projected portfolio savings. Therefore, only two have been grouped together for evaluation purposes -- Express Efficiency and Commercial Efficiency – and the Industrial Efficiency program will be evaluated separately.

The Express Efficiency Program (EXP) provides rebates to offset the higher cost of high-efficiency equipment when compared to standard efficiency equipment. Program incentives promote customer indifference to the higher cost of high-efficiency equipment and increase customer adoption of high-efficiency equipment. The EXP targets all Duquesne Light commercial and industrial customers with maximum demand less than 300 kW, that are not

[11] Duquesne Light Company – Revised Phase III Energy Efficiency and Conservation Plan

already participating in other Act 129 programs. The EXP is delivered by a core team of DLC staff.

Similar to the EXP, the Commercial Efficiency Program (CEP) provides rebates to offset the higher cost of high-efficiency equipment when compared to standard efficiency equipment. Program incentives promote customer indifference to the higher cost of high-efficiency equipment and increase customer adoption of high-efficiency equipment. The CEP also includes energy audits which provide business customers a readily available, reliable source of information about their energy use and outline ways to save energy, that when implemented, result in energy savings, reduced operating costs, lowered carbon emissions and improved air quality. The CEP targets all Duquesne Light commercial customers with maximum monthly demand equal to or greater than 300 kW. The CEP is delivered by Franklin Energy, the program's CSP. Key support by Franklin Energy includes outreach and assistance to trade allies that sell and install qualifying products, use of energy surveys to assist customers in identifying opportunities, and application qualification and processing to payment.

A participant is a customer participating in the given program within a given reporting year (e.g., Q1 through Q4 for PY8), represented by a unique participant account number within the tracking system. Customers participating in a program more than once within a reporting year (i.e., PYRTD) are counted once; customers participating more than once but in different years or programs are counted more than once (once in each year and/or program).

3.6.1 Participation and Reported Savings by Customer Segment

Table 55 presents the participation counts, reported energy and demand savings, and incentive payments for the two programs in PY8, by customer segment/program.

Table 55: CEP/EXP Participation and Reported Impacts

Parameter	Small C&I (Non-GNI)	Large C&I (Non-GNI)	Total
PYTD # Participants	94	10	104
PYRTD MWh/yr	3,239	3,642	6,882
PYRTD MW/yr	0.44	0.26	0.69
PY8 Incentives ($1000)	$139	$179	$318

3.6.2 Gross Impact Evaluation

The sample design for the Commercial Program Group used the stratified ratio estimator approach (Lohr 1999)[12]. The approach is similar to that used for the residential programs except

[12] Lohr, Sharon. *Sampling: Design and Analysis*. Pacific Grove, CA: Duxbury Press, 1999, 69-101.

that the sample is stratified by ex-ante energy savings (kWh) rather than by sub-program. Additionally, unlike with residential, all strata standard errors are estimated consistent with Lohr (1999) assuming a continuous distribution of the realization rate. The stratified ratio estimation approach takes advantage of information that is reported in the PMRS tracking system for each project in the program. The two key parameters in the stratified ratio estimate are a) the ratio between ex-post and ex-ante savings and b) the standard error of the estimate. The ratio between ex-post and ex-ante savings, known as the realization rate, measures the accuracy of the tracking estimates from project to project across the sample of projects. The standard error of the ratio estimate is a measure of the variability in the relationship between the ex-post and ex-ante estimates. Both estimates help to define the relationship (e.g., the ratio as well as the relative precision of the ratio) between the tracking estimates of savings and the actual project savings.

Ratios are calculated within each stratum and strata weights are applied to arrive at a program-level ratio. A stratum is a subset of the projects in the population that are grouped together based on some known variable, in this case ranges of ex-ante savings. In other words, a disaggregation of the population into strata is a classification of all units in the population into mutually exclusive strata that span the population. Under this design, each stratum is sampled according to simple random sampling protocols and the weighted estimates of parameters are then applied to the entire population.

In PY8, impact evaluation verification work was completed in two phases: in late spring/early summer of 2017 for projects completed in Q1-Q3 of PY8, and in late summer/early fall of 2017 for projects completed in the fourth quarter of PY8. Commercial Evaluation Group projects completed between 6/1/2015 and 11/30/2016 (Q1 and Q2), between 12/1/2016 and 2/28/2017 (Q3) and between 3/1/2017 and 5/31/2017 (Q4), were extracted from Duquesne Light's program tracking system and placed into strata based on each project's reported kWh savings.

In PY8, there were only two projects completed within the Large Commercial program. Navigant selected both of these projects for verification, and performed verification site visits for each of them. After the visit, Navigant obtained further trending data on the retrofit equipment to evaluate these projects (Verification and Trending).

For the Express Efficiency program, Navigant and its subcontractor, Karpinski Engineering, performed one of two evaluation activities. If the incentive for the project was greater than $2,000, Navigant or Karpinski performed a verification-only site visit, consisting of verification of the retrofit and baseline equipment (where possible), and a customer interview regarding retrofit and building details (Verification Only Visit). If the incentive was less than $2,000, Navigant or Karpinski called the customer and performed an interview over the phone to verify the project details (Phone Verification).

Table 56: CEP/EXP Gross Impact Sample Design for PY8

Stratum	Population Size[13]	Achieved Sample Size	Evaluation Activity
Commercial/Express - Large	2	2	On-Site Verification and Trending
Commercial/Express - Medium	11	6	Verification Only Visit
Commercial/Express - Small	94	8	Verification Only Visit (1) Phone Verification (7)
Program Total	**107**	**16**	

Table 57: CEP/EXP Gross Impact Results for Energy

Stratum	PYRTD MWh/yr	Energy Realization Rate	Sample C_v or Error Ratio	Relative Precision at 90% C.L.*
Commercial/Express - Large	2,982	99%	0.03	0.0%
Commercial/Express - Medium	1,939	99%	0.01	0.7%
Commercial/Express - Small	1,961	97%	0.10	6.6%
Program Total	**6,882**	**98%**		**1.7%**

*Commercial Efficiency/Express Efficiency was sampled targeting 90/15 for PY8.

[13] Participant counts when sampling reflect the total number of projects rather than the total number of participants.

Table 58: CEP/EXP Gross Impact Results for Demand

Stratum	PYRTD MW/yr	Demand Realization Rate	Sample C_v or Error Ratio	Relative Precision at 90% C.L.*
Commercial/Express - Large	0.15	128%	0.42	0.0%
Commercial/Express - Medium	0.24	100%	0.00	0.2%
Commercial/Express - Small	0.30	91%	0.14	11.2%
Program Total	**0.69**	**102%**		**3.8%**

*Commercial Efficiency/Express Efficiency was sampled targeting 90/15 for PY8.

The following factors led to variation between the reported and verified savings and led to the observed realization rates.

- For the two Large Commercial projects, Navigant obtained trend data to support its analysis. The addition of these data led to discrepancies in the overall realization rates. In the larger project, trend data indicated a slightly lower value for Hours of Use than was used in the ex ante analysis, lowering the realization rate by 3%. The other project had its realization rate boosted due to the analysis of the trend data.
- **Verified Fixture Counts:** The Express Efficiency program had one project that had a lower realization rate due to verification that approximately 17% of the fixtures rebated were not present at the site.
- **Hours of Use:** A second project in Express Efficiency had a higher HOU due to a change in building type, increasing its realization rate by 21% for energy.

3.6.3 Net Impact Evaluation

No NTG research was conducted in PY8 for most nonresidential programs, including the EXP and CEP programs. This research will be conducted in future years (PY9 and PY11), as specified in Navigant's Evaluation Plan. As a result, NTG values reported from PY7 research are used here.

In PY7, the evaluation team assessed free ridership using a customer self-report approach following the SWE framework.[14] This approach used a survey designed to assess the likelihood that participants would have installed some or all of the energy efficiency measures incented by the program, even if the program had not existed. Based on the SWE methodology, the free ridership analysis included the following two elements of free ridership: 1) *intention* to carry out

[14] SWE Guidance memorandum GM-024: Common Approach for Measuring Free riders for Downstream Programs, October 4, 2013.

the energy-efficient project without program funds and 2) *influence* of the program in the decision to carry out the energy-efficient improvements. The evaluation team also asked program participants a battery of questions to quantitatively assess spillover, in accordance with the SWE's guidance memorandum on this activity.[15]

The NTG was then calculated based on the generic formulation illustrated in Equation 3-3:

Equation 3-3. Total Net to Gross Ratio

$$Net\ to\ Gross\ Ratio = 1 - Free\ Ridership + Spillover$$

All commercial customers were included in a single stratum in PY7 for NTG research. The resulting NTG ratio is applied to the total gross savings for the EXP and CEP programs. A summary of the PY7 NTG results is included below in Table 59.

Table 59: CEP/EXP Net Impact Evaluation Results (PY7 Results)

Target Group	Estimated Free Ridership	Estimated Participant Spillover	NTG Ratio	Observed Coefficient of Variation	Relative Precision (@ 85% CL)
Commercial	44%	0%	56%	0.29	12.9%

See Navigant's PY7 final report for Duquesne Light for more detail regarding the PY7 NTG analysis.

High-Impact Measure Research

No net-to-gross analysis was performed in PY8 for these programs, and so there was no special HIM measure analysis.

3.6.4 Verified Savings Estimates

In Table 60 the realization rates and net-to-gross ratios determined by Navigant are applied to the reported energy and demand savings estimates to calculate the verified savings estimates for the CEP and EXP in PY8. These totals are added to the verified savings achieved in previous program years to calculate the P3TD program impacts.

[15] SWE Guidance memorandum GM-025: Common Approach for Measuring Spillover for Downstream Programs, February 28, 2014.

Table 60: EXP/CEP PYTD and P3TD Savings Summary

Savings Type	Energy (MWh/yr)	Demand (MW/yr)
PYRTD	6,882	0.69
PYVTD Gross	6,762	0.71
PYVTD Net	3,766	0.39
RTD	6,882	0.69
VTD Gross	6,762	0.71
VTD Net	3,766	0.39

3.6.5 Process Evaluation

Participant process evaluation and net-to-gross (NTG) surveys will be conducted every other year (years PY9 and PY11), along with similar surveys for other nonresidential programs. Such surveys were conducted of all nonresidential program participants in PY7 so were not completed in PY8. Trade Ally interviews were planned for PY8; however, participation in the program took longer to ramp up than expected, with a new CSP implementing the program. Consequently, these interviews will be completed in PY9. Navigant spoke with the program manager and CSP to gain a thorough understanding of the programs. Program documentation including the Program Management Plans and marketing plans were reviewed.

3.6.6 Cost-Effectiveness Reporting

A detailed breakdown of program finances and cost-effectiveness is presented in Table 61 and Table 63Table 24. TRC benefits in Table 61 and Table 63 were calculated using gross verified impacts. Net present value (NPV) PYTD costs and benefits are expressed in 2016 dollars. Net present value costs and benefits for P3TD financials are expressed in the 2016 dollars.

Table 61: Summary of Express Efficiency Program Finances – Gross Verified

Row #	Cost Category	PYTD ($1,000)		P3TD ($1,000)	
1	EDC Incentives to Participants [1]	$139		$139	
2	EDC Incentives to Trade Allies	$0		$0	
3	Participant Costs (net of incentives/rebates paid by utilities)	$242		$242	
4	**Incremental Measure Costs (Sum of rows 1 through 3)**	$381		$381	
		EDC	**CSP**	**EDC**	**CSP**
5	Design & Development [2]	$3	$36	$3	$36

6	Administration, Management, and Technical Assistance [3]	$23	$107	$23	$107
7	Marketing [4]	$0	$0	$0	$0
8	Program Delivery [5]	$371	$0	$371	$0
9	EDC Evaluation Costs	$17		$17	
10	SWE Audit Costs	$57		$57	
11*	**Program Overhead Costs (Sum of rows 5 through 10)**	$614		$614	
12	NPV of increases in costs of natural gas (or other fuels) for fuel switching programs	$0		$0	
13	**Total NPV TRC Costs [6] (Net present value of sum of rows 4, 11, and 12)**	$995		$995	
14	Total NPV Lifetime Electric Energy Benefits	$1,421		$1,421	
15	Total NPV Lifetime Electric Capacity Benefits	$501		$501	
16	Total NPV Lifetime Operation and Maintenance (O&M) Benefits	$71		$71	
17	Total NPV Lifetime Non-Electric Benefits (Fossil Fuel, Water)	$0		$0	
18	**Total NPV TRC Benefits [7] (Sum of rows 14 through 17)**	$1,993		$1,993	
19	**TRC Benefit-Cost Ratio [8]**	2.00		2.00	

[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. NOTE: Savings carried over from Phase II are not to be 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 62 and Table 64 presents program financials and cost-effectiveness on a net savings basis.

Table 62: Summary of Express Efficiency Program Finances – Net Verified

Row #	Cost Category	PYTD ($1,000)		P3TD ($1,000)	
1	EDC Incentives to Participants [1]	$182		$182	
2	EDC Incentives to Trade Allies	$0		$0	
3	Participant Costs (net of incentives/rebates paid by utilities)	$30		$30	
4	**Incremental Measure Costs (Sum of rows 1 through 3)**	$212		$212	
		EDC	CSP	EDC	CSP
5	Design & Development [2]	$3	$36	$3	$36
6	Administration, Management, and Technical Assistance [3]	$23	$107	$23	$107
7	Marketing [4]	$0	$0	$0	$0
8	Program Delivery [5]	$371	$0	$371	$0
9	EDC Evaluation Costs	$17		$17	
10	SWE Audit Costs	$57		$57	
11*	**Program Overhead Costs (Sum of rows 5 through 10)**	$614		$614	
12	NPV of increases in costs of natural gas (or other fuels) for fuel switching programs	$0		$0	
13	**Total NPV TRC Costs [6] (Net present value of sum of rows 4, 11, and 12)**	$826		$826	
14	Total NPV Lifetime Electric Energy Benefits	$792		$792	
15	Total NPV Lifetime Electric Capacity Benefits	$279		$279	

16	Total NPV Lifetime Operation and Maintenance (O&M) Benefits	$40	$40
17	Total NPV Lifetime Non-Electric Benefits (Fossil Fuel, Water)	$0	$0
18	**Total NPV TRC Benefits [7] (Sum of rows 14 through 17)**	$1,110	$1,110
19	**TRC Benefit-Cost Ratio [8]**	1.34	1.34

[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. NOTE: Savings carried over from Phase II are not to be 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 Commercial Efficiency Program Finances – Gross Verified

Row #	Cost Category	PYTD ($1,000)		P3TD ($1,000)	
1	EDC Incentives to Participants [1]	$179		$179	
2	EDC Incentives to Trade Allies	$0		$0	
3	Participant Costs (net of incentives/rebates paid by utilities)	$633		$633	
4	**Incremental Measure Costs (Sum of rows 1 through 3)**	$812		$812	
		EDC	CSP	EDC	CSP
5	Design & Development [2]	$3	$41	$3	$41
6	Administration, Management, and Technical Assistance [3]	$24	$124	$24	$124
7	Marketing [4]	$0	$0	$0	$0
8	Program Delivery [5]	$0	$338	$0	$338

9	EDC Evaluation Costs	$20	$20
10	SWE Audit Costs	$66	$66
11*	**Program Overhead Costs (Sum of rows 5 through 10)**	$616	$616
12	NPV of increases in costs of natural gas (or other fuels) for fuel switching programs	$0	$0
13	**Total NPV TRC Costs [6] (Net present value of sum of rows 4, 11, and 12)**	$1,428	$1,428
14	Total NPV Lifetime Electric Energy Benefits	$1,544	$1,544
15	Total NPV Lifetime Electric Capacity Benefits	$281	$281
16	Total NPV Lifetime Operation and Maintenance (O&M) Benefits	$14	$14
17	Total NPV Lifetime Non-Electric Benefits (Fossil Fuel, Water)	$0	$0
18	**Total NPV TRC Benefits [7] (Sum of rows 14 through 17)**	$1,839	$1,839
19	**TRC Benefit-Cost Ratio [8]**	1.29	1.29

[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. NOTE: Savings carried over from Phase II are not to be 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 Commercial Efficiency Program Finances – Net Verified

Row #	Cost Category	PYTD ($1,000)		P3TD ($1,000)	
1	EDC Incentives to Participants [1]	$179		$179	
2	EDC Incentives to Trade Allies	$0		$0	
3	Participant Costs (net of incentives/rebates paid by utilities)	$273		$273	
4	**Incremental Measure Costs (Sum of rows 1 through 3)**	$452		$452	
		EDC	CSP	EDC	CSP
5	Design & Development [2]	$3	$41	$3	$41
6	Administration, Management, and Technical Assistance [3]	$24	$124	$24	$124
7	Marketing [4]	$0	$0	$0	$0
8	Program Delivery [5]	$0	$338	$0	$338
9	EDC Evaluation Costs	$20		$20	
10	SWE Audit Costs	$66		$66	
11*	**Program Overhead Costs (Sum of rows 5 through 10)**	$616		$616	
12	NPV of increases in costs of natural gas (or other fuels) for fuel switching programs	$0		$0	
13	**Total NPV TRC Costs [6] (Net present value of sum of rows 4, 11, and 12)**	$1,068		$1,068	
14	Total NPV Lifetime Electric Energy Benefits	$860		$860	
15	Total NPV Lifetime Electric Capacity Benefits	$157		$157	
16	Total NPV Lifetime Operation and Maintenance (O&M) Benefits	$8		$8	
17	Total NPV Lifetime Non-Electric Benefits (Fossil Fuel, Water)	$0		$0	
18	**Total NPV TRC Benefits [7] (Sum of rows 14 through 17)**	$1,024		$1,024	

19	**TRC Benefit-Cost Ratio [8]**	0.96	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. NOTE: Savings carried over from Phase II are not to be 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

Navigant limited its impact and process evaluation activities for the EXP/CEP in PY8. At this time, we make no recommendations for the program.

3.7 Small/Medium and Large Nonresidential Midstream Lighting Program

The Duquesne Light Nonresidential Midstream Lighting program was designed to remove barriers by providing point of sale incentives to commercial customers. Common barriers in traditional programs include lengthy application processes and rebate delays. However, this nonresidential program offers instant rebates (discounted pricing) at point of purchase to eligible customers who purchase program LEDs from participating DLC distributor partners. DLC electric commercial-rate customers and contractors are eligible to participate with the exclusion of new construction projects. Ecova is the Conservation Service Provider (CSP) responsible for establishing program guidelines, monitoring program operations, and managing distributor participation. This program launched in January 2017 with the goal of providing customers easy to access to efficient lighting.

A participant in this program is the account number associated with one or more qualifying purchases within the program year (e.g., Q1 through Q4 for PY8).

3.7.1 Participation and Reported Savings by Customer Segment

Table 65 presents the participation counts, reported energy and demand savings, and incentive payments for the Midstream Lighting program in PY8 by customer segment.

Table 65: Midstream Lighting Participation and Reported Impacts

Parameter	Small C&I (Non-GNI)	Large C&I (Non-GNI)	Total
PYTD # Participants	78	43	121
PYRTD MWh/yr	1,025	904	1,929
PYRTD MW/yr	0.1605	0.1545	0.32
PY8 Incentives ($1000)	$87	$109	$196

3.7.2 Gross Impact Evaluation

Navigant sampled the nonresidential midstream lighting program without stratifying. After the sample was drawn, one project far outweighed the others, so Navigant stratified the sample during the analysis process. For sampling purposes, a "project" was defined as a unique customer name/invoice upload date combination, as this grouped the purchases by both location and time. This led to the population and sample size detailed in Table 66.

Navigant or its subcontractor, Karpinski Engineering, performed site visits for all of the Midstream Lighting sites sampled for PY8, since this was the first year of the program. None of the projects in the population for PY8 met the 750,000-kWh metering threshold, so all projects were Verification Only.

Table 66: Midstream Lighting Gross Impact Sample Design for PY8

Stratum	Population Size[16]	Achieved Sample Size	Evaluation Activity
Midstream - Small	103	10	Verification Only Visit
Midstream - Large	69	12	Verification Only Visit
Total	**172**	**22**	

[16] Participant counts when sampling reflect the total number of projects rather than the total number of participants.

Table 67: Midstream Lighting Gross Impact Results for Energy

Stratum	PYRTD MWh/yr	Energy Realization Rate	Sample C_v or Error Ratio	Relative Precision at 85% C.L.
Midstream - Small	1,034	100%	0.37	17.6%
Midstream - Large	894	220%	0.42	16.9%
Program Total	**1,929**	**156%**		**12.1%**

Table 68: Midstream Lighting Gross Impact Results for Demand

Stratum	PYRTD MW/yr	Demand Realization Rate	Sample C_v or Error Ratio	Relative Precision at 85% C.L.
Midstream - Small	0.16	119%	0.28	13.0%
Midstream - Large	0.15	216%	0.45	18.3%
Program Total	**0.31**	**166%**		**12.0%**

The following factors led to variation between the reported and verified savings and led to the observed realization rates.

- **Large Stratum:** there was only one site in the large stratum, and since the savings were greater than 20kW, it required a different method of calculation than the other projects in the sample. Specifically, the team adjusted the baseline fixtures in this project to match the in-situ baseline, which reduced the realization rate. Additionally, on-site verification confirmed that the bulbs were installed in a variety of space types. Updating the HOU to match the space types increased savings by almost 100%. Finally, the site visit indicated that not all purchased bulbs had been installed, dropping the savings by about 10%.
- **In Service Rate (ISR):** Ecova, the CSP for this program, assumed an ISR of 85% for each site. Most sites had an actual ISR of 100%, though several (n=8) had a lower ISR. Overall ISR for the sample was 89%.
- **Building Type:** Navigant adjusted the building type for several of the sites (n=7), which changed the HOU and CF for these sites. This increased the savings for six sites, and reduced it for one.

- **Bulb Type:** There were two sites where Navigant or Karpinski found pin-based bulbs. However, the reported savings calculations used HOU and CF based on screw-in bulbs. This correction in the ex post analysis increased realization rates for those two sites.

3.7.3 Net Impact Evaluation

Net-to-gross (NTG) factors for the midstream lighting program was estimated based on results from the telephone survey of program participants. An attempted census was completed for program participants. In total, 25 midstream lighting program participants responded to the battery of NTG questions.

The primary objective of the net-to-gross analysis is to determine the program's net effect on customer energy consumption. After the Navigant team calculates verified gross program impacts, the team derives net program impacts by estimating a NTG ratio that quantifies the percentage of the program impacts that can reliably be attributed to the program. The NTG ratio is comprised of two terms:

1. A free ridership (FR) score, which accounts for the proportion of customers who would have installed "an energy efficiency measure without the program financial incentives"[17] and without information and non-financial support that can be integral parts of the DSM program including audits, technical assistance, product selection, and the like.
2. A spillover (SO) score, which accounts for "reductions in energy consumption and/or demand caused by the presence of the energy efficiency program, beyond the program-related gross savings of the participants. There can be participant and/or non-participant spillover."[18]

The generic formulation of this ratio is illustrated in Equation :

Equation 4. Total Net to Gross Ratio

$$Net\ to\ Gross\ Ratio = 1 - Free\ Ridership + Spillover$$

The balance of this section presents Navigant's approach used for calculating participant free-ridership and participant spillover. As required, both approaches followed closely the guidance provided by the Pennsylvania Statewide Evaluator (SWE).

[17] Heins, S. (2006). *Energy Efficiency and the Spectre of Free-Ridership*. ACEEE Summer Study on Energy Efficiency in Buildings. http://aceee.org/files/proceedings/2006/data/papers/SS06_Panel12_Paper08.pdf.
[18] Shiller, S., Peters, J., and Drew, T. (2010). *Gross and Net Savings*. EPA State Climate Change Program, http://www.emvwebinar.org/Meeting%20Materials/2010/2010-04-06/2010-04-06-Schiller.pdf.

Free-Ridership Methodology

The evaluation team assessed free ridership using a customer self-report approach following the SWE framework.[19] This approach uses a survey designed to assess the likelihood that participants would have installed some or all of the energy efficiency measures incented by the program, even if the program had not existed. Based on the SWE methodology, the free ridership analysis included the following two elements of free ridership: 1) *intention* to carry out the energy-efficient project without program funds and 2) *influence* of the program in the decision to carry out the energy-efficient improvements.

The total free ridership score illustrated in Equation 5 is the sum of the intention and the program influence scores, resulting in a score ranging from 0 to 100. This score is divided by 100 to convert it into a percentage for application to gross savings values.

Equation 5. Total Free Ridership

$$Free\ Ridership\ (FR) = \frac{Intention\ Score + Program\ Influence\ Score}{100}$$

Intention Score

The intention score was assessed through several brief questions used to determine how the upgrade or equipment replacement likely would have differed if the respondent had not received the program assistance. The initial question asked the respondent to identify, out of a limited set of options, the option that best described what most likely would have occurred without the program assistance. Note that "program assistance" often includes more than just the incentive – it may also include audits, technical assistance, and the like. The offered response options were:

1. Would not have completed the lighting project
2. Would have postponed the installation
3. Would have installed non-LED bulbs.
4. Would have reduced the project size or scope.
5. Would have installed exactly the same LEDs at the same time.
6. Don't know

The algorithm provides an intention score of 0 to respondents who said they would have canceled or postponed the project if there had been no program. The approach considers respondents who indicated they would have done something that would have resulted in less

[19] SWE Guidance memorandum GM-024: Common Approach for Measuring Free riders for Downstream Programs, October 4, 2013.

energy savings as partial free riders in terms of intention (free ridership ranging from 12.5 to 37.5 for the intention component in the case of these nonresidential programs). The respondents who indicated they would have undertaken the project as implemented without the program receive a score based on whether they would have paid full price for the upgrade (intention score of 50 if they would have paid full price, 25 if they would not have, and 37.5 if they said they did not know whether they would have). “Don’t know” responses were assigned the midpoint score of 25 for the intention component.

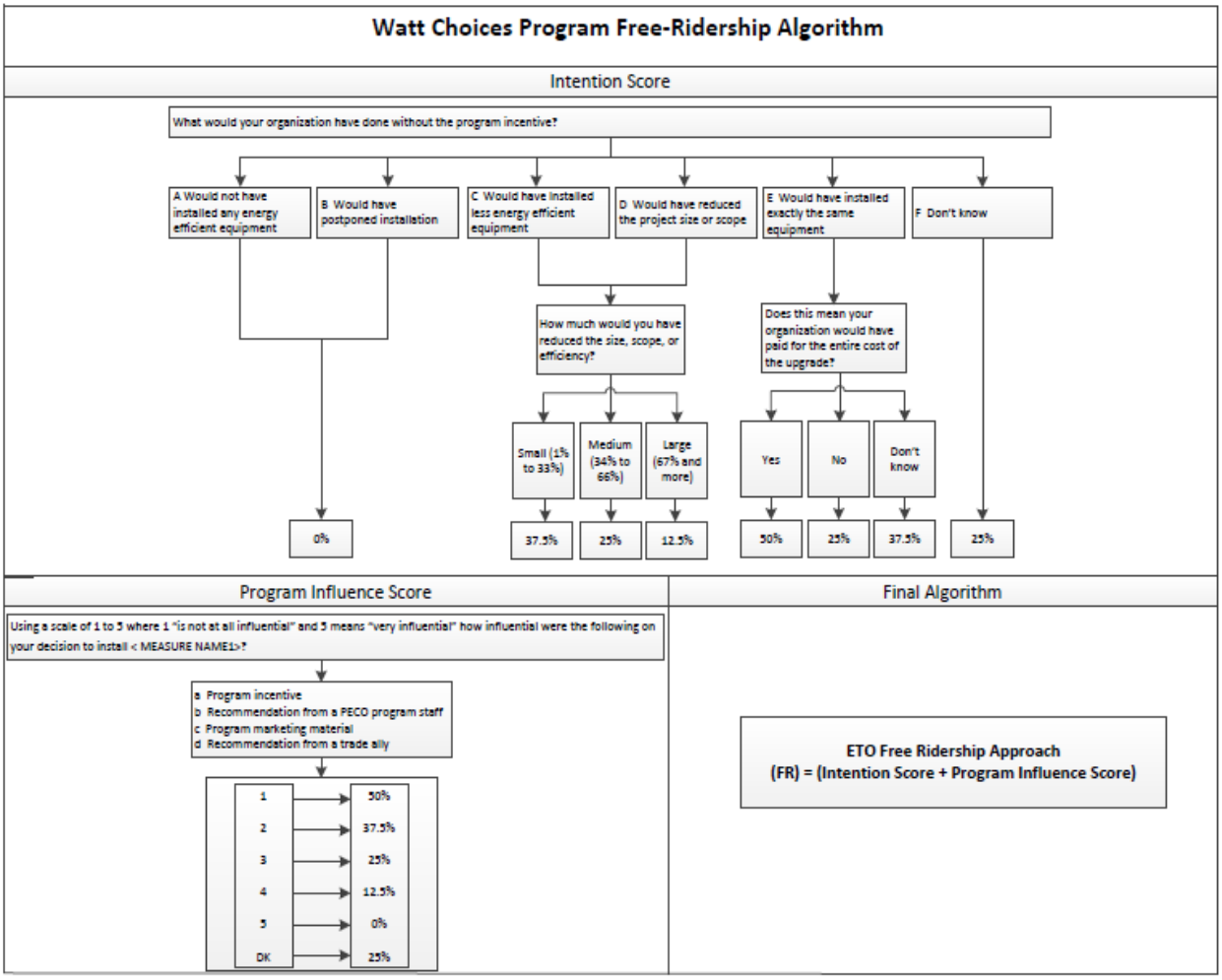
Program Influence Score

To assess the program influence score on the program participant’s decision to implement energy efficient improvements, the Navigant team asked respondents how much influence – on a scale of 1 (no influence) to 5 (great influence) – various program elements had on the decision to implement the project. The elements used to influence customer decision making included program information, program incentives, interaction with program staff (technical assistance), and interaction with program proxies, such as members of a trade ally network.

A participant’s program influence score was then set to the participant’s maximum influence rating for any program element. The rationale was that if any given program element had a great influence score on the respondent’s decision, and then the program itself had that level of influence, even if other elements had less influence. The program influence score and free ridership have an inverse relationship: the greater the program influence, the lower the free ridership and vice versa.

Figure 12 summarizes both the intention score and program influence score calculations for the program. The figure shows the possible response combinations to the questions described in the intention score section and the value assigned to each unique combination. In addition, it shows the program influence score and possible answers to the five-point scale along with the “don’t know” answers.

Figure 12. Free-Ridership Algorithm



Source: Navigant

Spillover Methodology

Spillover occurs when there are reductions in energy consumption or demand caused by the presence of the energy efficiency program, but which the program does not directly influence or track as part of its gross savings. The evaluation team asked program participants a battery of questions to quantitatively assess spillover, in accordance with the SWE's guidance memorandum on this activity.[20] The spillover questions used are:

[20] SWE Guidance memorandum GM-025: Common Approach for Measuring Spillover for Downstream Programs, February 28, 2014.

1. Since your participation in the program, did you install any additional energy-efficient measures at this facility that did not receive incentives through a Duquesne Light program?
2. Please describe the energy efficient equipment or energy efficiency improvement that was implemented without a Duquesne Light incentive at the [ADDRESS] facility?
3. How influential was your experience in Duquesne Light's [NAME OF PROGRAM] Program in your decision to make this energy efficiency improvement, **using a scale of 1 to 5, where 1 is not at all influential and 5 is extremely influential**?
4. Would you say the energy savings from the **ADDITIONAL** energy efficiency improvement you made **WITHOUT** a Duquesne Light incentive **at this same facility** was more or less than the savings from the equipment you installed **at this same facility** for which you **DID** receive a Duquesne Light incentive?
5. About what percentage [MORE/LESS] was the energy savings of the ADDITIONAL efficiency improvement?
6. What were the reasons that you chose not to pursue obtaining a Duquesne Light incentive for this **ADDITIONAL** energy efficiency improvement?

This battery of questions was then repeated with respect to additional efficiency improvements made to *other* facilities in the Duquesne service territory operated by the same customer.

The battery of questions attempted to quantify all the savings from additional non-incented equipment installed after the respondent's participation in the program.

The evaluation team was to assign the influence rating a value which determined what proportion of the measure's energy savings were attributed to the program:

- A rating of 4 or 5 = 1.0 (full savings attributed to the program).
- A rating of 2 or 3 = 0.5 (half of the savings attributed to the program).
- A rating of 0 or 1 = 0 (no savings attributed to the program).

The spillover savings would then be estimated using a self-report approach. Respondents are asked the following additional question: Thinking of the additional equipment you installed at this facility that did not receive a rebate; how does the energy savings compare to what you installed through the program? The additional equipment saved _____% of the savings saved by the equipment installed by the program. This percentage is used to estimate the savings of the additional measure. The team would then calculate spillover for measures reported as the product of the measure savings, number of units, and influence score, as illustrated in Equation 6.

Equation 6. Spillover Savings from Installed Measures

$$Measure\ SO = Measure\ Savings * Number\ of\ Units * Program\ Influence$$

For each of the above categories, the evaluation team would then total the savings associated with each program participant, to give the overall participant spillover savings reflected in Equation 7.

Equation 7. Overall Participant Spillover

$$Participant\ SO = \Sigma Measure\ SO$$

The team would then multiply the mean participant spillover savings for the participant sample by the total number of program participants to yield an estimated total participant spillover savings for the program. Equation 8 shows the algorithm to be used in calculating spillover for the program.

Equation 8. Spillover Savings for the Program

$$\Sigma Participant\ SO\ (population) = \frac{\sum Participant\ SO\ (sample)}{Sample\ n} * \text{Population } N$$

Finally, the evaluation team would divide the total spillover savings by the total program savings to yield a participant spillover percentage, as shown in Equation 9.

Equation 9. Participant Spillover Percentage

$$\%\ Participant\ SO\ = \frac{\sum Participant\ SO\ (population)}{Program\ Savings} * 100$$

Unfortunately, the SWE's spillover methodology requires "proof" of the existence of spillover measures, beyond program participants reporting that they have installed them and estimating the savings value from them. This was not feasible to do, given the length of the survey used to estimate free ridership. The Navigant team calculated all spillover estimates using customer self-reported data and did not conduct follow-up interviews or site visits. Spillover therefore is being reported as 0%.

The overall net impacts were determined by post stratifying the sample into large, medium and small projects as shown in Table 69. The results are shown below in Table 70.

Table 69: Midstream Lighting Net Impact Sample Design

Stratum	Stratum Boundaries	Population Size	Achieved Sample Size	Response Rate
Large	>25,000 kWh	20	4	20%
Medium	5,000 – 25,000 kWh	52	11	21%
Small	<5,000 kWh	56	10	18%
Program Total		**128**	**25**	**20%**

Table 70: Midstream Lighting Net Impact Evaluation Results

Target Group or Stratum (if appropriate)	PYVTD	Free Ridership (%)	Spillover (%)	NTG Ratio	Relative Precision (@ 85% CL)
Large	1,224,095	0.09	0	0.91	16.7%
Medium	596,994	0.14	0	0.86	7.4%
Small	107,466	0.29	0	0.71	10.2%
Program Total	**1,928,555**	**0.12**	**0**	**0.88**	**8.7%**

Some key observations about the NTG ratio have been included below:

- Intention FR scores were divided mostly between 0 and 25% - many participants indicated that they would not have bought the program bulbs if the discounts had not been available
- Influence FR scores were also low with the majority of respondents indicating the program was very influential (5 on a scale of 1 to 5) in their decision to purchase the program bulbs

High-Impact Measure Research

The late start to the Midstream Lighting resulted in low participation and therefore no HIMs.

3.7.4 Verified Savings Estimates

In Table 71 the realization rates and net-to-gross ratios determined by Navigant are applied to the reported energy and demand savings estimates to calculate the verified savings estimates for Midstream Lighting in PY8. These totals are added to the verified savings achieved in

previous program years to calculate the P3TD program impacts.

Table 71: Midstream Lighting PYTD and P3TD Savings Summary

Savings Type	Energy (MWh/yr)	Demand (MW/yr)
PYRTD	1,929	0.32
PYVTD Gross	3,003	0.52
PYVTD Net	2,657	0.46
RTD	1,929	0.32
VTD Gross	3,003	0.52
VTD Net	2,657	0.46

3.7.5 Process Evaluation

In PY8 Navigant completed an in-depth process evaluation of the Midstream Lighting program. In addition to a review of the impact evaluation project verification findings, this included interviews with the Duquesne Light program manager and the implementation contractor, interviews with registered distributors (both those who had been active and those who were not active in the program), and surveys with program participants. An attempt was made to conduct surveys with a census of all unique Midstream Lighting program participant decision-makers (some participated more than once or responded for more than one project or facility). Out of 102 potential respondents, surveys were completed with 25[21]. Navigant completed phone interviews with 11 registered active and 2 registered non-active distributors enrolled in the program during PY8. Active distributors are those who registered for the program and documented sales of eligible program bulbs during the PY8 period (January to May 31, 2017) and registered non-active distributors enrolled in the program but did not submit any invoices of bulbs sales. The results of these activities are summarized below.

- All surveyed customers reported that they knew about the program before Navigant reached out to them. The majority (16 of 25) indicated that they heard about the program from distributors.
- Respondents reported that lack of awareness was the largest barrier to participation (for companies who have not already participated)
- Participants reported very high satisfaction with all aspects of the program. The highest rating was for the interactions with the lighting distributor which received an average rating of 5 on a scale of 1 to 5, where 5 is very satisfied.
- Overall, distributors view the Duquesne Light Midstream Lighting program in a positive light and are generally satisfied with the program. The program can be integrated into a

[21] The total number of unique participants does not match the total number of projects. In some cases a decision maker was responsible for more than 1 unique project. These individuals were only asked about a single project with respect to NTG.

variety of business models and its discounts can influence sales of LEDs that otherwise would not have happened, which is beneficial for both the distributor and its customers.

- For distributors who currently do not have large volumes of LED sales, the program can also be effective in helping them increase market share in this area.
- An area in which the program could improve is with the online portal. Distributors would like the process for submitting invoices to be more streamlined, with less troubleshooting required. Ecova has acknowledged this issue and is working on improving the portal.
- The realization rate for energy savings for this program was 156%. Reasons for other than 100% realization rate included the following:
    - For the largest project, Navigant used customer-specific hours of use for several usage groups, while the CSP used the TRM building type default hours of use (the only choice they had, given that this was a midstream program). The use of the building type default hours of use grossly under-estimated the hours of use in this situation, resulting in a 240% realization rate. Because this project accounted for 64% of the savings for the PY8 program, this was the main driver behind the 156% realization rate for the program. Excluding this project, the program realization rate would have been lower.
    - Bulb counts (ISR). With respect to bulb counts verified, 2,649 out of a total of 2,991 bulbs reported as installed by sampled participants could be verified (89%). This is close to the CSP's assumed 85% ISR. For one participant, 80 bulbs (out of a total of 320) were not installed because the new LEDs made the space bright enough without them. For almost all of the other participants having less than 100% ISR, bulbs were in storage or count differences were only slight.
    - Building type (Hours of Use). The reported building type was accurate for 15 of the 22 sites visited. For 6 of the other 7 sites, the incorrect reported building type served to understate the hours of use and therefore savings (i.e., was "conservative").
    - Bulb type (Hours of Use). For two projects, pin-base lamps were used but the CSP used the TRM hours of use associated with screw-in bulbs, which is lower, resulting in an understatement of savings (i.e., was "conservative").
    - Baseline bulb wattage. Baseline bulb wattages were generally correct, except for bulb types requiring the use of the IMP's formula (certain PAR and MR16 bulbs). For these the CSP chose to use the manufacturer's or Energy Star Qualified Products List baseline wattage. However, the IMP states that the IMP formula should be used if possible. Not using the formula in these cases resulted in again understating the project savings (i.e., was "conservative").

- Program participation slowly ramped up in PY8, and the PY8 evaluation findings may not predict what will happen in PY9. However, thus far, except for the current 98% ISR in the program's IMP, the key IMP factors – baseline bulb wattage and building type/HOU – do not appear to have resulted in overstated savings. Rather, they have resulted in savings being understated. It is not clear whether the use of the baseline bulb wattage formula for PAR and MR bulbs produces a more accurate baseline wattage than that of either the manufacturer's projected baseline wattage or the baseline wattage provided in the Energy Star Qualified Products List (QPL). For the few sites requiring the use of the formula, the formula yielded a much higher baseline wattage (and therefore higher savings) relative to these other sources.

3.7.6 Cost-Effectiveness Reporting

A detailed breakdown of program finances and cost-effectiveness is presented in Table 72 and Table 74. TRC benefits in Table 72 and Table 74 were calculated using gross verified impacts. Net present value (NPV) PYTD costs and benefits are expressed in 2016 dollars. Net present value costs and benefits for P3TD financials are expressed in the 2016 dollars.

Table 72: Summary of Small/Medium Midstream Program Finances – Gross Verified

Row #	Cost Category	PYTD ($1,000)		P3TD ($1,000)	
1	EDC Incentives to Participants [1]	$87		$87	
2	EDC Incentives to Trade Allies	$0		$0	
3	Participant Costs (net of incentives/rebates paid by utilities)	-$37		-$37	
4	**Incremental Measure Costs (Sum of rows 1 through 3)**	$51		$51	
		EDC	**CSP**	**EDC**	**CSP**
5	Design & Development [2]	$3	$13	$3	$13
6	Administration, Management, and Technical Assistance [3]	$22	$38	$22	$38
7	Marketing [4]	$0	$0	$0	$0
8	Program Delivery [5]	$0	$0	$0	$0
9	EDC Evaluation Costs	$6		$6	
10	SWE Audit Costs	$20		$20	
11*	**Program Overhead Costs (Sum of rows 5 through 10)**	$102		$102	

12	NPV of increases in costs of natural gas (or other fuels) for fuel switching programs	$0	$0
13	**Total NPV TRC Costs [6] (Net present value of sum of rows 4, 11, and 12)**	$153	$153
14	Total NPV Lifetime Electric Energy Benefits	$538	$538
15	Total NPV Lifetime Electric Capacity Benefits	$215	$215
16	Total NPV Lifetime Operation and Maintenance (O&M) Benefits	$154	$154
17	Total NPV Lifetime Non-Electric Benefits (Fossil Fuel, Water)	$0	$0
18	**Total NPV TRC Benefits [7] (Sum of rows 14 through 17)**	$908	$908
19	**TRC Benefit-Cost Ratio [8]**	5.95	5.95

[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. NOTE: Savings carried over from Phase II are not to be 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 and Table 75 presents program financials and cost-effectiveness on a net savings basis.

Table 73: Summary of Small/Medium Midstream Program Finances – Net Verified

Row #	Cost Category	PYTD ($1,000)	P3TD ($1,000)
1	EDC Incentives to Participants [1]	$87	$87

2	EDC Incentives to Trade Allies	$0		$0	
3	Participant Costs (net of incentives/rebates paid by utilities)	-$43		-$43	
4	**Incremental Measure Costs (Sum of rows 1 through 3)**	$45		$45	
		EDC	**CSP**	**EDC**	**CSP**
5	Design & Development [2]	$3	$13	$3	$13
6	Administration, Management, and Technical Assistance [3]	$22	$38	$22	$38
7	Marketing [4]	$0	$0	$0	$0
8	Program Delivery [5]	$0	$0	$0	$0
9	EDC Evaluation Costs	$6		$6	
10	SWE Audit Costs	$20		$20	
11*	**Program Overhead Costs (Sum of rows 5 through 10)**	$102		$102	
12	NPV of increases in costs of natural gas (or other fuels) for fuel switching programs	$0		$0	
13	**Total NPV TRC Costs [6] (Net present value of sum of rows 4, 11, and 12)**	$147		$147	
14	Total NPV Lifetime Electric Energy Benefits	$477		$477	
15	Total NPV Lifetime Electric Capacity Benefits	$191		$191	
16	Total NPV Lifetime Operation and Maintenance (O&M) Benefits	$136		$136	
17	Total NPV Lifetime Non-Electric Benefits (Fossil Fuel, Water)	$0		$0	
18	**Total NPV TRC Benefits [7] (Sum of rows 14 through 17)**	$803		$803	
19	**TRC Benefit-Cost Ratio [8]**	5.48		5.48	

[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. NOTE: Savings carried over from Phase II are not to be 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 Large Midstream Program Finances – Gross Verified

Row #	Cost Category	PYTD ($1,000)		P3TD ($1,000)	
1	EDC Incentives to Participants [1]	$109		$109	
2	EDC Incentives to Trade Allies	$0		$0	
3	Participant Costs (net of incentives/rebates paid by utilities)	-$51		-$51	
4	**Incremental Measure Costs (Sum of rows 1 through 3)**	$58		$58	
		EDC	CSP	EDC	CSP
5	Design & Development [2]	$3	$30	$3	$30
6	Administration, Management, and Technical Assistance [3]	$24	$91	$24	$91
7	Marketing [4]	$0	$0	$0	$0
8	Program Delivery [5]	$0	$158	$0	$158
9	EDC Evaluation Costs	$14		$14	
10	SWE Audit Costs	$48		$48	
11*	**Program Overhead Costs (Sum of rows 5 through 10)**	$368		$368	
12	NPV of increases in costs of natural gas (or other fuels) for fuel switching programs	$0		$0	

13	**Total NPV TRC Costs [6] (Net present value of sum of rows 4, 11, and 12)**	$426	$426
14	Total NPV Lifetime Electric Energy Benefits	$534	$534
15	Total NPV Lifetime Electric Capacity Benefits	$224	$224
16	Total NPV Lifetime Operation and Maintenance (O&M) Benefits	$204	$204
17	Total NPV Lifetime Non-Electric Benefits (Fossil Fuel, Water)	$0	$0
18	**Total NPV TRC Benefits [7] (Sum of rows 14 through 17)**	$962	$962
19	**TRC Benefit-Cost Ratio [8]**	2.26	2.26

[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. NOTE: Savings carried over from Phase II are not to be 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 75: Summary of Large Midstream Program Finances – Net Verified

Row #	Cost Category	PYTD ($1,000)		P3TD ($1,000)	
1	EDC Incentives to Participants [1]	$109		$109	
2	EDC Incentives to Trade Allies	$0		$0	
3	Participant Costs (net of incentives/rebates paid by utilities)	-$58		-$58	
4	**Incremental Measure Costs (Sum of rows 1 through 3)**	$52		$52	
		EDC	CSP	EDC	CSP
5	Design & Development [2]	$3	$30	$3	$30

6	Administration, Management, and Technical Assistance [3]	$24	$91	$24	$91
7	Marketing [4]	$0	$0	$0	$0
8	Program Delivery [5]	$0	$158	$0	$158
9	EDC Evaluation Costs	$14		$14	
10	SWE Audit Costs	$48		$48	
11*	**Program Overhead Costs (Sum of rows 5 through 10)**	$368		$368	
12	NPV of increases in costs of natural gas (or other fuels) for fuel switching programs	$0		$0	
13	**Total NPV TRC Costs [6] (Net present value of sum of rows 4, 11, and 12)**	$420		$420	
14	Total NPV Lifetime Electric Energy Benefits	$472		$472	
15	Total NPV Lifetime Electric Capacity Benefits	$198		$198	
16	Total NPV Lifetime Operation and Maintenance (O&M) Benefits	$180		$180	
17	Total NPV Lifetime Non-Electric Benefits (Fossil Fuel, Water)	$0		$0	
18	**Total NPV TRC Benefits [7] (Sum of rows 14 through 17)**	$851		$851	
19	**TRC Benefit-Cost Ratio [8]**	2.03		2.03	

[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. NOTE: Savings carried over from Phase II are not to be 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

The impact and process evaluation activities in PY8 led to the following findings and recommendations from Navigant to Duquesne Light, along with a summary of how Duquesne Light plans to address the recommendation in program delivery.

Finding #1: Participants reported that lack of awareness was the largest barrier to participation in the midstream lighting program.

Recommendation #1: Additional advertising directly to customers or contractors would help improve program awareness and increase program participation.

DLC Status Report #1: Duquesne Light has plans to advertise the program to contractors and trade allies at an upcoming event in which Ecova will also participate.

Finding #2: Several distributors said they observe demand for lighting products which do not have LED versions that are currently incentivized through the program. Distributors recommended adding LED flat panels, pin-based bulbs, medium-base bulbs, and fixtures to the program-eligible product list. This recommendation was made by both active and non-active distributors.

Recommendation #2: Navigant recommends that Duquesne Light and Ecova reevaluate product offerings regularly as the lighting market is transitioning quickly.

DLC Status Report #2: Duquesne Light has acknowledged that there are some products which are not currently available through the midstream program but that a number of these products are available through the rebate programs. Some products are more successful as rebated measures.

Finding #3: Under half of the distributors indicated that Ecova reached out to them to initiate participation in the program. The others indicated that they had to contact Ecova to sign up. Given the short time frame of the program in PY8 this may have been related to focusing on specific distributors first.

Recommendation #3: Ecova may consider methods to expand outreach to distributors as many reported that they had to reach out to Ecova to sign up.

DLC Status Report #3: As a result of the delayed start-up of the program, ECOVA targeted specific distributors initially. This may be why some distributors were not contacted before they heard about the program from others. Given that the program is now ramped up, ECOVA has been able to expand its outreach to additional distributors.

Finding #4: Several distributors said that the online portal site was not very functional or easy to use, which caused them some frustration. In particular, users cited the address lookup on the website as being difficult to work with.

Recommendation #4: Ecova should consider improving the online portal to make it more user friendly. This may be addressed through Ecova's planned improvements.

DLC Status Report #4: Ecova, the program CSP, has acknowledged the need for portal improvements and is actively making changes to this process.

Finding #5: Program participation slowly ramped up in PY8, and the PY8 evaluation findings may not predict what will happen in PY9. However, thus far, except for the current 98% ISR in the program's IMP, the key IMP factors – baseline bulb wattage and building type/HOU – do not appear to have resulted in overstated savings. Rather, they have resulted in savings being understated. It is not clear whether the use of the baseline wattage formula for PAR and MR bulbs produces a more accurate baseline wattage than that of either the manufacturer's projected baseline wattage or the baseline wattage provided in the Energy Star Qualified Products List (QPL). For the few sites requiring the use of the formula, the formula yielded a much higher baseline wattage (and therefore higher savings) relative to these other sources.

Recommendation #5: Navigant should continue to conduct on-site verification in PY9, so that findings regarding the efficacy of the program's IMP can be determined using a full year of program activity.

DLC Status Report #5: Navigant will complete on-site verification in PY9. Sites that also go through verifications by Ecova will be flagged for Navigant so that we can ensure customer satisfaction remains high.

3.8 Small Commercial Direct Install Program

The Small Commercial Direct Install (SCDI) Program offers no-cost direct installation of energy efficient measures at small and medium C&I customer locations. This program targets Duquesne Light commercial and industrial customers with monthly demand less than 300 kW, addressing small and medium C&I customer sector-specific barriers. Customers in these segments are often subject to "split-incentives," where electric bill paying customers are tenants but not the owners of the properties at which they conduct their businesses. Owners do not pay the electric bills, so they are not motivated to upgrade energy using equipment in order to save on electric bills; electric bill-paying tenants are not motivated to upgrade properties they do not own. The program addresses these barriers by providing no-cost efficiency upgrades, whereby landlords received no-cost building upgrades and small business tenants benefit from lower electric bills. While others are eligible, the program is targeting primarily independent small commercial customers (typically convenience stores and restaurants) with some refrigeration

measures which contribute to more cost-effective projects.

The SCDI is implemented by CLEAResult with support from a sub-contractor, Three Rivers Electric, who is responsible for identifying eligible customers and installing measures. CLEAResult is responsible for developing program marketing materials, customer engagement, oversight of direct installation of program measures, verification of project details and uploading project files to Duquesne Light and to PMRS.

A participant is a customer participating in the program within a given reporting year (e.g., Q1 through Q4 for PY8), represented by a unique participant account number within the tracking system. Customers participating in a program more than once within a reporting year (i.e., PYRTD) are counted once; customers participating more than once but in different years or programs are counted more than once (once in each year and/or program).

3.8.1 Participation and Reported Savings by Customer Segment

Table 76 presents the participation counts, reported energy and demand savings, and incentive payments for the SCDI program in PY8 by customer segment.

Table 76: SCDI Program Participation and Reported Impacts

Parameter	Small C&I (Non-GNI)
PYTD # Participants	38
PYRTD MWh/yr	3,626
PYRTD MW/yr	0.36
PY8 Incentives ($1000)	$0

3.8.2 Gross Impact Evaluation

The sample design for the SCDI program was essentially the same approach that was used for the Commercial Efficiency and Express Efficiency programs, a stratified ratio estimator approach (Lohr 1999)[22]. The sample is stratified by ex-ante energy savings (kWh) and all strata standard errors are estimated consistent with Lohr (1999) assuming a continuous distribution of the realization rate. The stratified ratio estimation approach takes advantage of information that is reported in the PMRS tracking system for each project in the program. The two key parameters in the stratified ratio estimate are a) the ratio between ex-post and ex-ante savings and b) the standard error of the estimate. The ratio between ex-post and ex-ante savings, known as the realization rate, measures the accuracy of the tracking estimates from project to project across the sample of projects. The standard error of the ratio estimate is a measure of

[22] Lohr, Sharon. *Sampling: Design and Analysis*. Pacific Grove, CA: Duxbury Press, 1999, 69-101.

the variability in the relationship between the ex-post and ex-ante estimates. Both estimates help to define the relationship (e.g., the ratio as well as the relative precision of the ratio) between the tracking estimates of savings and the actual project savings.

Ratios are calculated within each stratum and strata weights are applied to arrive at a program-level ratio. A stratum is a subset of the projects in the population that are grouped together based on some known variable, in this case ranges of ex-ante savings. In other words, a disaggregation of the population into strata is a classification of all units in the population into mutually exclusive strata that span the population. Under this design, each stratum is sampled according to simple random sampling protocols and the weighted estimates of parameters are then applied to the entire population.

For the SCDI program, Navigant or Karpinski performed a verification-only site visit, consisting of verification of the retrofit and (where possible) baseline equipment, and a customer interview regarding retrofit and building details (Verification Only Visit).

Table 77: SCDI Program Gross Impact Sample Design for PY8

Stratum	Population Size	Achieved Sample Size	Evaluation Activity
SCDI - Large	7	3	Verification Only Visit
SCDI - Medium	9	2	Verification Only Visit
SCDI - Small	22	5	Verification Only Visit
Program Total	38	10	

Table 78: SCDI Program Gross Impact Results for Energy

Stratum	PYRTD MWh/yr	Energy Realization Rate	Sample C_v or Error Ratio	Relative Precision at 85% C.L.
SCDI - Large	2,329	99%	0.15	15.3%
SCDI - Medium	532	96%	0.05	13.8%
SCDI - Small	766	94%	0.13	9.3%
Program Total	**3,626**	**98%**		**7.1%**

Table 79: SCDI Program Gross Impact Results for Demand

Stratum	PYRTD MW/yr	Demand Realization Rate	Sample C_v or Error Ratio	Relative Precision at 85% C.L.
SCDI - Large	0.25	102%	0.07	6.9%
SCDI - Medium	0.04	103%	0.02	4.9%
SCDI - Small	0.08	99%	0.01	1.0%
Program Total	**0.36**	**102%**		**3.3%**

The following factors led to variation between the reported and verified savings and led to the observed realization rates.

- **Verification Rate:** Two SCDI projects had exterior lights that had not been installed as reported, leading to low realization rates. One of these two also had Electrically Commutated Motors that had not been installed. This decreased savings as well.
- **Hours of Use:** Three projects had reported HOU based on building type default values. Since, according to Navigant's Evaluation Plan, Direct Install programs default to customer-reported HOU, this altered realization rates. This increased savings in the Large stratum and decreased savings in the Medium and Small strata.

3.8.3 Net Impact Evaluation

No NTG research was conducted in PY8 for most nonresidential programs, including the SCDI program. This research will be conducted in future years (PY9 and PY11), as specified in Navigant's Evaluation Plan. As a result, NTG values reported from PY6 research are used here.[23]

In PY6, the evaluation team assessed free ridership using a customer self-report approach following the SWE framework.[24] This approach used a survey designed to assess the likelihood that participants would have installed some or all of the energy efficiency measures incented by the program, even if the program had not existed. Based on the SWE methodology, the free ridership analysis included the following two elements of free ridership: 1) *intention* to carry out the energy-efficient project without program funds and 2) *influence* of the program in the decision to carry out the energy-efficient improvements. The evaluation team also asked program participants a battery of questions to quantitatively assess spillover, in accordance with the SWE's guidance memorandum on this activity.[25]

23 No NTG research for this program was conducted in PY7, either, because the program had achieved its goals by the end of PY6.
[24] SWE Guidance memorandum GM-024: Common Approach for Measuring Free riders for Downstream Programs, October 4, 2013.
[25] SWE Guidance memorandum GM-025: Common Approach for Measuring Spillover for Downstream Programs, February 28, 2014.

The NTG was then calculated based on the generic formulation illustrated in Equation 3-3:

Equation 3-10. Total Net to Gross Ratio

$$Net\ to\ Gross\ Ratio = 1 - Free\ Ridership + Spillover$$

An attempted census was targeted for these surveys in PY6. The resulting overall NTG ratio is applied to the total gross savings for the SCDI program. A summary of the PY6 NTG results is included below in Table 80.

Table 80: SCDI Program Net Impact Results

Target Group	Estimated Free Ridership	Estimated Participant Spillover	NTG Ratio	Observed Coefficient of Variation	Relative Precision (@ 85% CL)
SCDI Total	**7%**	**7%**	**99%**		**1.9%**

See Navigant's PY6 final report for Duquesne Light for more detail regarding the PY6 NTG analysis.

High-Impact Measure Research

No NTG research was done in PY8, and therefore no HIM analysis was conducted.

3.8.4 Verified Savings Estimates

In Table 81 the realization rates and net-to-gross ratios determined by Navigant are applied to the reported energy and demand savings estimates to calculate the verified savings estimates for the SCDI program in PY8. These totals are added to the verified savings achieved in previous program years to calculate the P3TD program impacts, which are the same as those of PY8.

Table 81: SCDI PYTD and P3TD Savings Summary

Savings Type	Energy (MWh/yr)	Demand (MW/yr)
PYRTD	3,626	0.36
PYVTD Gross	3,546	0.37
PYVTD Net	3,521	0.37
RTD	3,626	0.36
VTD Gross	3,546	0.37
VTD Net	3,521	0.37

3.8.5 Process Evaluation

Participant process evaluation and net-to-gross (NTG) surveys will be conducted every other year (years PY9 and PY11), along with similar surveys for other nonresidential programs. Navigant completed interviews with the Duquesne Light program manager and the CSP in order to determine whether there were any changes in program delivery from previous years. Navigant also reviewed all program documentation including the CSP Program Management Plans and marketing plans.

3.8.6 Cost-Effectiveness Reporting

A detailed breakdown of program finances and cost-effectiveness is presented in Table 82. TRC benefits in Table 82 were calculated using gross verified impacts. Net present value (NPV) PYTD costs and benefits are expressed in 2016 dollars. Net present value costs and benefits for P3TD financials are expressed in the 2016 dollars.

Table 82: Summary of SCDI Program Finances – Gross Verified

Row #	Cost Category	PYTD ($1,000)		P3TD ($1,000)	
1	EDC Incentives to Participants [1]	$0		$0	
2	EDC Incentives to Trade Allies	$0		$0	
3	Participant Costs (net of incentives/rebates paid by utilities)	$0		$0	
4	**Incremental Measure Costs (Sum of rows 1 through 3)**	$0		$0	
		EDC	CSP	EDC	CSP
5	Design & Development [2]	$3	$21	$3	$21
6	Administration, Management, and Technical Assistance [3]	$22	$63	$22	$63
7	Marketing [4]	$0	$0	$0	$0
8	Program Delivery [5]	$0	$831	$0	$831
9	EDC Evaluation Costs	$10		$10	
10	SWE Audit Costs	$33		$33	
11*	**Program Overhead Costs (Sum of rows 5 through 10)**	$983		$983	
12	NPV of increases in costs of natural gas (or other fuels) for fuel switching programs	$0		$0	

13	**Total NPV TRC Costs [6] (Net present value of sum of rows 4, 11, and 12)**	$983	$983
14	Total NPV Lifetime Electric Energy Benefits	$1,424	$1,424
15	Total NPV Lifetime Electric Capacity Benefits	$388	$388
16	Total NPV Lifetime Operation and Maintenance (O&M) Benefits	$12	$12
17	Total NPV Lifetime Non-Electric Benefits (Fossil Fuel, Water)	$0	$0
18	**Total NPV TRC Benefits [7] (Sum of rows 14 through 17)**	$1,824	$1,824
19	**TRC Benefit-Cost Ratio [8]**	1.86	1.86

[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. NOTE: Savings carried over from Phase II are not to be 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 83 presents program financials and cost-effectiveness on a net savings basis.

Table 83: Summary of SCDI Program Finances – Net Verified

Row #	Cost Category	PYTD ($1,000)	P3TD ($1,000)
1	EDC Incentives to Participants [1]	$0	$0
2	EDC Incentives to Trade Allies	$0	$0
3	Participant Costs (net of incentives/rebates paid by utilities)	$0	$0
4	**Incremental Measure Costs (Sum of rows 1 through 3)**	$0	$0

		EDC	CSP	EDC	CSP
5	Design & Development [2]	$3	$21	$3	$21
6	Administration, Management, and Technical Assistance [3]	$22	$63	$22	$63
7	Marketing [4]	$0	$0	$0	$0
8	Program Delivery [5]	$0	$831	$0	$831
9	EDC Evaluation Costs	$10		$10	
10	SWE Audit Costs	$33		$33	
11*	**Program Overhead Costs (Sum of rows 5 through 10)**	$983		$983	
12	NPV of increases in costs of natural gas (or other fuels) for fuel switching programs	$0		$0	
13	**Total NPV TRC Costs [6] (Net present value of sum of rows 4, 11, and 12)**	$983		$983	
14	Total NPV Lifetime Electric Energy Benefits	$1,414		$1,414	
15	Total NPV Lifetime Electric Capacity Benefits	$386		$386	
16	Total NPV Lifetime Operation and Maintenance (O&M) Benefits	$11		$11	
17	Total NPV Lifetime Non-Electric Benefits (Fossil Fuel, Water)	$0		$0	
18	**Total NPV TRC Benefits [7] (Sum of rows 14 through 17)**	$1,811		$1,811	
19	**TRC Benefit-Cost Ratio [8]**	1.84		1.84	

[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. NOTE: Savings carried over from Phase II are not to be 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

3.8.7 Status of Recommendations

Navigant limited its impact and process evaluation activities for the SCDI in PY8. At this time, we make no recommendations for the program.

3.9 Multifamily Housing Retrofit Program

The Multifamily Housing Retrofit (MFHR) Program targets multifamily housing for income-qualified occupants and provides a "one-stop shop," simplifying program participation and energy efficiency measure adoption for this specialized target market. The program generally assists these customers in improving the efficiency of common area spaces in master metered multifamily buildings serving low-income households. However, the program will serve the dwelling units of a qualified building if they are also served by a master meter.

The MFHR program is delivered by a core team of DLC staff supported by MCR Performance Solutions (MCR) staff. Program services include the administration of energy efficiency audits, technical assistance for measure-level project review and bundling, property aggregation, contractor negotiation and equipment bulk purchasing. Services also include processing rebate applications and other funding source documentary requirements.

A participant is a customer participating in the given program within a given reporting year (e.g., Q1 through Q4 for PY8), represented by a unique participant account number within the tracking system. Customers participating in a program more than once within a reporting year (i.e., PYRTD) are counted once; customers participating more than once but in different years or programs are counted more than once (once in each year and/or program).

3.9.1 Participation and Reported Savings by Customer Segment

Table 84 presents the participation counts, reported energy and demand savings, and incentive payments for MFHR program in PY8, by customer segment.

Table 84: MFHR Program Participation and Reported Impacts

Parameter	Small C&I (Non-GNI)*
PYTD # Participants	4
PYRTD MWh/yr	159
PYRTD MW/yr	0.02
PY8 Incentives ($1000)	$33

*While this program falls under the small C&I sector, a percentage of its savings are counted toward the low-income compliance target. See earlier discussion of LIEEP for more information.

3.9.2 Gross Impact Evaluation

Because there were only four projects in the Multifamily program in PY8, Navigant selected all projects in this program for verification. However, verification was only completed for two of the four projects in time for this report. The verification results for the two "unverified" projects will be incorporated into the PY9 semi-annual report. Since none of the projects met the TRM-required metering thresholds for lighting of savings greater than 750,000 kWh, Karpinski performed verification-only site visits, consisting of verification of the retrofit and baseline equipment (where possible), and a customer interview regarding retrofit and building details (Verification Only Visit).

In PY8, all verification efforts for Multifamily took place in late summer/early fall 2017.

Table 85: MFHR Program Gross Impact Sample Design for PY8

Stratum	Population Size	Achieved Sample Size	Evaluation Activity
All Projects	4	2	On-site verification
Program Total	**4**	**2**	

Table 86: MFHR Program Gross Impact Results for Energy

Stratum	PYRTD MWh/yr	Energy Realization Rate	Sample C_V or Error Ratio	Relative Precision at 85% C.L.
MFHR	57	100%	0.00	0.0%
MFHR unverified*	101	N/A	N/A	N/A
Total	**159**	**N/A**		**0.0%**

*All four projects were sampled and visited. However, results for two of the four projects could not be completed in time for this final report and therefore remain "unverified." Final results for these projects will be incorporated into the PY9 Semi-Annual Report.

Table 87: MFHR Program Gross Impact Results for Demand

Stratum	PYRTD MW/yr	Demand Realization Rate	Sample C_V or Error Ratio	Relative Precision at 85% C.L.
MFHR	0.00	100%	0.00	0.0%
MFHR unverified*	0.01	N/A	N/A	N/A
Total	**0.02**	**N/A**		**0.0%**

*Does not include results for two of the four projects, which remain "unverified" and whose verification results will be incorporated into the PY9 Semi-Annual Report.

The following factors led to variation between the reported and verified savings and led to the observed realization rates.

- **Verification Rate:** One of the two verified sites had a slight fixture count discrepancy for exterior fixtures, reducing the realization rates by less than 1%.

Verification for the two other sites were not completed as of the writing of this report. Results from these verifications will be incorporated into the PY9 Semi-Annual Report.

3.9.3 Net Impact Evaluation

No NTG research was conducted in PY8 for most nonresidential programs, including the MFHR program. This research will be conducted in future years (PY9 and PY11), as specified in Navigant's Evaluation Plan. As a result, NTG values reported from PY7 research are used here.

In PY7, the evaluation team assessed free ridership using a customer self-report approach following the SWE framework.[26] This approach used a survey designed to assess the likelihood that participants would have installed some or all of the energy efficiency measures incented by the program, even if the program had not existed. Based on the SWE methodology, the free ridership analysis included the following two elements of free ridership: 1) *intention* to carry out the energy-efficient project without program funds and 2) *influence* of the program in the decision to carry out the energy-efficient improvements. The evaluation team also asked program participants a battery of questions to quantitatively assess spillover, in accordance with the SWE's guidance memorandum on this activity.[27]

The NTG was then calculated based on the generic formulation illustrated in Equation 3-3:

Equation 3-11. Total Net to Gross Ratio

$$Net\ to\ Gross\ Ratio = 1 - Free\ Ridership + Spillover$$

An attempted census was targeted for these multifamily surveys in PY7. The resulting overall NTG ratio is applied to the total gross savings for the multifamily program. A summary of the PY7 NTG results is included below in Table 88.

Table 88: MFHR Program Net Impact Evaluation Results

Target Group	Estimated Free Ridership	Estimated Participant Spillover	NTG Ratio	Observed Coefficient of Variation	Relative Precision (@ 85% CL)
Multifamily	29%	0%	71%	0.19	14.8%

See Navigant's PY7 final report for Duquesne Light for more detail regarding the PY7 NTG analysis.

High-Impact Measure Research

No NTG research was done in PY8, and therefore no HIM analysis was conducted.

3.9.4 Verified Savings Estimates

In Table 89 the realization rates and net-to-gross ratios determined by Navigant are applied to the reported energy and demand savings estimates to calculate the verified savings estimates for the MFHR Program in PY8. These totals are added to the verified savings achieved in previous program years to calculate the P3TD program impacts.

[26] SWE Guidance memorandum GM-024: Common Approach for Measuring Free riders for Downstream Programs, October 4, 2013.
[27] SWE Guidance memorandum GM-025: Common Approach for Measuring Spillover for Downstream Programs, February 28, 2014.

Table 89: MFHR PYTD and P3TD Savings Summary*

Savings Type	Energy (MWh/yr)	Demand (MW/yr)
PYRTD	159	0.02
PYVTD Gross	57	0.00
PYVTD Net	41	0.00
RTD	159	0.02
VTD Gross	57	0.00
VTD Net	41	0.00

*Excludes results from two PY8 projects whose verification is not yet complete.

3.9.5 Process Evaluation

Participant process evaluation and net-to-gross (NTG) surveys will be conducted every other year (years PY9 and PY11), along with similar surveys for all other nonresidential programs. Such surveys were conducted of all nonresidential program participants in PY7 so were not completed in PY8. Navigant completed interviews with the Duquesne Light program manager and the program CSP in order to identify any changes in program delivery from previous years.

3.9.6 Cost-Effectiveness Reporting

A detailed breakdown of program finances and cost-effectiveness is presented in Table 90. TRC benefits in Table 90 were calculated using gross verified impacts. Net present value (NPV) PYTD costs and benefits are expressed in 2016 dollars. Net present value costs and benefits for P3TD financials are expressed in the 2016 dollars.

Table 90: Summary of MFHR Program Finances – Gross Verified

Row #	Cost Category	PYTD ($1,000)		P3TD ($1,000)	
1	EDC Incentives to Participants [1]	$33		$33	
2	EDC Incentives to Trade Allies	$0		$0	
3	Participant Costs (net of incentives/rebates paid by utilities)	$35		$35	
4	**Incremental Measure Costs (Sum of rows 1 through 3)**	$68		$68	
		EDC	**CSP**	**EDC**	**CSP**
5	Design & Development [2]	$5	$19	$5	$19
6	Administration, Management, and Technical Assistance [3]	$22	$57	$22	$57
7	Marketing [4]	$0	$0	$0	$0

8	Program Delivery [5]	$0	$99	$0	$99
9	EDC Evaluation Costs	$9		$9	
10	SWE Audit Costs	$31		$31	
11*	**Program Overhead Costs (Sum of rows 5 through 10)**	$242		$242	
12	NPV of increases in costs of natural gas (or other fuels) for fuel switching programs	$0		$0	
13	**Total NPV TRC Costs [6] (Net present value of sum of rows 4, 11, and 12)**	$310		$310	
14	Total NPV Lifetime Electric Energy Benefits	$27		$27	
15	Total NPV Lifetime Electric Capacity Benefits	$5		$5	
16	Total NPV Lifetime Operation and Maintenance (O&M) Benefits	$0		$0	
17	Total NPV Lifetime Non-Electric Benefits (Fossil Fuel, Water)	$0		$0	
18	**Total NPV TRC Benefits [7] (Sum of rows 14 through 17)**	$32		$32	
19	**TRC Benefit-Cost Ratio [8]**	0.10		0.10	

[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. NOTE: Savings carried over from Phase II are not to be 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 91 presents program financials and cost-effectiveness on a net savings basis.

Table 91: Summary of MFHR Program Finances – Net Verified

Row #	Cost Category	PYTD ($1,000)		P3TD ($1,000)	
1	EDC Incentives to Participants [1]	$33		$33	
2	EDC Incentives to Trade Allies	$0		$0	
3	Participant Costs (net of incentives/rebates paid by utilities)	$16		$16	
4	**Incremental Measure Costs (Sum of rows 1 through 3)**	$48		$48	
		EDC	**CSP**	**EDC**	**CSP**
5	Design & Development [2]	$5	$19	$5	$19
6	Administration, Management, and Technical Assistance [3]	$22	$57	$22	$57
7	Marketing [4]	$0	$0	$0	$0
8	Program Delivery [5]	$0	$99	$0	$99
9	EDC Evaluation Costs	$9		$9	
10	SWE Audit Costs	$31		$31	
11*	**Program Overhead Costs (Sum of rows 5 through 10)**	$242		$242	
12	NPV of increases in costs of natural gas (or other fuels) for fuel switching programs	$0		$0	
13	**Total NPV TRC Costs [6] (Net present value of sum of rows 4, 11, and 12)**	$290		$290	
14	Total NPV Lifetime Electric Energy Benefits	$19		$19	
15	Total NPV Lifetime Electric Capacity Benefits	$4		$4	
16	Total NPV Lifetime Operation and Maintenance (O&M) Benefits	$0		$0	
17	Total NPV Lifetime Non-Electric Benefits (Fossil Fuel, Water)	$0		$0	

18	**Total NPV TRC Benefits [7] (Sum of rows 14 through 17)**	$23	$23
19	**TRC Benefit-Cost Ratio [8]**	0.08	0.08

[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. NOTE: Savings carried over from Phase II are not to be 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

3.9.7 Status of Recommendations

Navigant limited its impact and process evaluation activities for the MFHR in PY8. At this time, we make no recommendations for the program.

3.10 Industrial Efficiency Program

Similar to the EXP and CEP, the Industrial Efficiency Program (IEP) provides rebates to offset the higher cost of high-efficiency equipment when compared to standard efficiency equipment. Program incentives promote customer indifference to the higher cost of high-efficiency equipment and increase customer adoption of high-efficiency equipment. The IEP also includes energy assessments, energy manager walkabouts, system optimization studies, consultations and project reviews at no cost to the customer.

The IEP provides assistance to eligible industrial customers with identifying and pursuing energy management and energy efficiency improvements in their facilities. Industrial facilities in DLC's service territory with monthly electric demand greater than 300 kW are eligible to participate in the IEP.

A participant is a customer participating in the given program within a given reporting year (e.g., Q1 through Q4 for PY8), represented by a unique participant account number within the tracking system. Customers participating in a program more than once within a reporting year (i.e., PYRTD) are counted once; customers participating more than once but in different years or in different programs are counted more than once (once in each year and/or program).

3.10.1 Participation and Reported Savings by Customer Segment

Table 92 presents the participation counts, reported energy and demand savings, and incentive payments for the Industrial Program in PY8 by customer segment.

Table 92: Industrial Efficiency Program Participation and Reported Impacts

Parameter	Large C&I (Non-GNI)
PYTD # Participants	11
PYRTD MWh/yr	4,651
PYRTD MW/yr	0.59
PY8 Incentives ($1000)	$156

3.10.2 Gross Impact Evaluation

Navigant did not evaluate the Industrial Efficiency program in PY8, as detailed in the Evaluation Plan approved by the SWE. For PY8, Navigant utilized the verification results from PY7 and applied them to the PY8 ex-ante numbers. Navigant will sample Industrial projects from both PY8 and PY9 to evaluate during the PY9 evaluation.

Table 93: Industrial Efficiency Program Gross Impact Results for Energy

Stratum	PYRTD MWh/yr	Energy Realization Rate (from PY7)	Sample C_v or Error Ratio	Relative Precision at 85% C.L.
Program Total	**4,651**	**99%**		**2.2%**

Table 94: Industrial Efficiency Program Gross Impact Results for Demand

Stratum	PYRTD MW/yr	Demand Realization Rate (from PY7)	Sample C_v or Error Ratio	Relative Precision at 85% C.L.
Program Total	**0.59**	**98%**		**8.2%**

Details regarding the energy and demand savings realization rate analyses from PY7 can be found in the final PY7 report.

3.10.3 Net Impact Evaluation

No NTG research was conducted in PY8 for most nonresidential programs, including the Industrial Efficiency program. This research will be conducted in future years (PY9 and PY11), as specified in Navigant's Evaluation Plan. As a result, NTG values reported from PY7 research, as shown in Table 95 below, will be applied to the PY8 total gross savings for the Industrial Efficiency program.

Table 95: Industrial Efficiency Program Net Impact Evaluation Results

Target Group	Estimated Free Ridership	Estimated Participant Spillover	NTG Ratio	Observed Coefficient of Variation	Relative Precision (@ 85% CL)
Industrial	32%	0%	68%	0.36	12.8%

See Navigant's PY7 final report for Duquesne Light for more detail regarding the PY7 NTG analysis.

High-Impact Measure Research

No NTG research was done in PY8, and therefore no HIM analysis was conducted.

3.10.4 Verified Savings Estimates

In Table 96 the realization rates and net-to-gross ratios determined by Navigant are applied to the reported energy and demand savings estimates to calculate the verified savings estimates for the Industrial Efficiency Program in PY8. These totals are added to the verified savings achieved in previous program years to calculate the P3TD program impacts.

Table 96: Industrial Program PYTD and P3TD Savings Summary

Savings Type	Energy (MWh/yr)	Demand (MW/yr)
PYRTD	4,651	0.59
PYVTD Gross	4,627	0.58
PYVTD Net	3,166	0.39
RTD	4,651	0.59
VTD Gross	4,627	0.58
VTD Net	3,166	0.39

3.10.5 Process Evaluation

Participant process evaluation and net-to-gross (NTG) surveys will be conducted every other year (years PY9 and PY11), along with similar surveys for all other nonresidential programs.

Such surveys were conducted of all nonresidential program participants in PY7 so were not completed in PY8. Similar to the Commercial Efficiency program, Trade Ally interviews were planned for PY8; however, participation in the program took longer to ramp up than expected with a new CSP implementing the program. In order to have a larger sample of Trade Allies to interview, these interviews will be completed in PY9. Navigant spoke with the Duquesne Light program manager and the program CSP, to gain a thorough understanding of the program. Program Documentation including the Program Management Plan was also reviewed.

3.10.6 Cost-Effectiveness Reporting

A detailed breakdown of program finances and cost-effectiveness is presented in Table 97. TRC benefits in Table 97 were calculated using gross verified impacts. Net present value (NPV) PYTD costs and benefits are expressed in 2016 dollars. Net present value costs and benefits for P3TD financials are expressed in the 2016 dollars.

Table 97: Summary of Industrial Program Finances – Gross Verified

Row #	Cost Category	PYTD ($1,000)		P3TD ($1,000)	
1	EDC Incentives to Participants [1]	$156		$156	
2	EDC Incentives to Trade Allies	$0		$0	
3	Participant Costs (net of incentives/rebates paid by utilities)	$62		$62	
4	**Incremental Measure Costs (Sum of rows 1 through 3)**	$219		$219	
		EDC	**CSP**	**EDC**	**CSP**
5	Design & Development [2]	$4	$69	$4	$69
6	Administration, Management, and Technical Assistance [3]	$25	$206	$25	$206
7	Marketing [4]	$0	$0	$0	$0
8	Program Delivery [5]	$0	$322	$0	$322
9	EDC Evaluation Costs	$33		$33	
10	SWE Audit Costs	$110		$110	
11*	**Program Overhead Costs (Sum of rows 5 through 10)**	$769		$769	
12	NPV of increases in costs of natural gas (or other fuels) for fuel switching programs	$0		$0	

13	**Total NPV TRC Costs [6] (Net present value of sum of rows 4, 11, and 12)**	$988	$988
14	Total NPV Lifetime Electric Energy Benefits	$2,265	$2,265
15	Total NPV Lifetime Electric Capacity Benefits	$650	$650
16	Total NPV Lifetime Operation and Maintenance (O&M) Benefits	$29	$29
17	Total NPV Lifetime Non-Electric Benefits (Fossil Fuel, Water)	$0	$0
18	**Total NPV TRC Benefits [7] (Sum of rows 14 through 17)**	$2,945	$2,945
19	**TRC Benefit-Cost Ratio [8]**	2.98	2.98

[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. NOTE: Savings carried over from Phase II are not to be 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 98Table 25 presents program financials and cost-effectiveness on a net savings basis.

Table 98: Summary of Industrial Program Finances – Net Verified

Row #	Cost Category	PYTD ($1,000)	P3TD ($1,000)
1	EDC Incentives to Participants [1]	$156	$156
2	EDC Incentives to Trade Allies	$0	$0
3	Participant Costs (net of incentives/rebates paid by utilities)	-$7	-$7
4	**Incremental Measure Costs (Sum of rows 1 through 3)**	$150	$150

		EDC	CSP	EDC	CSP
5	Design & Development [2]	$4	$69	$4	$69
6	Administration, Management, and Technical Assistance [3]	$25	$206	$25	$206
7	Marketing [4]	$0	$0	$0	$0
8	Program Delivery [5]	$0	$322	$0	$322
9	EDC Evaluation Costs	$33		$33	
10	SWE Audit Costs	$110		$110	
11*	**Program Overhead Costs (Sum of rows 5 through 10)**	$769		$769	
12	NPV of increases in costs of natural gas (or other fuels) for fuel switching programs	$0		$0	
13	**Total NPV TRC Costs [6] (Net present value of sum of rows 4, 11, and 12)**	$919		$919	
14	Total NPV Lifetime Electric Energy Benefits	$1,550		$1,550	
15	Total NPV Lifetime Electric Capacity Benefits	$445		$445	
16	Total NPV Lifetime Operation and Maintenance (O&M) Benefits	$20		$20	
17	Total NPV Lifetime Non-Electric Benefits (Fossil Fuel, Water)	$0		$0	
18	**Total NPV TRC Benefits [7] (Sum of rows 14 through 17)**	$2,015		$2,015	
19	**TRC Benefit-Cost Ratio [8]**	2.19		2.19	

[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. NOTE: Savings carried over from Phase II are not to be 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

3.10.7 Status of Recommendations

Navigant limited its impact and process evaluation activities for the Industrial in PY8. At this time, we make no recommendations for the program.

3.11 Public Agency Partnership Program

The Public Agency Partnership Program (PAPP) serves public agency customers such as federal, state and local governments, municipalities and school districts and may serve some healthcare systems, institutions of higher education and other non-profit entities. It engages these customers in a partnership to implement an Energy Efficiency Action Plan. Each Public Agency Partnership is established through the execution of a Memorandum of Understanding (MOU) by and between Duquesne Light and the selected local governmental agency. The MOU establishes working groups comprising Duquesne Light and agency representatives who identify project areas within agency departments (and jurisdictional agencies). Working groups define project scopes of service and establish project agreements to co-fund agreed-to projects. The project agreements contain the terms to leverage local agency staff to reach, pre-screen and enroll program participants.

The PAPP is run by MCR Performance Solutions (MCR). MCR support for the program includes initial outreach to customers, the administration of energy efficiency audits, technical assistance for measure level project review and bundling, property aggregation, contractor negotiation and equipment bulk purchasing. MCR integrates funding sources to include program and agency co-funding, performance contracting, grant funding and available financing options.

A participant is a customer participating in the given program within a given reporting year (e.g., Q1 through Q4 for PY8), represented by a unique participant account number within the tracking system. Customers participating in a program more than once within a reporting year (i.e., PYRTD) are counted once; customers participating more than once but in different years or in different programs are counted more than once (once in each year and/or program).

3.11.1 Participation and Reported Savings by Customer Segment

Table 99 presents the participation counts, reported energy and demand savings, and incentive payments for PAPP in PY8 by customer segment.

Table 99: PAPP Participation and Reported Impacts

Parameter	PAPP (GNI)
PYTD # Participants	41
PYRTD MWh/yr	3,793
PYRTD MW/yr	0.36
PY8 Incentives ($1000)	$149

3.11.2 Gross Impact Evaluation

As with other nonresidential program evaluation sampling, the sample design for PAPP used the stratified ratio estimator approach (Lohr 1999)[28]. The sample is stratified by ex-ante energy savings (kWh), and all strata standard errors are estimated consistent with Lohr (1999) assuming a continuous distribution of the realization rate. The stratified ratio estimation approach takes advantage of information that is reported in the PMRS tracking system for each project in the program. The two key parameters in the stratified ratio estimate are a) the ratio between ex-post and ex-ante savings and b) the standard error of the estimate. The ratio between ex-post and ex-ante savings, known as the realization rate, measures the accuracy of the tracking estimates from project to project across the sample of projects. The standard error of the ratio estimate is a measure of the variability in the relationship between the ex-post and ex-ante estimates. Both estimates help to define the relationship (e.g., the ratio as well as the relative precision of the ratio) between the tracking estimates of savings and the actual project savings.

Ratios are calculated within each stratum and strata weights are applied to arrive at a program-level ratio. A stratum is a subset of the projects in the population that are grouped together based on some known variable, in this case ranges of ex-ante savings. In other words, a disaggregation of the population into strata is a classification of all units in the population into mutually exclusive strata that span the population. Under this design, each stratum is sampled according to simple random sampling protocols and the weighted estimates of parameters are then applied to the entire population.

In PY8, Navigant performed one of three types of verification for the PAPP programs. There was one site which met the >750,000kWh metering threshold for lighting, for which Karpinski performed a site visit and metered a sample of the lights (Verification and Metering). If the incentive for the project was greater than $2,000, Navigant or Karpinski performed a verification-only site visit, consisting of verification of the retrofit and baseline equipment (where possible), and a customer interview regarding retrofit and building details (Verification Only Visit). If the incentive was less than $2,000, Navigant or Karpinski called the customer and performed an interview over the phone to verify the project details (Phone Verification).

[28] Lohr, Sharon. *Sampling: Design and Analysis*. Pacific Grove, CA: Duxbury Press, 1999, 69-101.

Table 100: PAPP Gross Impact Sample Design for PY8

Stratum	Population Size[29]	Achieved Sample Size	Evaluation Activity
PAPP - Large	8	5	Verification and Metering (1) Verification Only Visit (4)
PAPP- Small	47	12	Verification Only Visit (2) Phone Verification (10)
Program Total	**55**	**17**	

Table 101: PAPP Gross Impact Results for Energy

Stratum	PYRTD MWh/yr	Energy Realization Rate	Sample C_v or Error Ratio	Relative Precision at 85% C.L.
PAPP - Large	2,594	97%	0.13	6.3%
PAPP- Small	1,200	112%	0.25	9.7%
Program Total	**3,793**	**101%**		**4.8%**

Table 102: PAPP Gross Impact Results for Demand

Stratum	PYRTD MW/yr	Demand Realization Rate	Sample C_v or Error Ratio	Relative Precision at 85% C.L.
PAPP - Large	0.26	96%	0.19	12.8%
PAPP- Small	0.11	67%	1.39	66.4%
Program Total	**0.36**	**87%**		**16.2%**

The following factors led to variation between the reported and verified savings and led to the observed realization rates.

[29] Participant counts when sampling reflect the total number of projects rather than the total number of participants.

- **Savings Factors:** the large, metered project had slightly larger savings factors for the installed controls based on the metered data, increasing the realization rates for this project.
- **Building Type Change:** Due to many PAPP sites having savings <20kW, Navigant used whole-building deemed HOU and CF for most of the projects, per the Evaluation Plan. There were three projects for which the building type was changed, reducing the savings for two of these projects significantly. The other had an increase in HOU but a decrease in Coincidence Factor.
- **Baseline Equipment:** One VFD site had to upgrade the motors post-retrofit, as the old motors were not compatible with the VFDs. These motors were 1.3% more efficient, dropping the savings by an equivalent amount.

3.11.3 Net Impact Evaluation

No NTG research was conducted in PY8 for most nonresidential programs, including the PAPP program. This research will be conducted in future years (PY9 and PY11), as specified in Navigant's Evaluation Plan. As a result, NTG values reported from PY7 research are used here.

An attempted census of GNI (PAPP/Non-profit) program participants was completed in PY7. The resulting overall NTG ratio is applied to the total gross savings for the PAPP program. A summary of the PY7 NTG results is included below in Table 103.

Table 103: PAPP Program Net Impact Evaluation Results

Target Group	Estimated Free Ridership	Estimated Participant Spillover	NTG Ratio	Observed Coefficient of Variation	Relative Precision (@ 85% CL)
GNI	20%	0%	80%	0.33	10.7%

See Navigant's PY7 final report for Duquesne Light for more detail regarding the PY7 NTG analysis.

High-Impact Measure Research

No NTG research was done in PY8, and therefore no HIM analysis was conducted.

3.11.4 Verified Savings Estimates

In Table 104 the realization rates and net-to-gross ratios determined by Navigant are applied to the reported energy and demand savings estimates to calculate the verified savings estimates for PAPP in PY8. These totals are added to the verified savings achieved in previous program years to calculate the P3TD program impacts.

Table 104: PAPP PYTD and P3TD Savings Summary

Savings Type	Energy (MWh/yr)	Demand (MW/yr)
PYRTD	3,793	0.36
PYVTD Gross	3,845	0.32
PYVTD Net	3,093	0.26
RTD	3,793	0.36
VTD Gross	3,845	0.32
VTD Net	3,093	0.26

3.11.5 Process Evaluation

Participant process evaluation and net-to-gross (NTG) surveys will be conducted every other year (years PY9 and PY11), along with similar surveys for all other nonresidential programs. Such surveys were conducted of all nonresidential program participants in PY7 so were not completed in PY8. Navigant spoke with the program manager and implementation contractor to gain a thorough understanding of the program.

3.11.6 Cost-Effectiveness Reporting

A detailed breakdown of program finances and cost-effectiveness is presented in Table 105. TRC benefits in Table 105 were calculated using gross verified impacts. Net present value (NPV) PYTD costs and benefits are expressed in 2016 dollars. Net present value costs and benefits for P3TD financials are expressed in the 2016 dollars.

Table 105: Summary of PAPP Finances – Gross Verified

Row #	Cost Category	PYTD ($1,000)		P3TD ($1,000)	
1	EDC Incentives to Participants [1]	$149		$149	
2	EDC Incentives to Trade Allies	$0		$0	
3	Participant Costs (net of incentives/rebates paid by utilities)	$428		$428	
4	**Incremental Measure Costs (Sum of rows 1 through 3)**	$577		$577	
		EDC	**CSP**	**EDC**	**CSP**
5	Design & Development [2]	$4	$38	$4	$38
6	Administration, Management, and Technical Assistance [3]	$22	$115	$22	$115
7	Marketing [4]	$0	$0	$0	$0

8	Program Delivery [5]	$0	$683	$0	$683
9	EDC Evaluation Costs	$18		$18	
10	SWE Audit Costs	$61		$61	
11*	**Program Overhead Costs (Sum of rows 5 through 10)**	$941		$941	
12	NPV of increases in costs of natural gas (or other fuels) for fuel switching programs	$0		$0	
13	**Total NPV TRC Costs [6] (Net present value of sum of rows 4, 11, and 12)**	$1,518		$1,518	
14	Total NPV Lifetime Electric Energy Benefits	$1,742		$1,742	
15	Total NPV Lifetime Electric Capacity Benefits	$354		$354	
16	Total NPV Lifetime Operation and Maintenance (O&M) Benefits	$83		$83	
17	Total NPV Lifetime Non-Electric Benefits (Fossil Fuel, Water)	$0		$0	
18	**Total NPV TRC Benefits [7] (Sum of rows 14 through 17)**	$2,179		$2,179	
19	**TRC Benefit-Cost Ratio [8]**	1.44		1.44	

[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. NOTE: Savings carried over from Phase II are not to be 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 106 presents program financials and cost-effectiveness on a net savings basis.

Table 106: Summary of PAPP Finances – Net Verified

Row #	Cost Category	PYTD ($1,000)		P3TD ($1,000)	
1	EDC Incentives to Participants [1]	$149		$149	
2	EDC Incentives to Trade Allies	$0		$0	
3	Participant Costs (net of incentives/rebates paid by utilities)	$315		$315	
4	**Incremental Measure Costs (Sum of rows 1 through 3)**	$464		$464	
		EDC	CSP	EDC	CSP
5	Design & Development [2]	$4	$38	$4	$38
6	Administration, Management, and Technical Assistance [3]	$22	$115	$22	$115
7	Marketing [4]	$0	$0	$0	$0
8	Program Delivery [5]	$0	$683	$0	$683
9	EDC Evaluation Costs	$18		$18	
10	SWE Audit Costs	$61		$61	
11*	**Program Overhead Costs (Sum of rows 5 through 10)**	$941		$941	
12	NPV of increases in costs of natural gas (or other fuels) for fuel switching programs	$0		$0	
13	**Total NPV TRC Costs [6] (Net present value of sum of rows 4, 11, and 12)**	$1,405		$1,405	
14	Total NPV Lifetime Electric Energy Benefits	$1,401		$1,401	
15	Total NPV Lifetime Electric Capacity Benefits	$285		$285	
16	Total NPV Lifetime Operation and Maintenance (O&M) Benefits	$66		$66	
17	Total NPV Lifetime Non-Electric Benefits (Fossil Fuel, Water)	$0		$0	

18	**Total NPV TRC Benefits [7] (Sum of rows 14 through 17)**	$1,753	$1,753
19	**TRC Benefit-Cost Ratio [8]**	1.25	1.25

[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. NOTE: Savings carried over from Phase II are not to be 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

3.11.7 Status of Recommendations

Navigant limited its impact and process evaluation activities for the PAPP in PY8. At this time, we make no recommendations for the program.

3.12 Community Education Program

The Community Education Energy Efficiency Program (CEEP) which launched in PY8 was designed to prepare middle school and high school students to become energy efficiency auditors and provide hands-on training while they perform energy audits at their schools. The objective is to build the community capacity and early workforce development. Follow-on objectives will be to grow the program so that student energy auditors can “fan out” into their communities performing energy audits at small businesses and residential energy audits for income qualified populations. The program is delivered by MCR, which is responsible for developing program marketing materials, enrolling schools in the program, providing training and materials to schools, evaluating the resulting action plans, and entering project information into PMRS.

The program is designed to target first the schools where the students complete the training but eventually will branch out to additional buildings. They will develop a Conservation Action Plan, which identifies additional school district buildings which students plan to complete audits at and eventually these plans will also identify other community buildings.

The program also involves a competition aspect. Participating schools are automatically enrolled in the competition and prizes are awarded based on the energy savings achieved (based on a percent of original energy consumption) and on the content of the Conservation Action Plan.

A participant is a customer participating in the given program within a given reporting year (e.g., Q1 through Q4 for PY8), represented by a unique participant account number within the tracking system. Customers participating in a program more than once within a reporting year (i.e., PYRTD) are counted once; customers participating more than once but in different year or in different programs are counted more than once (once in each year and/or program).

3.12.1 Participation and Reported Savings by Customer Segment

Table 107Table 17 presents the participation counts, reported energy and demand savings, and incentive payments for CEEP in PY8 by customer segment.

Table 107: CEEP Participation and Reported Impacts

Parameter	CEEP (GNI)
PYTD # Participants	13
PYRTD MWh/yr	1,084
PYRTD MW/yr	0.23
PY8 Incentives ($1000)	$77

3.12.2 Gross Impact Evaluation

The sample design for the Community Education Efficiency Program used the stratified ratio estimator approach (Lohr 1999)[30]. The sample is stratified by ex-ante energy savings (kWh) and all strata standard errors are estimated consistent with Lohr (1999) assuming a continuous distribution of the realization rate. The stratified ratio estimation approach takes advantage of information that is reported in the PMRS tracking system for each project in the program. The two key parameters in the stratified ratio estimate are a) the ratio between ex-post and ex-ante savings and b) the standard error of the estimate. The ratio between ex-post and ex-ante savings, known as the realization rate, measures the accuracy of the tracking estimates from project to project across the sample of projects. The standard error of the ratio estimate is a measure of the variability in the relationship between the ex-post and ex-ante estimates. Both estimates help to define the relationship (e.g., the ratio as well as the relative precision of the ratio) between the tracking estimates of savings and the actual project savings.

Ratios are calculated within each stratum and strata weights are applied to arrive at a program-level ratio. A stratum is a subset of the projects in the population that are grouped together based on some known variable, in this case ranges of ex-ante savings. In other words, a disaggregation of the population into strata is a classification of all units in the population into mutually exclusive strata that span the population. Under this design, each stratum is sampled

[30] Lohr, Sharon. *Sampling: Design and Analysis*. Pacific Grove, CA: Duxbury Press, 1999, 69-101.

according to simple random sampling protocols and the weighted estimates of parameters are then applied to the entire population.

In PY8, Navigant or Karpinski performed a verification-only site visit, consisting of verification of the retrofit and baseline equipment (where possible), and a customer interview regarding retrofit and building details (Verification Only Visit) for each of the sampled CEEP projects.

Table 108: CEEP Gross Impact Sample Design for PY8

Stratum	Population Size[31]	Achieved Sample Size	Evaluation Activity
Community Education - Large	4	4	Verification Only Visit (4)
Community Education - Small	11	4	Verification Only Visit (3) Phone Verification (1)
Program Total	**15**	**8**	

Table 109: CEEP Gross Impact Results for Energy

Stratum	PYRTD MWh/yr	Energy Realization Rate	Sample C_v or Error Ratio	Relative Precision at 85% C.L.
Community Ed- Large	799	100%	0.00	0.0%
Community Ed - Small	285	112%	0.11	8.1%
Program Total	**1,084**	**103%**		**2.0%**

Table 110: CEEP Gross Impact Results for Demand

Stratum	PYRTD MW/yr	Demand Realization Rate	Sample C_v or Error Ratio	Relative Precision at 85% C.L.
Community Ed- Large	0.19	101%	0.02	0.0%
Community Ed - Small	0.04	86%	0.17	13.3%
Program Total	**0.23**	**98%**		**1.8%**

[31] Participant counts when sampling reflect the total number of projects rather than the total number of participants.

The following factors led to variation between the reported and verified savings and led to the observed realization rates.

- **Verification Rate:** Two projects had lower fixture counts for lighting than reported in the project files, dropping the realization rates by about 1%.
- **Hours of Use:** One site had a customer-reported HOU that was slightly lower than reported in the project files, but this did not significantly affect the realization rate.

3.12.3 Net Impact Evaluation

No NTG research was conducted in PY8 for most nonresidential programs, including CEEP. This research will be conducted in future years (PY9 and PY11), as specified in Navigant's Evaluation Plan. As a result, the PY7 GNI NTG ratio has been applied to the CEEP program. Prior to introducing the CEEP program, education facilities fell under the GNI category so this is the most appropriate NTG ratio to apply.

In PY7, the evaluation team assessed free ridership using a customer self-report approach following the SWE framework.[32] An attempted census of GNI participants was completed in PY7. The resulting overall NTG ratio is applied to the total gross savings for CEEP. A summary of the PY7 NTG results is included below in Table 111.

Table 111: CEEP Program Net Impact Evaluation Results

Target Group	Estimated Free Ridership	Estimated Participant Spillover	NTG Ratio	Observed Coefficient of Variation	Relative Precision (@ 85% CL)
GNI	20%	0%	80%	0.33	10.7%

See Navigant's PY7 final report for Duquesne Light for more detail regarding the PY7 NTG analysis.

High-Impact Measure Research

No NTG research was done in PY8, and therefore no HIM analysis was conducted.

3.12.4 Verified Savings Estimates

In Table 112 the realization rates and net-to-gross ratios determined by Navigant are applied to the reported energy and demand savings estimates to calculate the verified savings estimates for CEEP in PY8. These totals are added to the verified savings achieved in previous program years to calculate the P3TD program impacts.

[32] SWE Guidance memorandum GM-024: Common Approach for Measuring Free riders for Downstream Programs, October 4, 2013.

Table 112: CEEP PYTD and P3TD Savings Summary

Savings Type	Energy (MWh/yr)	Demand (MW/yr)
PYRTD	1,084	0.23
PYVTD Gross	1,115	0.22
PYVTD Net	897	0.18
RTD	1,084	0.23
VTD Gross	1,115	0.22
VTD Net	897	0.18

3.12.5 Process Evaluation

The CEEP program was launched in PY8. To fully understand the program, Navigant completed in depth interviews with the program manager at Duquesne Light as well as with the implementation CSP staff supporting the program. A review of all program materials including the education training materials was also completed, and a program logic model was developed. Navigant had planned to perform a detailed process evaluation in PY8, but the program ramped up more slowly than expected and, as a result, schools did not participate until the spring of 2016. This participation occurred in PY8, but the decision makers (school staff) were not available to speak with to assess NTG during the evaluation period. As a result, no interviews could be completed with school staff.

MCR noted some key lessons learned through the first year of program implementation. The lessons learned relate primarily to tailoring the training materials to the DLC territory. They have noted the importance of connecting with participating schools early in the training process to ensure that the teachers who are delivering the material are supported sufficiently. They also identified the importance of remaining flexible with schools. This has included allowing materials to be delivered through both traditional class times as well as through clubs provided required training hours are achieved.

3.12.6 Cost-Effectiveness Reporting

A detailed breakdown of program finances and cost-effectiveness is presented in

Table 113. TRC benefits in

Table 113 were calculated using gross verified impacts. Net present value (NPV) PYTD costs and benefits are expressed in 2016 dollars. Net present value costs and benefits for P3TD financials are expressed in the 2016 dollars.

Table 113: Summary of CEEP Finances – Gross Verified

Row #	Cost Category	PYTD ($1,000)	P3TD ($1,000)

1	EDC Incentives to Participants [1]	$77		$77	
2	EDC Incentives to Trade Allies	$0		$0	
3	Participant Costs (net of incentives/rebates paid by utilities)	$394		$394	
4	**Incremental Measure Costs (Sum of rows 1 through 3)**	$471		$471	
		EDC	**CSP**	**EDC**	**CSP**
5	Design & Development [2]	$3	$9	$3	$9
6	Administration, Management, and Technical Assistance [3]	$4	$28	$4	$28
7	Marketing [4]	$0	$0	$0	$0
8	Program Delivery [5]	$0	$99	$0	$99
9	EDC Evaluation Costs	$4		$4	
10	SWE Audit Costs	$15		$15	
11*	**Program Overhead Costs (Sum of rows 5 through 10)**	$162		$162	
12	NPV of increases in costs of natural gas (or other fuels) for fuel switching programs	$0		$0	
13	**Total NPV TRC Costs [6] (Net present value of sum of rows 4, 11, and 12)**	$633		$633	
14	Total NPV Lifetime Electric Energy Benefits	$552		$552	
15	Total NPV Lifetime Electric Capacity Benefits	$244		$244	
16	Total NPV Lifetime Operation and Maintenance (O&M) Benefits	$131		$131	
17	Total NPV Lifetime Non-Electric Benefits (Fossil Fuel, Water)	$0		$0	
18	**Total NPV TRC Benefits [7] (Sum of rows 14 through 17)**	$926		$926	
19	**TRC Benefit-Cost Ratio [8]**	1.46		1.46	

[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. NOTE: Savings carried over from Phase II are not to be 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 presents program financials and cost-effectiveness on a net savings basis.

Table 114: Summary of CEEP Finances – Net Verified

Row #	Cost Category	PYTD ($1,000)		P3TD ($1,000)	
1	EDC Incentives to Participants [1]	$77		$77	
2	EDC Incentives to Trade Allies	$0		$0	
3	Participant Costs (net of incentives/rebates paid by utilities)	$302		$302	
4	**Incremental Measure Costs (Sum of rows 1 through 3)**	$379		$379	
		EDC	**CSP**	**EDC**	**CSP**
5	Design & Development [2]	$3	$9	$3	$9
6	Administration, Management, and Technical Assistance [3]	$4	$28	$4	$28
7	Marketing [4]	$0	$0	$0	$0
8	Program Delivery [5]	$0	$99	$0	$99
9	EDC Evaluation Costs	$4		$4	
10	SWE Audit Costs	$15		$15	
11*	**Program Overhead Costs (Sum of rows 5 through 10)**	$162		$162	

12	NPV of increases in costs of natural gas (or other fuels) for fuel switching programs		

13	**Total NPV TRC Costs [6] (Net present value of sum of rows 4, 11, and 12)**	$541	$541
14	Total NPV Lifetime Electric Energy Benefits	$444	$444
15	Total NPV Lifetime Electric Capacity Benefits	$196	$196
16	Total NPV Lifetime Operation and Maintenance (O&M) Benefits	$105	$105
17	Total NPV Lifetime Non-Electric Benefits (Fossil Fuel, Water)	$0	$0
18	**Total NPV TRC Benefits [7] (Sum of rows 14 through 17)**	$745	$745

19	**TRC Benefit-Cost Ratio [8]**	1.38	1.38

[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. NOTE: Savings carried over from Phase II are not to be 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

3.12.7 Status of Recommendations

Navigant limited its impact and process evaluation activities for the CEEP in PY8. At this time, we make no recommendations for the program.

Section 4 Cost Recovery

Act 129 allows Pennsylvania EDCs to recover EE&C plan costs through a cost-recovery mechanism. Duquesne Light's 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 Table 115 and Section 2.4. For example, the low-income customer segment is a subset of Duquesne Light's residential tariff(s) and therefore not listed in Table 115.

Table 115: EE&C Plan Expenditures by Cost-Recovery Category[33] ($1,000)

Cost Recovery Sector	Rate Classes Included	PYTD Spending	P3TD Spending
Residential	RS, RH, RA	$5,420	$5,420
Small/Medium Commercial	GS, GM, GMH	$2,171	$2,171
Small/Medium Industrial	GM, GMH	$268	$268
Large Commercial	GL, GLH, L	$2,226	$2,226
Large Industrial	GL, GLH, L, HVPS	$1,546	$1,546
Portfolio Total		**$11,631**	**$11,631**

[33] Includes SWE costs

Appendix A. Upstream Lighting Cross Sector Sales

Navigant completed in-store intercepts at the beginning of PY7 to re-evaluate cross sector sales for both PY6 and PY7; these results are also being used in this report for PY8. The surveys were used not only to estimate free ridership for the program but also to determine the extent to which bulbs being sold through the program were destined for non-residential facilities and, if so, which types of facilities. The surveys found that none of the program bulbs purchased were reported to be destined for non-residential facilities. As a result, no cross-sector sales are being applied to the upstream lighting program savings.

Appendix B. Site Inspection Summary

Table 116: PY8 Site Visit Summary

Program	Inspection Firm	Number of Inspections Conducted	Number of Sites with Discrepancies from Reported Values	Summary of Common Discrepancies
Large Commercial	Navigant	2	2	Trending Data yielded different savings values
Express Efficiency	Navigant, Karpinski Engineering	14	3	Low fixture counts for two sites, HOU update based on building type correction
Nonresidential Upstream Lighting	Navigant, Karpinski Engineering	22	22*	Bulb Counts, HOU based on incorrect building type
Small Commercial Direct Install	Navigant, Karpinski Engineering	10	8	Missing retrofit measures (particularly exterior lighting). HOU based on customer-reported schedules
Multifamily Housing	Karpinski Engineering	4 (2 unverified)	1 (2 unverified)	Missing Retrofit fixtures. Incorrect use of 24/7 HOU
PAPP	Navigant, Karpinski Engineering	17	7	Incorrect HOU used by CSP, Metering yielded higher SVG factors, fixture counts
Community Education	Karpinski Engineering	8	3	HOU based on customer-reported schedules, Verified fixture counts. PMRS database savings mismatch
TOTAL		**77 (2 unverified)**	**46 (2 unverified)**	

*The program CSP assumed an 85% ISR for all sites, such that even when all bulbs were found to be installed as reported there was still a discrepancy between the reported and verified savings.

Appendix C. HER Impact Evaluation Detail

Table 117, Table 118, and Table 119 show the regression results details for the two waves that comprise the HER program (Table 117 and Table 118) and the single wave representing the LI HER component of LIEEP (Table 119). Table 120 shows the participant homes present for each month of the analysis.

Table 117: 2012 Market Rate Wave Regression Results

Term	Estimate	Standard Error	Statistic	P-value
treatment	-0.5017019	0.036087787	-13.90226	6.235271e-44
yrmo201606	5.8112440	0.133341770	43.58157	0.000000e+00
yrmo201607	5.3173483	0.141683124	37.52986	6.914732e-308
yrmo201608	10.1621476	0.149359966	68.03796	0.000000e+00
yrmo201609	8.9730168	0.141661972	63.34104	0.000000e+00
yrmo201610	5.8787752	0.145762083	40.33131	0.000000e+00
yrmo201611	5.5636205	0.139525228	39.87537	0.000000e+00
yrmo201612	1.7875480	0.135941482	13.14939	1.737410e-39
yrmo201701	3.1858947	0.125722699	25.34065	1.355813e-141
yrmo201702	4.5366044	0.115496195	39.27925	0.000000e+00
yrmo201703	4.5970103	0.130209062	35.30484	9.515069e-273
yrmo201704	4.0729178	0.170464749	23.89302	4.153117e-126
yrmo201705	4.9590206	0.156299267	31.72773	9.871220e-221
yrmo201606:pre_use	0.7794464	0.003010953	258.87031	0.000000e+00
yrmo201607:pre_use	0.7408898	0.002376388	311.77141	0.000000e+00
yrmo201608:pre_use	0.7871464	0.002535248	310.48107	0.000000e+00
yrmo201609:pre_use	0.9147843	0.003298658	277.32015	0.000000e+00
yrmo201610:pre_use	0.7865949	0.004528978	173.68045	0.000000e+00
yrmo201611:pre_use	0.7062253	0.004188285	168.61923	0.000000e+00
yrmo201612:pre_use	0.9101369	0.003450592	263.76254	0.000000e+00
yrmo201701:pre_use	0.8454266	0.002779132	304.20523	0.000000e+00
yrmo201702:pre_use	0.7617046	0.002747699	277.21542	0.000000e+00
yrmo201703:pre_use	0.7838593	0.003564773	219.89042	0.000000e+00
yrmo201704:pre_use	0.7956997	0.005587554	142.40572	0.000000e+00
yrmo201705:pre_use	0.6636861	0.004481561	148.09259	0.000000e+00

Table 118: 2015 Market Rate Wave Regression Results

Term	Estimate	Standard Error	Statistic	P-value
treatment	-0.2916844	0.025129464	-11.60727	3.812999e-31
yrmo201606	5.6500291	0.082833716	68.20929	0.000000e+00
yrmo201607	5.5536219	0.087663314	63.35172	0.000000e+00
yrmo201608	10.3986360	0.089374220	116.34939	0.000000e+00
yrmo201609	6.0656813	0.088504127	68.53558	0.000000e+00
yrmo201610	3.9049448	0.086196060	45.30305	0.000000e+00
yrmo201611	4.2794499	0.086211655	49.63888	0.000000e+00
yrmo201612	3.9047291	0.078676314	49.63030	0.000000e+00
yrmo201701	3.4642042	0.075614536	45.81400	0.000000e+00
yrmo201702	5.9286651	0.070306565	84.32591	0.000000e+00
yrmo201703	7.4007311	0.070546422	104.90583	0.000000e+00
yrmo201704	4.5751062	0.090534086	50.53463	0.000000e+00
yrmo201705	3.8152941	0.100467201	37.97552	3.336493e-315
yrmo201606:pre_use	0.8586544	0.002930916	292.96454	0.000000e+00
yrmo201607:pre_use	0.8623882	0.002348971	367.13440	0.000000e+00
yrmo201608:pre_use	1.0511846	0.002694043	390.18854	0.000000e+00
yrmo201609:pre_use	0.9913626	0.002631114	376.78436	0.000000e+00
yrmo201610:pre_use	0.9485345	0.003736256	253.87299	0.000000e+00
yrmo201611:pre_use	0.7476508	0.003529289	211.84174	0.000000e+00
yrmo201612:pre_use	0.7909477	0.002564278	308.44857	0.000000e+00
yrmo201701:pre_use	0.8372057	0.002209892	378.84464	0.000000e+00
yrmo201702:pre_use	0.6430362	0.001979194	324.89802	0.000000e+00
yrmo201703:pre_use	0.5260264	0.001966990	267.42710	0.000000e+00
yrmo201704:pre_use	0.7065403	0.003485447	202.71153	0.000000e+00
yrmo201705:pre_use	0.7716205	0.004454946	173.20535	0.000000e+00

Table 119: 2015 Low Income Wave Regression Results

Term	Estimate	Standard Error	Statistic	P-value
treatment	-0.1477535	0.044407581	-3.327213	8.773339e-04
yrmo201606	4.4564703	0.133250584	33.444284	1.241383e-244
yrmo201607	4.0498162	0.133143474	30.416934	8.452545e-203
yrmo201608	5.8763032	0.141626163	41.491650	0.000000e+00
yrmo201609	4.3186240	0.143334678	30.129652	4.930196e-199
yrmo201610	4.2623439	0.145222642	29.350408	5.365226e-189
yrmo201611	5.4667077	0.134023827	40.789073	0.000000e+00
yrmo201612	4.3862746	0.125451201	34.963991	4.133630e-267
yrmo201701	4.6441823	0.122337546	37.962036	2.415139e-314
yrmo201702	5.9971135	0.118834546	50.466078	0.000000e+00
yrmo201703	6.7424938	0.119765439	56.297491	0.000000e+00
yrmo201704	5.0650479	0.148183269	34.180970	2.094097e-255
yrmo201705	4.6294007	0.164681201	28.111288	1.423018e-173
yrmo201606:pre_use	0.8619150	0.005333721	161.597316	0.000000e+00
yrmo201607:pre_use	0.8742492	0.004181888	209.056100	0.000000e+00
yrmo201608:pre_use	1.1116278	0.004973836	223.495071	0.000000e+00
yrmo201609:pre_use	0.9973918	0.005066837	196.847035	0.000000e+00
yrmo201610:pre_use	0.8442435	0.006777357	124.568246	0.000000e+00
yrmo201611:pre_use	0.6645904	0.005204835	127.687126	0.000000e+00
yrmo201612:pre_use	0.7831354	0.003779167	207.224359	0.000000e+00
yrmo201701:pre_use	0.7976341	0.003298411	241.823754	0.000000e+00
yrmo201702:pre_use	0.6329340	0.002980983	212.323913	0.000000e+00
yrmo201703:pre_use	0.5527993	0.003026153	182.673928	0.000000e+00
yrmo201704:pre_use	0.6728986	0.005217378	128.972573	0.000000e+00
yrmo201705:pre_use	0.6975105	0.007436891	93.790600	0.000000e+00

Table 120: 2015 Houses per Month

Year_Month	2012 Market Rate Treatment Homes	2015 Market Rate Treatment Homes	2012 Low Income Treatment Homes
201207	15,242		
201208	15,242		
201209	15,242		
201210	15,242		
201211	15,242		
201212	15,242		
201301	15,242		
201302	15,242		
201303	15,242		
201304	15,242		
201305	15,242		
201306	15,242		
201307	15,242		
201308	15,242		
201309	15,242		
201310	15,242		
201311	15,242		
201312	15,242		
201401	15,242		
201402	15,242		
201403	15,242		
201404	15,242		
201405	15,242		
201406	15,242		
201407	15,242		
201408	15,242		
201409	15,242		
201410	15,242		
201411	15,242		
201412	15,242		
201501	15,242		
201502	15,242		
201503	15,242	45,851	17,526
201504	15,242	45,851	17,406
201505	15,242	45,851	17,276
201506	15,242	45,851	17,122
201507	15,242	45,851	16,950
201508	15,242	45,851	16,800

201509	15,242	45,851	16,622
201510	15,242	45,850	16,466
201511	15,242	45,850	16,323
201512	15,242	45,850	16,160
201601	15,242	45,850	16,052
201602	15,242	45,850	15,947
201603	15,242	45,849	15,829
201604	15,242	45,849	15,708
201605	15,242	45,848	15,625
201606	15,242	45,848	15,497
201607	15,242	45,848	15,375
201608	15,242	45,846	15,253
201609	15,242	45,846	15,134
201610	15,242	45,845	15,034
201611	15,241	45,839	14,913
201612	15,238	45,818	14,800
201701	15,229	45,764	14,712
201702	15,216	45,718	14,631
201703	15,210	45,675	14,551
201704	15,203	45,631	14,507
201705	15,154	45,308	14,348

To the extent that the HER waves increase participation in other solutions, some savings from the evaluation's regression analysis could be double counted if appropriate adjustments are not made. Double counting can be avoided for downstream programs that track participation at the customer level by generating estimates of uplift—that is, the increase in participation in the given program among HER participants. This is also known as the overlap savings.

To generate estimates of uplift, Navigant followed the Phase III Evaluation Framework guidance on completing dual participation analyses. The Phase III Evaluation Framework conveys that exposure to the HER messaging often motivates participants to take advantage of other Duquesne Light program offerings that may be promoted through HER promotional materials. This exposure creates a situation where households in the treatment groups tend to participate in other programs at a higher rate than households in the control groups. The Phase III Evaluation Framework methodology calls for program-specific uplift calculations, and the SWE requests those values be reported.

Navigant estimated aggregate uplift across residential programs. From a theoretical standpoint, the program uplift, associated with suggestions provided in the HERs, may be allocated to either the Behavioral program or (LIEEP for the LI HER wave) or the other program involved in its realization since the savings would not have occurred in the absence of either program. Notably, however, the industry standard approach is to subtract the amount of the double counted savings (DCS) from the Behavioral program savings; Navigant followed this approach. This approach is also consistent with the detailed methodology described in Section 6.1.1.8.1 of the Phase III Evaluation Framework.

Navigant's overlap analysis also accounts for upstream programs, notable the upstream

lighting component of REEP. The calculation of DCS from upstream programs is complicated by the fact that participation is not tracked at the customer level and, therefore, the approaches described previously for specific homes are infeasible. Per Section 6.1.1.8.2 of the Phase III Evaluation Framework, the team utilized the Framework's assumed upstream reduction factor dependent on the number of years of activity for the given wave. That reduction factor was subtracted from the estimate of energy savings for each wave after downstream DCS had been removed.

Figure 13: Overlap Analysis: 2012 Market Rate Wave

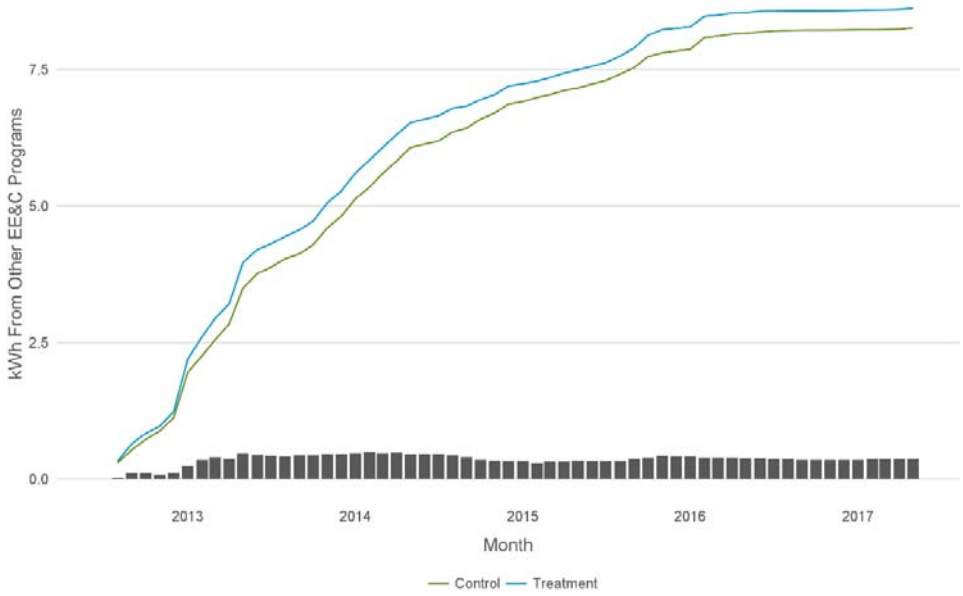


Figure 14: Overlap Analysis: 2015 Market Rate Wave

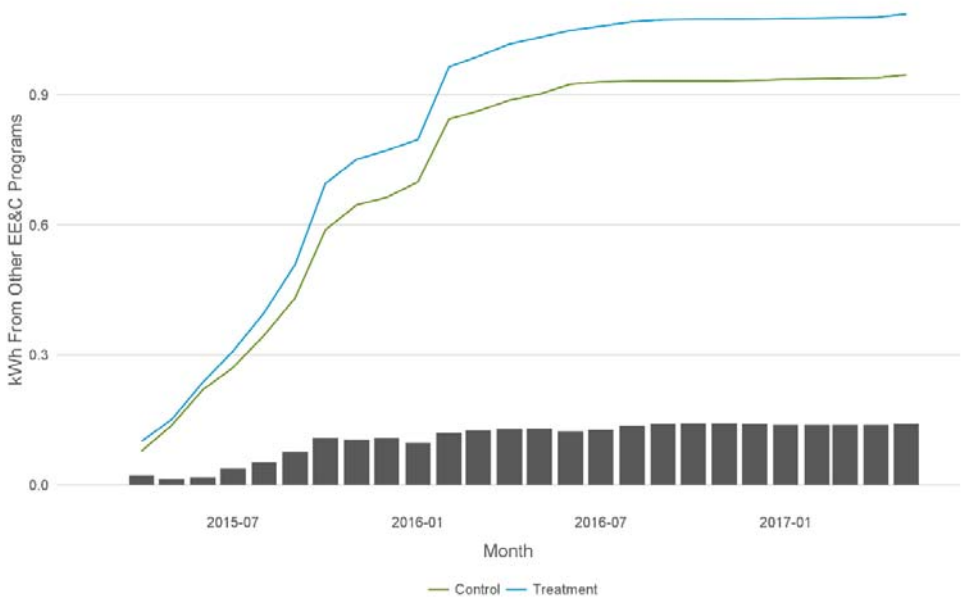


Figure 15: Overlap Analysis: 2015 Low Income Wave