Final Annual Report to the Pennsylvania Public Utility Commission

Phase III of Act 129

Program Year 9

(June 1, 2017 – May 31, 2018)

For Pennsylvania Act 129 of 2008

Energy Efficiency and Conservation Plan

Prepared by Navigant Consulting Inc.

For

Duquesne Light Company

November 15, 2018

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1. Acronyms

BDR	Behavioral Demand Response
CBL	Customer Baseline
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).

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 9 (PY9), as well as the cumulative accomplishments of the Phase III programs since inception. This report additionally documents the energy savings carried over from Phase II. The Phase II carryover savings count towards EDC savings compliance targets for Phase III.

This report details the participation, spending, reported gross, verified gross, and verified net impacts of the energy efficiency programs in PY9. Compliance with Act 129 savings goals are ultimately based on verified gross savings. This report also includes estimates of cost-effectiveness 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 programs. 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 initiated its Demand Response program in PY9. Verified gross savings results from the EDC's first demand response season, which ran from June through September 2017, were originally reported in the PY9 Semi-Annual Report that was submitted in January 2018.

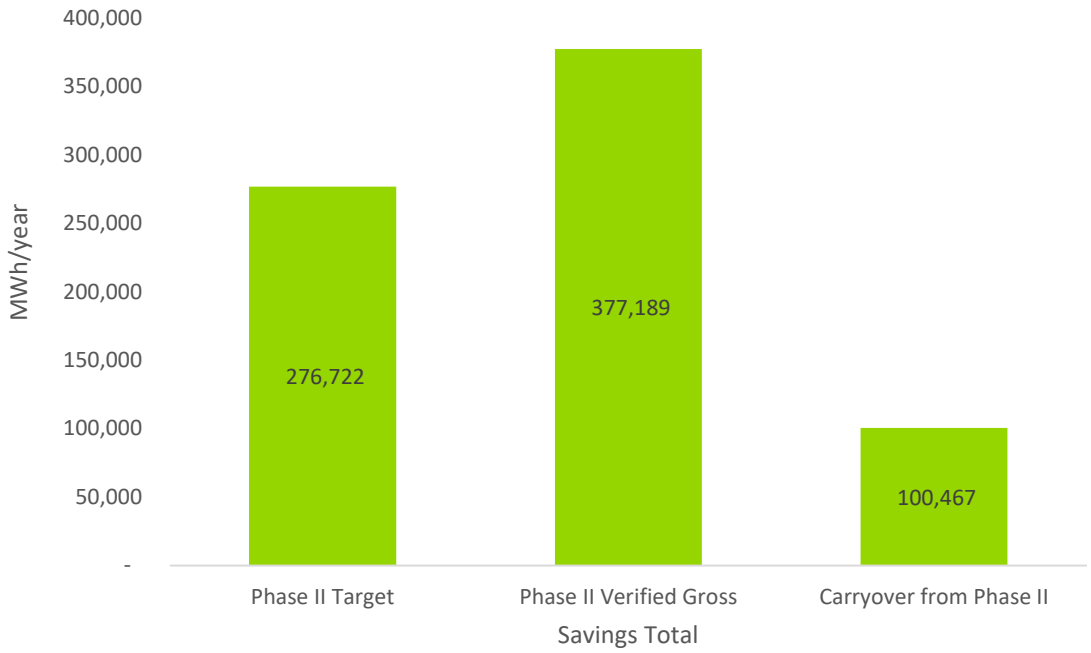
[1] The Pennsylvania TRC Test for Phase I was adopted by PUC order at Docket No. M-2009-2108601 on June 23, 2009 (*2009 PA TRC Test Order*). The TRC Test Order for Phase I later was refined in the same docket on August 2, 2011 (2011 PA TRC Test Order). The 2013 TRC Order for Phase II of Act 129 was issued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

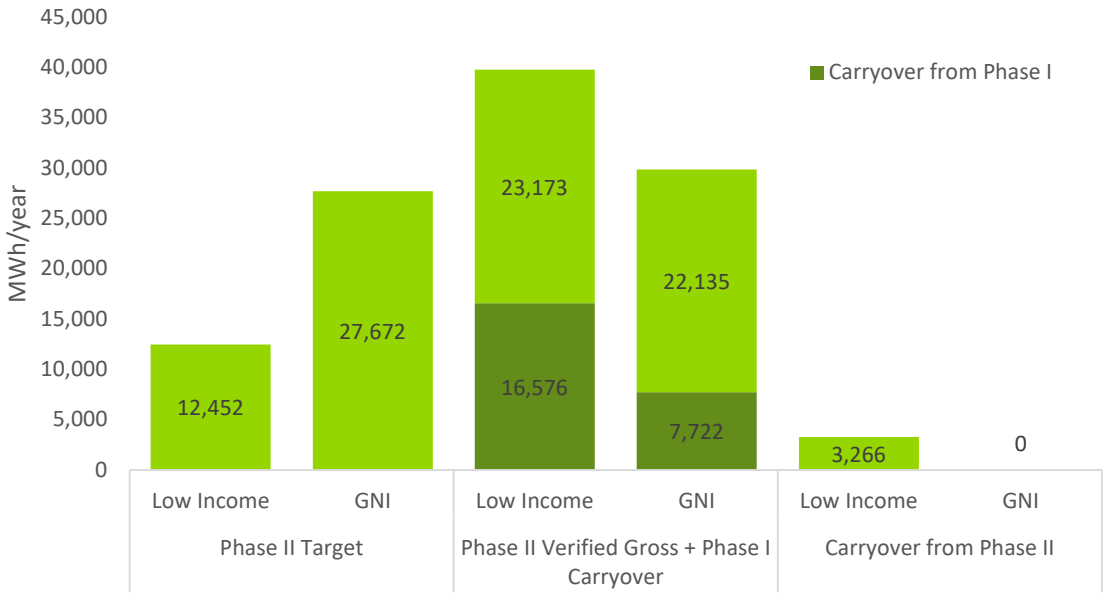


Source: Navigant analysis.

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



Source: Navigant analysis.

2.2 Phase III Energy Efficiency Achievements to Date

Since the beginning of Program Year 9 on June 1, 2017, Duquesne Light has claimed:

- 98,822 MWh/yr of reported gross electric energy savings (PYRTD)
- 11.30 MW/yr of reported gross peak demand savings (PYRTD) from energy efficiency programs
- 100,310 MWh/yr of verified gross electric energy savings (PYVTD)
- 11.83 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:

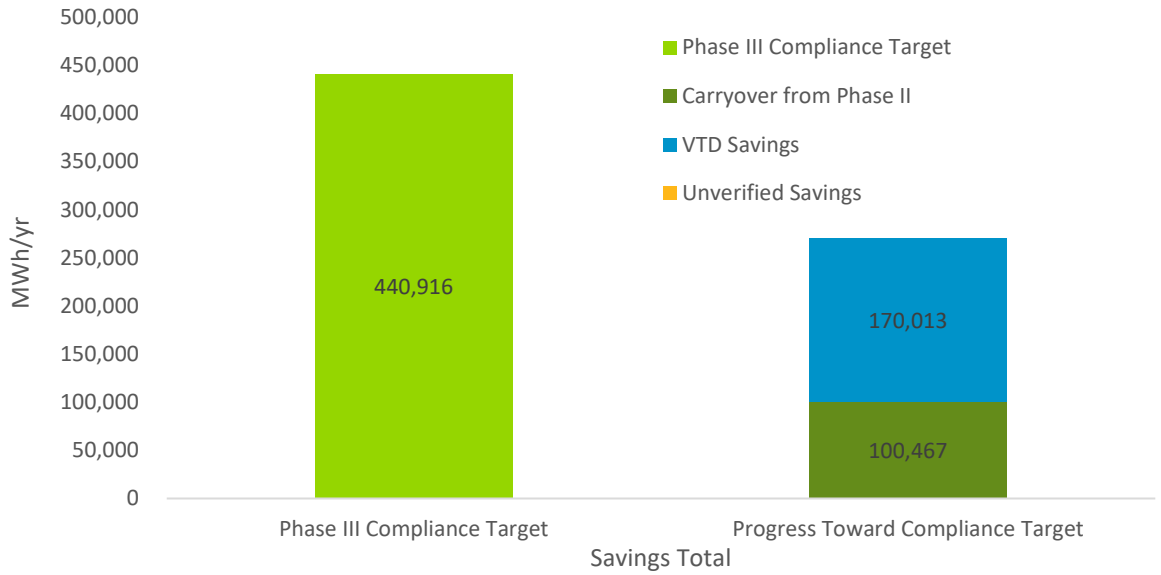
- 166,558 MWh/yr of reported gross electric energy savings (RTD)
- 18.73 MW/yr of reported gross peak demand savings (RTD) from energy efficiency programs
- 170,013 MWh/yr of verified gross electric energy savings (VTD)
- 19.53 MW/yr of verified gross peak demand savings (VTD) from energy efficiency programs

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

- 270,480 MWh/yr of VTD + portfolio-level CO energy savings.
    - This represents 61.3 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: EE&C Plan Performance Toward Phase III Portfolio Compliance Target



Source: Navigant analysis.

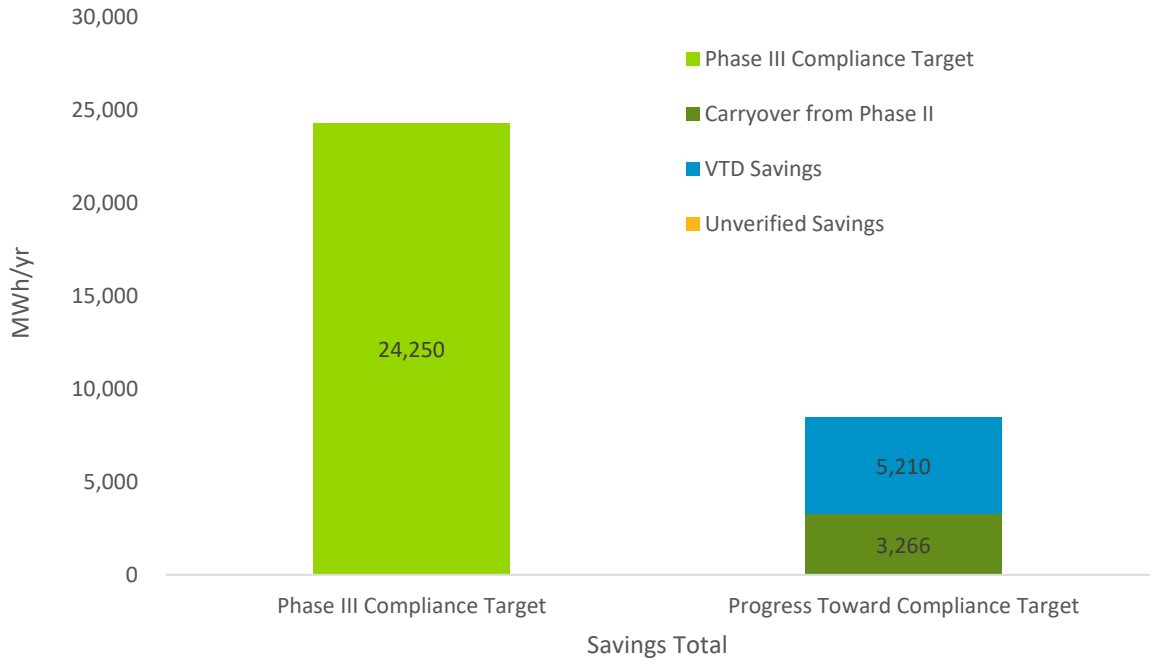
The Phase III Implementation Order directed EDCs to offer conservation measures to the low-income customer segment based on the proportion of electric sales attributable to low-income households. The proportionate number of measures target for Duquesne Light is 8.4 percent. Duquesne Light offers a total 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. Duquesne Light has achieved 35.0 percent of the Phase III low-income energy savings target.

Following PY9, Duquesne Light clarified for Navigant that a portion of participants who received energy efficiency kits from the utility are low-income and that the kit distribution efforts

specifically targeted this customer segment. Within the PY9 Preliminary Final Report, Navigant had assigned all reported savings from such kits to the Residential Energy Efficiency Program (REEP). However, with this clarification, Navigant reassigned 3,722 PY9 kit participants from REEP to the Low-Income Energy Efficiency Program (LIEEP). Savings from these reassignments also contribute to the low-income energy savings target. Reassignments were completed at the individual participant level within Duquesne Light's tracking system. Navigant also looked back to PY8 for similar updates and these are reflected within Phase III achievements presented throughout this report.[4]

Figure 4: EE&C Plan Performance Toward Phase III Low-Income Compliance Target

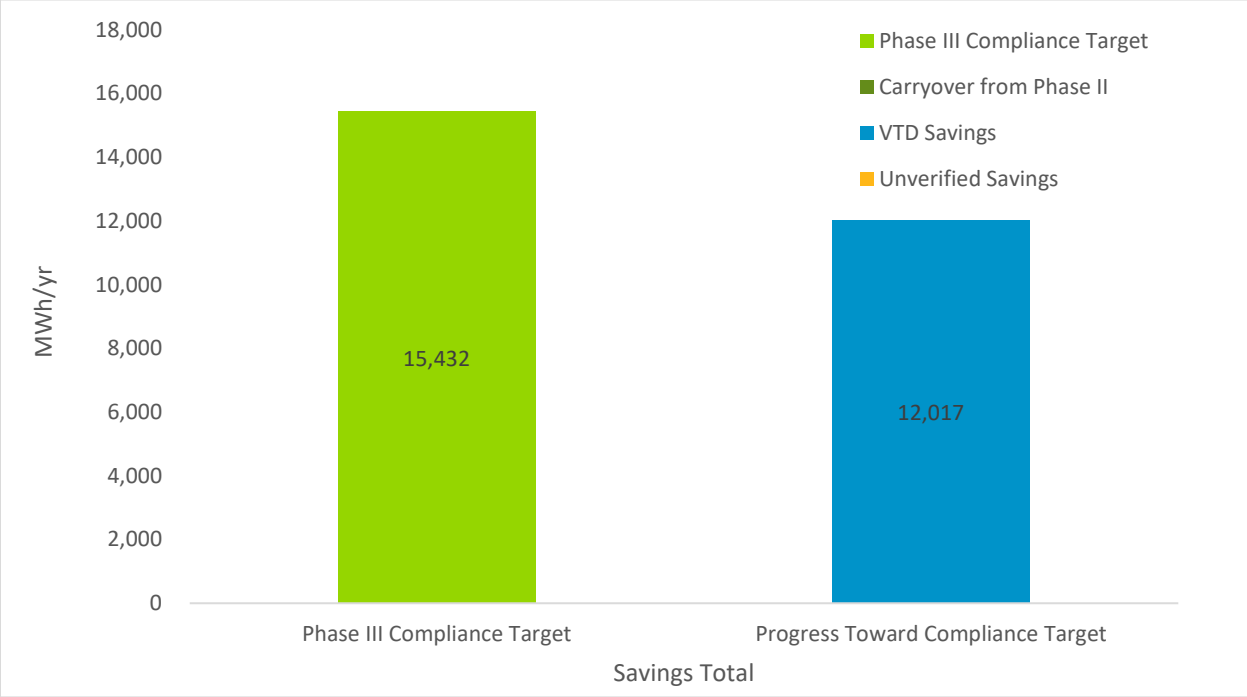


Source: Navigant analysis.

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 77.9 percent of the Phase III GNI energy savings target.

[4]During PY8, a total of 455 energy efficiency kits were distributed to low-income participants. Duquesne Light reported savings of 186 MWh/yr and 0.02 MW/yr for these kits, and Navigant's verification estimated 119 MWh/yr and 0.01 MW/yr. Within this report as reflected in Phase III achievements, these savings and participation values are reassigned from REEP to LIEEP and contribute to the low-income carve-out. Given the small size of this update, no adjustments were made to the Phase-to-date program-level cost-effectiveness estimates.

Figure 5: EE&C Plan Performance Against Phase III GNI Compliance Target



Source: Navigant analysis.

2.3 Phase III Demand Response Achievements to Date

The Phase III demand response performance target for Duquesne Light is 42 MW. Compliance targets for demand response programs are based on average performance across events and were established at the system level, which means the load reductions measured at the customer meter must be escalated to reflect transmission and distribution losses.

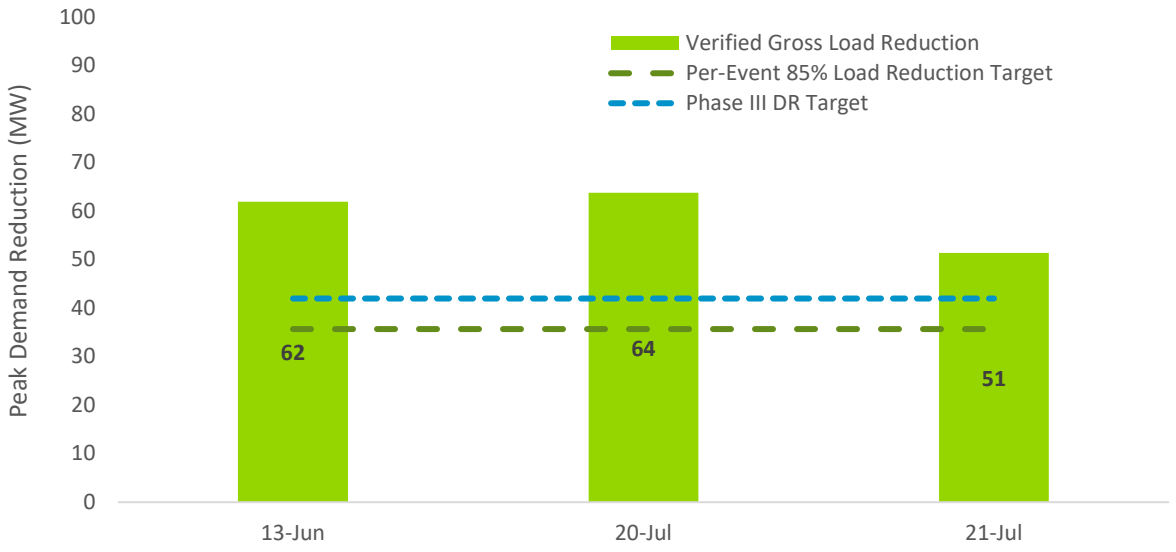
Act 129 demand response events are triggered by PJM's day-ahead load forecast. When the day-ahead forecast is above 96% of the peak load forecast for the year, a demand response event is initiated for the following day. In PY9 there were three demand response events called. Table 1 lists the days that DR events were called along with the verified gross demand reductions achieved by each program. Table 1 also lists the average DR performance for PY9 and for Phase III to date. Duquesne's average DR performance to date is above the Phase III compliance reduction target by 41% (performance–goal/goal).

Table 1: PY9 Demand Response PYVTD Performance by Event (MW)

Event Date	Start Hour (Hour Ending)	End Hour (Hour Ending)	Small CI Load Curtailment	Large CI Load Curtailment	Residential DLC	BDR	Average Portfolio MW Impact
2017-06-13	15	18	0.47	61.51	NA	NA	61.99
2017-07-20	15	18	0.43	63.37	NA	NA	63.81
2017-07-21	15	18	0.39	50.98	NA	NA	51.38
PYVTD - Average PY9 DR Event Performance							59.06
VTD - Average Phase III DR Event Performance							59.06

The Commission's Phase III Implementation Order also established a requirement that EDCs achieve at least 85% of the Phase III compliance reduction target in each DR event. For Duquesne Light, this translates to a 35.7 MW minimum for each DR event. Figure 6 compares the performance of each of the DR events in PY9 to the event-specific minimum and average targets.

Figure 6: Event Performance Compared to 85% Per-Event Target



Source: Navigant analysis.

2.4 Phase III Performance by Customer Segment

Table 2 presents the participation, savings, and spending by customer sector for PY9. The residential, small C&I, large C&I sectors are defined by EDC tariff and the residential low-income and governmental/educational/non-profit sector were defined by statute (66 Pa. C.S. § 2806.1). The residential low-income segment is a subset of the residential customer class and the GNI segment will include customers who are part of the Small C&I or Large C&I rate classes. The savings, spending, and participation values for the LI and GNI segments have been removed from the parent sectors in Table 2.

Table 2: Program Year 9 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	75,437	20,849	644	267	139	**97,336**
PY9 Energy Realization Rate	92%	89%	120%	106%	101%	**102%**
PYVTD MWh/yr	39,687	3,787	22,283	27,496	7,057	**100,310**
PY9 Demand Realization Rate	93%	91%	121%	117%	90%	**105%**
PYVTD MW/yr (Energy Efficiency)	4.45	0.39	3.45	2.80	0.74	**11.83**
PYVTD MW (Demand Response)	0.00	0.00	0.38	48.36	10.33	**59.06**
Incentives ($1000)*	$1,238	$0	$797	$1,759	$540	**$4,334**

*Large C&I Demand Response Curtailable incentives were initially allocated in the July Preliminary Final Report to the Large C&I (Non-GNI) segment. Incentives are distributed here across Small C&I (Non-GNI), Large C&I (Non-GNI), and GNI in alignment with the program participants.

Table 3 summarizes plan performance by sector since the beginning of Phase III.

Table 3: 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	142,046	40,510	858	331	193	**183,938**
P3TD Energy Realization Rate	97%	92%	116%	106%	101%	**102%**
VTD MWh/yr	84,999	5,113	30,775	37,109	12,017	**170,013**
P3TD Demand Realization Rate	98%	94%	119%	115%	91%	**104%**
VTD MW (Energy Efficiency)	9.28	0.53	4.55	3.89	1.28	**19.53**
VTD MW (Demand Response)	0.00	0.00	0.38	48.36	10.33	**59.06**
Incentives ($1000)	$3,102	$0	$1,056	$2,203	$766	**$7,127**

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 4, and Table 5 provides the current participation totals for PY9 and Phase III.

Table 4: Program Participation Definitions

Programs	Component	Definition
REEP: Residential Energy Efficiency Low-Income Energy Efficiency Residential Appliance Recycling Express Efficiency Small/Medium Midstream Lighting Small Commercial Direct Install	Downstream/ Midstream Rebates or Kits	A participant is a customer participating in the given program within a given reporting period (e.g., Q1 through Q4 for PY9), represented by a unique participant account number. 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 each of the periods represented (i.e., PYRTD or P3TD). Customers participating in a

Programs	Component	Definition
Multifamily Housing Retrofits Commercial Efficiency Community Education Energy Efficiency Large Midstream Lighting Industrial Efficiency Public Agency Partnership		program more than once within a reporting period (e.g., PYRTD) are counted once; customers participating more than once but in different annual periods or programs are counted more than once (once in each period and/or program).
Large Curtailable Load Program	Demand Response Curtailment	A participant is a customer participating in the program within the program event period for the program year (e.g., June-September 2017), represented by a unique participant account number. The count appearing in Table 4, below, represents the summation of the unique customer participant account numbers in the tracking system for the program, including all account numbers for which DR activity has been reported for at least one event during the program period for the year.
Residential Behavioral Savings Program	Home Energy Reports	A participant is a customer that is a member of the program's treatment group whose energy consumption is analyzed at the end of the program year, represented by a unique account number.
REEP: Residential Energy Efficiency (Upstream Lighting)	Upstream rebates for lamp sales	Participation cannot be counted because reported program data comprises lamp sales activities and not individual participating customer activities.
REEP: Residential Energy Efficiency	Giveaways	A portion of REEP program savings result from giveaways during events in which the utility has participated (event giveaways). Duquesne Light tracks events and the measures given away and not the individual participants who receive the measures.
Low-Income Energy Efficiency		A portion of program savings results from low-income-specific events during which the utility provides free kits to attendees. Duquesne Light tracks events and the measures given away and not the individual participants who receive the measures.
Residential Whole House Retrofit Low-Income Whole House Retrofit	Direct Installs Audits	Defined similarly to the Downstream/Midstream Rebates or Kits Component. Additionally, Whole House Retrofits also occur in multifamily buildings where a mix of market rate and low-income audits occur. The income status of individual participants is not known, but the known building-level proportion of tenants that are low-income is used split the total count of participants between the market rate and low-income programs.

Table 5: EE&C Portfolio Participation by Program

Program	PYTD Participation	P3TD Participation*
REEP: Residential Energy Efficiency	17,085	21,578
REEP: Residential Energy Efficiency (Upstream Lighting)	N/A	N/A
Residential Appliance Recycling	2,469	3,630
Residential Behavioral Savings	55,609	116,564
Residential Whole House Retrofit	274	274
Low-Income Energy Efficiency	20,849	40,510
Express Efficiency	298	392
Small/Medium Midstream Lighting	245	323
Small Commercial Direct Install	94	132
Multifamily Housing Retrofit	3	7
Commercial Efficiency	49	59
Large Midstream Lighting	158	201
Industrial Efficiency	25	36
Public Agency Partnership	71	112
Community Education	33	46
Large C&I Demand Response Curtailable	74	74
Portfolio Total	**97,336**	**183,938**

*As previously noted in Footnote 4, Navigant reassigned 455 energy efficiency kit participants from PY8 from REEP to LIEEP.

2.6 Summary of Impact Evaluation Results

During PY9, Navigant completed impact evaluations for many of the energy efficiency programs in the portfolio. Table 6 summarizes the realization rates and net-to-gross ratios by program or evaluation initiative.

Table 6: Impact Evaluation Results Summary

Program\Initiative	Energy Realization Rate	Demand Realization Rate	Net to Gross Ratio
REEP: Residential Energy Efficiency	78%	88%	0.72
REEP: Residential Energy Efficiency (Upstream Lighting)	97%	97%	0.43
Residential Appliance Recycling	92%	92%	0.47
Residential Behavioral Savings	88%	88%	1.00
Residential Whole House Retrofit	84%	84%	1.00
Low-Income Energy Efficiency	89%	91%	1.00
Express Efficiency	132%	131%	0.55
Small/Medium Midstream Lighting	140%	119%	0.88
Small Commercial Direct Install	97%	102%	0.99
Multifamily Housing Retrofit	95%	93%	0.45
Commercial Efficiency	99%	103%	0.60
Large Midstream Lighting	210%	213%	0.88
Industrial Efficiency	103%	110%	0.31
Public Agency Partnership	101%	88%	0.45
Community Education	104%	95%	0.45
Large C&I Demand Response Curtailable	N/A	115%	N/A

Findings from net-to-gross (NTG) research are not used to adjust compliance savings in Pennsylvania. Instead, NTG research provides directional information for program planning purposes. Table 7 presents NTG findings for high impact measures (HIMs) studied in PY9. Navigant conducted HIM research for two measures implemented during PY9. The first measure, LED lamps within energy efficiency kits, relates to the 9W, 11W, and 15W LEDs included in the kits that also hold LED nightlights. Nightlights are excluded from the HIM research, and while these kits are distributed to market rate and low-income participants, only the market rate participants were surveyed for NTG ratio research. Kit participants were also asked about LEDs in general, and survey respondents were not asked to distinguish behaviors for different wattages. The second measure, four-foot linear replacement LED lamps within non-residential buildings, were implemented through the Commercial Energy Efficiency/Express Efficiency, Industrial Efficiency, Public Agency Partnership, Multifamily House Retrofit, and Community Education programs.

Table 7: High Impact Measure Net-to-Gross

HIM	Free Ridership	Spillover	Net-to-Gross Ratio
LED lamps within energy efficiency kits	0.33	0.08	0.74
Four-foot linear replacement LED lamps	0.33	0.00	0.67

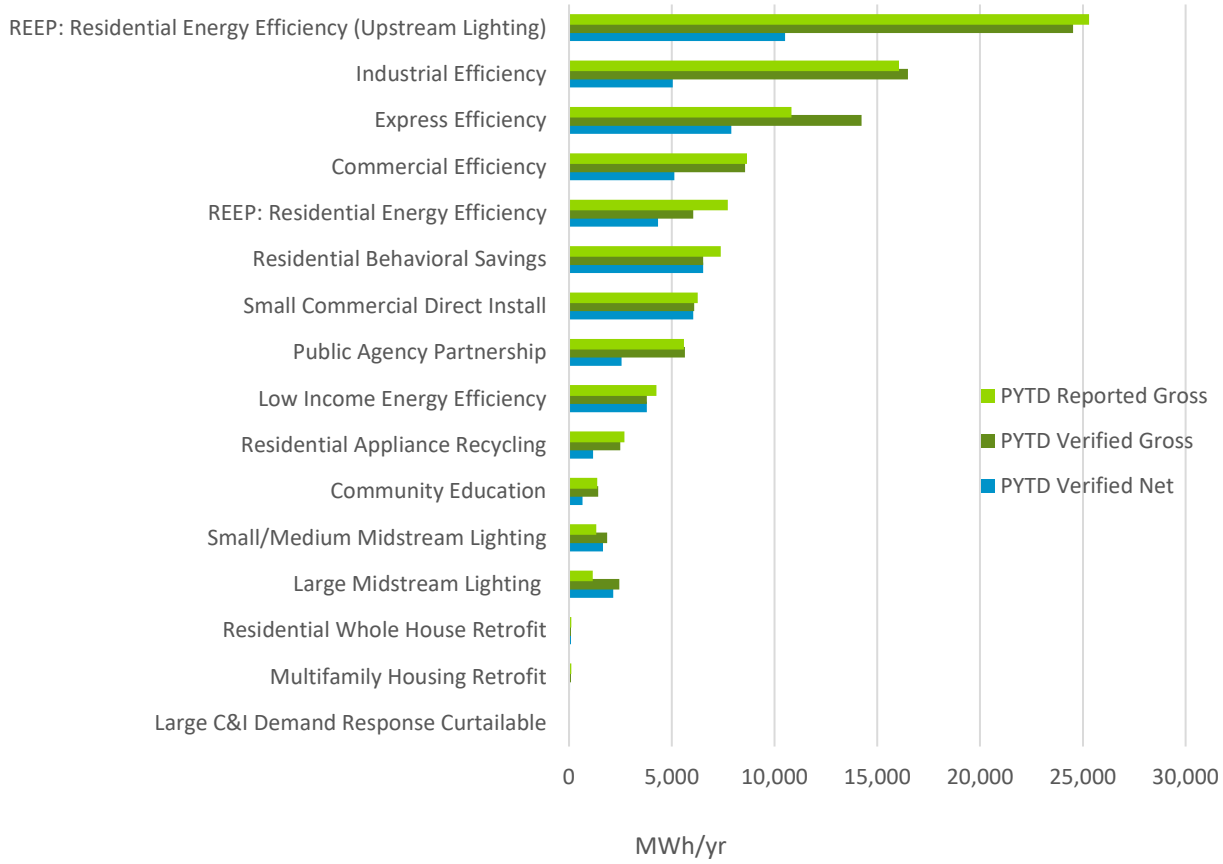
2.7 Summary of Energy Impacts by Program

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 7 presents a summary of the PYTD energy savings by program for PY9. 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.

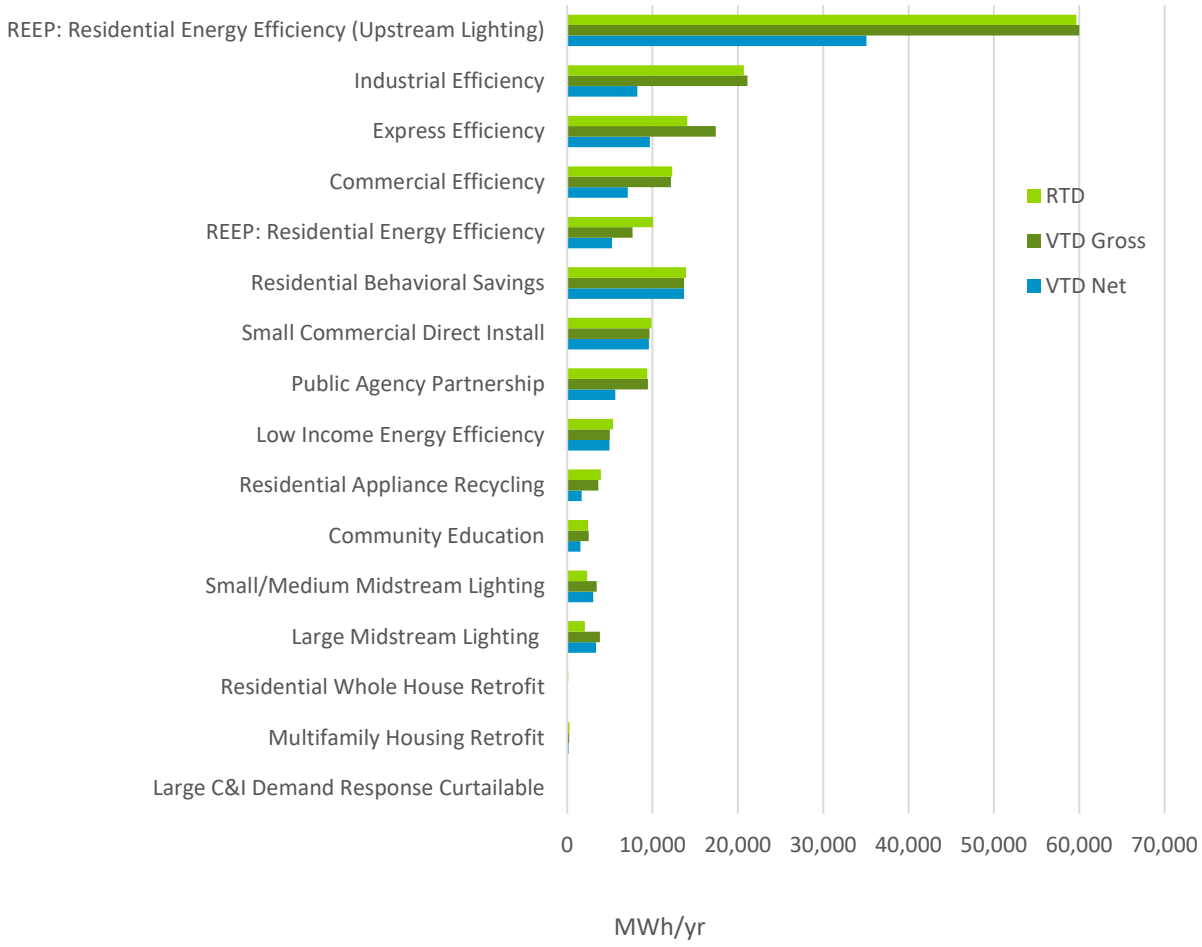
Figure 7: PYTD Energy Savings by Program



Source: Navigant analysis.

Figure 8 presents a summary of the energy savings by program for Phase III of Act 129.

Figure 8: P3TD Energy Savings by Program



Source: Navigant analysis.

A summary of energy impacts by program through PY9 is presented in Table 8.

Table 8: 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*	7,730	6,046	4,324	9,870	7,533	5,182
REEP: Residential Energy Efficiency (Upstream Lighting)	25,298	24,523	10,509	59,656	60,019	35,080
Residential Appliance Recycling	2,703	2,496	1,166	3,965	3,660	1,709
Residential Behavioral Savings	7,376	6,524	6,524	13,912	13,686	13,686
Residential Whole House Retrofit	118	99	99	118	99	99
Low-Income Energy Efficiency*	4,246	3,787	3,787	5,565	5,113	5,019
Express Efficiency	10,818	14,229	7,895	14,057	17,412	9,668
Small/Medium Midstream Lighting	1,329	1,860	1,646	2,353	3,456	3,058
Small Commercial Direct Install	6,264	6,093	6,050	9,890	9,655	9,587
Multifamily Housing Retrofit	107	101	46	265	252	153
Commercial Efficiency	8,653	8,565	5,123	12,296	12,144	7,116
Large Midstream Lighting	1,159	2,440	2,159	2,063	3,847	3,404
Industrial Efficiency	16,050	16,491	5,047	20,701	21,118	8,213
Public Agency Partnership	5,599	5,631	2,562	9,393	9,476	5,655
Community Education	1,372	1,426	649	2,455	2,541	1,546
Large C&I Demand Response Curtailable	0	0	0	0	0	0
Portfolio Total	**98,822**	**100,310**	**57,584**	**166,558**	**170,013**	**109,177**

*As previously noted in Footnote 4, Navigant reassigned 455 energy efficiency kit participants from PY8 from REEP to LIEEP. Savings were moved between programs by 186 MWh/yr for RTD, 119 MWh/yr for VTD Gross, and 68 MWh/yr for VTD Net.

2.7.2 Lifetime Energy Savings by Program

Table 9 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 9: 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	81,278	58,131	99,467	68,620
REEP: Residential Energy Efficiency (Upstream Lighting)	175,852	75,357	476,873	283,733
Residential Appliance Recycling	16,789	7,841	25,242	11,784
Residential Behavioral Savings	6,524	6,524	13,300	13,300
Residential Whole House Retrofit	800	800	800	800
Low-Income Energy Efficiency	26,233	26,233	28,451	27,953
Express Efficiency	184,627	102,441	231,797	128,712
Small/Medium Midstream Lighting	13,143	11,631	28,523	25,241
Small Commercial Direct Install	83,005	82,422	130,630	129,712
Multifamily Housing Retrofit	1,522	693	2,382	1,304
Commercial Efficiency	128,390	76,785	177,482	104,127
Large Midstream Lighting	16,839	14,901	31,999	28,317
Industrial Efficiency	244,857	74,937	313,614	121,987
Public Agency Partnership	82,637	37,594	138,884	82,839
Community Education	20,636	9,388	36,568	22,203
Large C&I Demand Response Curtailable	0	0	0	0
Portfolio Total	**1,083,131**	**585,677**	**1,736,009**	**1,050,630**

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.

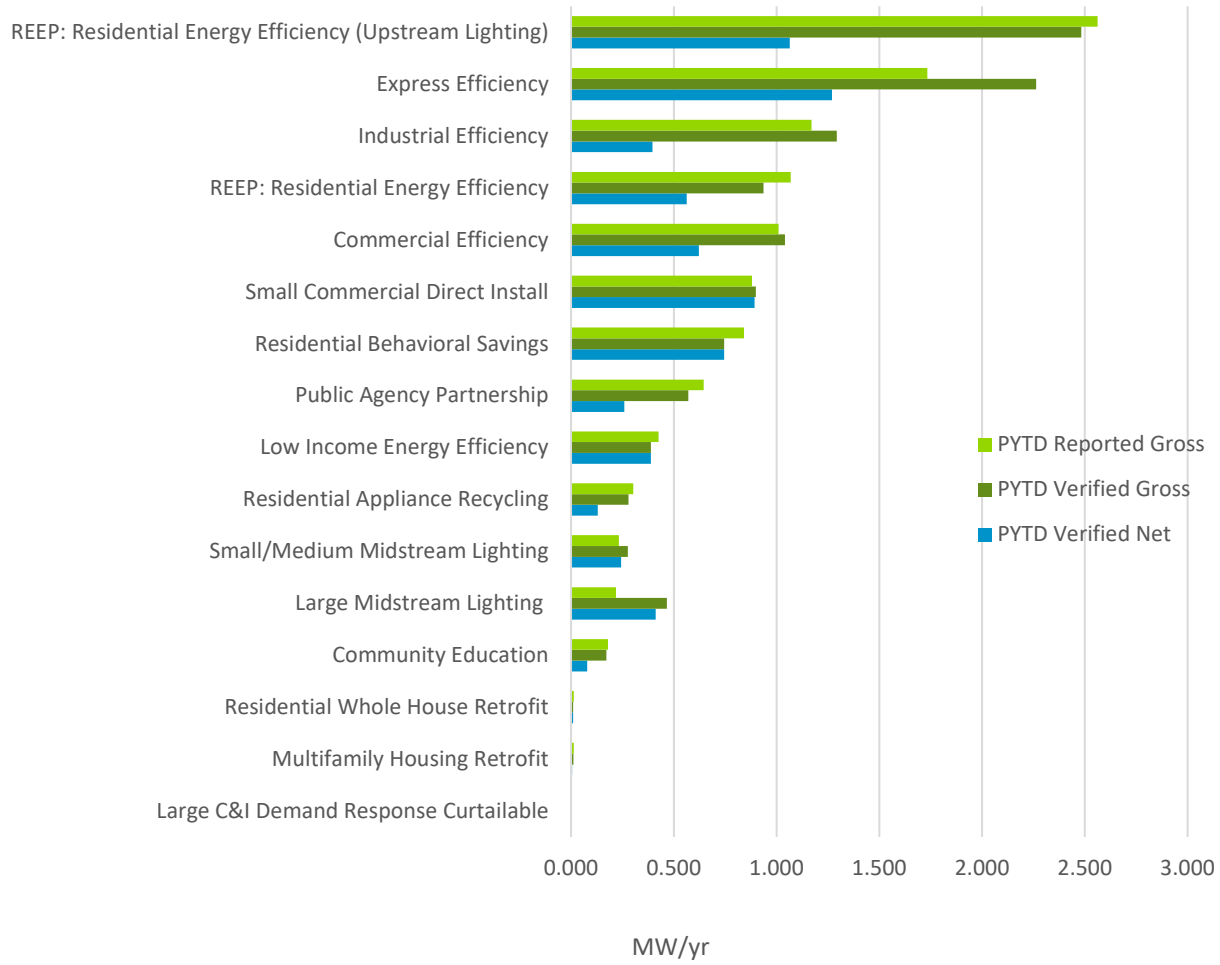
The two types of peak demand reduction savings are also treated differently for reporting purposes. Peak demand reductions from energy efficiency are generally additive across program years, meaning that the P3TD savings reflect the sum of the first-year savings in each program year. Conversely, demand 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 9 presents a summary of the PYTD demand savings by energy efficiency program for PY9.

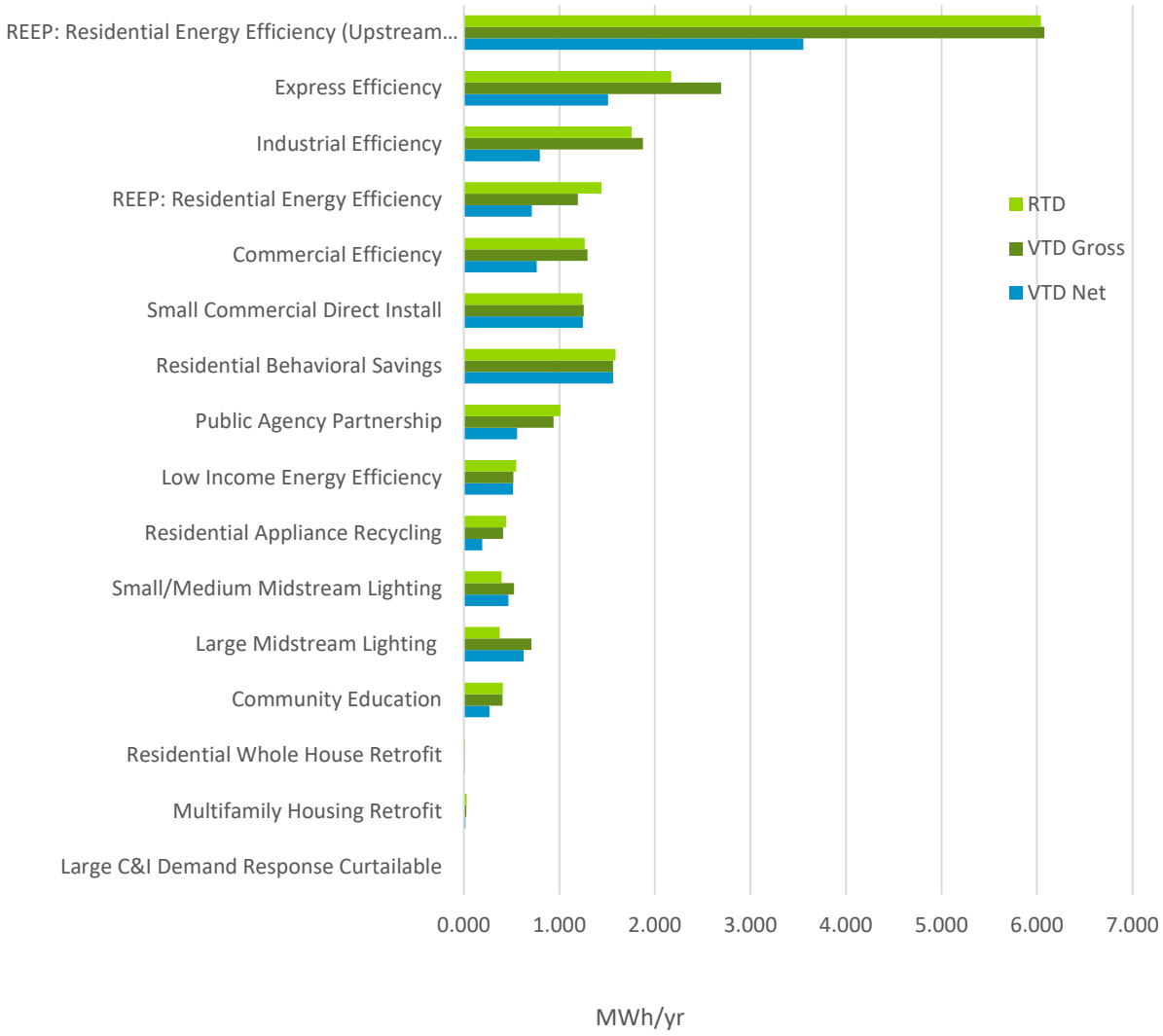
Figure 9: PYTD Demand Savings by Energy Efficiency Program



Source: Navigant analysis.

Figure 10 presents a summary of the P3TD demand savings by energy efficiency program for Phase III of Act 129.

Figure 10: P3TD Demand Savings by Energy Efficiency Program



Source: Navigant analysis.

A summary of the peak demand impacts by energy efficiency program through the current reporting period are presented in Table 10.

Table 10: 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*	1.07	0.94	0.56	1.42	1.22	0.74
REEP: Residential Energy Efficiency (Upstream Lighting)	2.56	2.48	1.06	6.04	6.07	3.55
Residential Appliance Recycling	0.30	0.28	0.13	0.44	0.41	0.19
Residential Behavioral Savings	0.84	0.74	0.74	1.59	1.56	1.56
Residential Whole House Retrofit	0.01	0.01	0.01	0.01	0.01	0.01
Low-Income Energy Efficiency*	0.43	0.39	0.39	0.56	0.53	0.52
Express Efficiency	1.73	2.26	1.27	2.17	2.71	1.52
Small/Medium Midstream Lighting	0.23	0.28	0.24	0.39	0.54	0.48
Small Commercial Direct Install	0.88	0.90	0.89	1.24	1.27	1.26
Multifamily Housing Retrofit	0.01	0.01	0.01	0.03	0.03	0.02
Commercial Efficiency	1.01	1.04	0.62	1.27	1.30	0.77
Large Midstream Lighting	0.22	0.47	0.41	0.37	0.72	0.64
Industrial Efficiency	1.17	1.29	0.40	1.76	1.87	0.79
Public Agency Partnership	0.65	0.57	0.26	1.01	0.89	0.52
Community Education	0.18	0.17	0.08	0.41	0.39	0.26
Large C&I Demand Response Curtailable	0.00	0.00	0.00	0.00	0.00	0.00
Portfolio Total	**11.30**	**11.83**	**7.08**	**18.73**	**19.53**	**12.82**

*As previously noted in Footnote 4, Navigant reassigned 455 energy efficiency kit participants from PY8 from REEP to LIEEP. Savings were moved between programs by 0.02 MW/yr for RTD, 0.01 MW/yr for VTD Gross, and 0.01 MW/yr for VTD Net.

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 PJM's 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 = 6.9% or 1.0741
- Small C&I = 6.9% or 1.0741
- Large C&I = 6.9% or 1.0741 and 0.8% or 1.0081[5]

Table 11 summarizes the PYVTD and VTD demand reductions for each of the demand response programs in the EE&C plan and for the demand response portfolio as a whole. VTD demand reductions are the average performance across all Phase III demand response events independent of how many events occurred in a given program year. The relative precision columns in Table 11 indicate the margin of error (at the 90% confidence interval) around the PYVTD and VTD demand reductions.

Table 11: Verified Gross Demand Response Impacts by Program

Program	PYVTD Gross MW	Relative Precision (90%)	VTD Gross MW	Relative Precision (90%)
Large Curtailable Load	59.06	12%	59.06	12%
Portfolio Total	**59.06**	**12%**	**59.06**	**12%**

Impacts were estimated using either a Customer Baseline (CBL) with weather-sensitivity adjustment or using a regression analysis. The determination of which approach to use for each customer was based on which method provided the most accurate estimate of consumption when applied to hypothetical events in summer 2016 (the testing criteria described in Navigant's Phase III evaluation plan). The CBL approach is slightly different from that described in the evaluation plan in that CBLs were adjusted using the PJM WSA (Weather Sensitive Adjustment) Factor Method.[6] The WSA factors applied to deliver the adjustment were developed by Enerlogics, Duquesne's DR Program CSP, and are included in the Data Request files provided to the SWE.

[5] The 0.8% line loss factor applies to certain participants on the HPVS rate.
[6] PJM, *Weather Sensitive Adjustment Using the WSA Factor Method*, accessed October 2017 http://www.pjm.com/~/media/markets-ops/demand-response/dsr-weather-sensitive-adjustment-using-wsa-factor-method.ashx

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 12 shows the TRC ratios by program and for the portfolio. The benefits in Table 12 were calculated using gross verified impacts. Costs and benefits are expressed in 2017 dollars.

PY9 residential program gross TRC cost effectiveness generally was strong and carried by REEP which is the largest program in the portfolio for Phase III. Except for the Residential Appliance Recycling Program, the remainder of the residential program TRCs fell below 1.00. For example, Duquesne Light continued to incur costs related to developing and ramping up activities for the Whole House Retrofit Program that includes a low-income component under LIEEP. Similar to PY8 results, the non-residential programs had very positive gross TRC cost effectiveness results. The Multifamily Housing Retrofit Program (MFHR) cost effectiveness was the one exception in PY8 and continues to be the exception in PY9. MFHR completed four projects in PY8 and only an additional three in PY9.

Table 12: PY9 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	$12,977	$7,001	1.85	$5,976
Residential Appliance Recycling	$749	$410	1.83	$339
Residential Behavioral Savings	$331	$456	0.73	($125)
Residential Whole House Retrofit	$55	$236	0.23	($181)
Low-Income Energy Efficiency	$1,152	$1,238	0.93	($86)
Residential Subtotal	**$15,264**	**$9,341**	**1.63**	**$5,923**
Express Efficiency	$8,199	$1,682	4.88	$6,518
Small/Medium Midstream Lighting	$782	$277	2.82	$504
Small Commercial Direct Install	$3,536	$1,630	2.17	$1,906
Multifamily Housing Retrofit	$62	$427	0.15	($365)
Commercial Efficiency	$5,424	$1,169	4.64	$4,255
Large Midstream Lighting	$1,011	$606	1.67	$405
Industrial Efficiency	$9,499	$2,113	4.50	$7,386
Public Agency Partnership	$3,371	$1,254	2.69	$2,117
Community Education	$872	$535	1.63	$337
Large C&I Demand Response Curtailable	$5,442	$1,640	3.32	$3,801
Non-Residential Subtotal	**$38,198**	**$11,334**	**3.37**	**$26,864**
Portfolio Total	**$53,462**	**$20,675**	**2.59**	**$32,787**

Table 13 presents PY9 cost-effectiveness using net verified savings to calculate benefits. Net TRC cost effectiveness for the residential programs generally followed the pattern of gross TRC cost effectiveness. Costs and benefits for net TRCs are the same as those for gross TRCs for Residential Behavioral Savings, Residential Whole House Retrofit, and Low-Income Energy Efficiency given that NTG ratios are assumed to be 1.00. Non-residential net TRC cost effectiveness results were also generally positive for all programs. For example, even with an NTG ratio of 0.31, the Industrial Efficiency program net TRC remains well above 1.00 at 2.21.

Table 13: PY9 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	$6,297	$5,016	1.26	$1,281
Residential Appliance Recycling	$350	$410	0.85	($60)
Residential Behavioral Savings	$331	$456	0.73	($125)
Residential Whole House Retrofit	$55	$236	0.23	($181)
Low-Income Energy Efficiency	$1,152	$1,238	0.93	($86)
Residential Subtotal	**$8,185**	**$7,356**	**1.11**	**$828**
Express Efficiency	$4,549	$1,482	3.07	$3,068
Small/Medium Midstream Lighting	$692	$261	2.65	$431
Small Commercial Direct Install	$3,512	$1,630	2.15	$1,882
Multifamily Housing Retrofit	$28	$408	0.07	($380)
Commercial Efficiency	$3,244	$1,037	3.13	$2,207
Large Midstream Lighting	$895	$589	1.52	$306
Industrial Efficiency	$2,907	$1,314	2.21	$1,594
Public Agency Partnership	$1,534	$894	1.71	$639
Community Education	$397	$457	0.87	($60)
Large C&I Demand Response Curtailable	$5,442	$1,640	3.32	$3,801
Non-Residential Subtotal	**$23,198**	**$9,711**	**2.39**	**$13,487**
Portfolio Total	**$31,383**	**$17,067**	**1.84**	**$14,315**

Table 14 summarizes cost-effectiveness by program for Phase III of Act 129. Cost and benefits are discounted back to 2016.

Table 14: 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	$32,024	$14,267	2.24	$17,757
Residential Appliance Recycling	$1,065	$612	1.74	$454
Residential Behavioral Savings	$847	$570	1.49	$278
Residential Whole House Retrofit	$51	$289	0.18	($238)
Low-Income Energy Efficiency	$1,210	$1,501	0.81	($291)
Residential Subtotal	**$35,197**	**$17,238**	**2.04**	**$17,960**
Express Efficiency	$9,663	$2,568	3.76	$7,096
Small/Medium Midstream Lighting	$1,639	$412	3.98	$1,227
Small Commercial Direct Install	$5,132	$2,508	2.05	$2,624
Multifamily Housing Retrofit	$90	$710	0.13	($620)
Commercial Efficiency	$6,913	$2,522	2.74	$4,391
Large Midstream Lighting	$1,907	$994	1.92	$914
Industrial Efficiency	$11,831	$2,964	3.99	$8,866
Public Agency Partnership	$5,333	$2,691	1.98	$2,642
Community Education	$1,742	$1,134	1.54	$608
Large C&I Demand Response Curtailable	$5,090	$2,019	2.52	$3,071
Non-Residential Subtotal	**$49,341**	**$18,521**	**2.66**	**$30,820**
Portfolio Total	**$84,538**	**$35,759**	**2.36**	**$48,779**

Table 15 presents P3TD cost-effectiveness results using net verified savings to calculate benefits. Cost and benefits are discounted back to 2016.

Table 15: 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	$19,556	$10,864	1.80	$8,692
Residential Appliance Recycling	$497	$612	0.81	($114)
Residential Behavioral Savings	$847	$570	1.49	$278
Residential Whole House Retrofit	$51	$289	0.18	($238)
Low-Income Energy Efficiency	$1,205	$1,501	0.80	($296)
Residential Subtotal	**$22,156**	**$13,834**	**1.60**	**$8,322**
Express Efficiency	$5,366	$2,212	2.43	$3,154
Small/Medium Midstream Lighting	$1,450	$391	3.71	$1,059
Small Commercial Direct Install	$5,096	$2,508	2.03	$2,588
Multifamily Housing Retrofit	$49	$672	0.07	($623)
Commercial Efficiency	$4,059	$2,038	1.99	$2,021
Large Midstream Lighting	$1,688	$971	1.74	$717
Industrial Efficiency	$4,735	$2,147	2.20	$2,587
Public Agency Partnership	$3,188	$2,242	1.42	$946
Community Education	$1,116	$969	1.15	$147
Large C&I Demand Response Curtailable	$5,090	$2,019	2.52	$3,071
Non-Residential Subtotal	**$31,837**	**$16,168**	**1.97**	**$15,669**
Portfolio Total	**$53,993**	**$30,003**	**1.80**	**$23,990**

2.11 Comparison of Performance to Approved EE&C Plan

Table 16 presents P3TD expenditures, by program, compared to the budget estimates set forth in the EE&C plan through PY9. All dollars in Table 16 are nominal.

Table 16: Comparison of P3TD Expenditures to Phase III EE&C Plan ($1,000)

Program	Phase III Budget from EE&C Plan through PY9	P3TD Actual Expenditures	Ratio (Actual/Plan)
REEP: Residential Energy Efficiency	$9,039	$8,890	0.98
Residential Appliance Recycling	$746	$769	1.03
Residential Behavioral Savings	$1,139	$599	0.53
Residential Whole House Retrofit	$702	$304	0.43
Low-Income Energy Efficiency	$1,408	$1,581	1.12
Express Efficiency	$2,371	$2,655	1.12
Small/Medium Midstream Lighting	$840	$430	0.51
Small Commercial Direct Install	$1,403	$2,613	1.86
Multifamily Housing Retrofit	$1,278	$684	0.54
Commercial Efficiency	$3,198	$2,087	0.65
Large Midstream Lighting	$2,350	$1,051	0.45
Industrial Efficiency	$5,313	$2,644	0.50
Public Agency Partnership	$2,759	$1,920	0.70
Community Education	$662	$720	1.09
Large C&I Demand Response Curtailable	$2,687	$2,288	0.85
Portfolio Total	**$35,895**	**$29,235**	**0.81**

Table 17 compares Phase III verified gross program savings compare to the energy savings projections filed in the EE&C plan.

Table 17: Comparison of Phase III Actual Program Savings to EE&C Plan Projections for Phase III

Program	EE&C Plan Through PY9	VTD Gross MWh Savings	Ratio (Actual/Plan)
REEP: Residential Energy Efficiency	60,413	67,553	1.12
Residential Appliance Recycling	2,645	3,660	1.38
Residential Behavioral Savings	6,037	13,686	2.27
Residential Whole House Retrofit	350	99	0.28
Low-Income Energy Efficiency	3,650	5,113	1.40
Express Efficiency	14,059	17,412	1.24
Small/Medium Midstream Lighting	3,893	3,456	0.89
Small Commercial Direct Install	2,187	9,655	4.42
Multifamily Housing Retrofit	2,228	252	0.11
Commercial Efficiency	20,230	12,144	0.60
Large Midstream Lighting	9,393	3,847	0.41
Industrial Efficiency	33,609	21,118	0.63
Public Agency Partnership	16,370	9,476	0.58
Community Education	1,874	2,541	1.36
Large C&I Demand Response Curtailable	0	0	0.00
Portfolio Total	**176,937**	**170,013**	**0.96**

- Through PY9, Duquesne Light achieved 123 percent of the EE&C Plan energy savings goals specified for the residential programs. Duquesne Light only expended 93 percent of the EE&C Plan residential program budgets through the same term. The Upstream

Lighting component of REEP, the Residential Behavioral Savings (Home Energy Reports) program, and the Home Energy Reports component of LIEEP remain as the primary drivers for these achievements during the phase. WHRP generated limited activities in the market rate segment, but PY9 efforts around WHRP audits focused primarily on the low-income market segment. Additionally, WHRP reported no savings during PY8.

- The non-residential program energy savings achieved by Duquesne Light through PY9 of the phase fell short of the utility's non-residential program savings goal, as reflected in its EE&C Plan. Over PY8 and PY9, Duquesne Light achieved 77 percent of its savings goal and expended 73 percent of the EE&C Plan non-residential program budgets. Programs continued to ramp up in PY9 achieving higher savings than in PY8. The SCDI program has greatly over-achieved planned savings and will no longer be offered. Other programs such as CEP, MFHR, PAPP, IEP and midstream are below targets.
- PY9 was the first year the Large C&I Demand Response Curtailable program reported demand achievements. The program has expended 85 percent of its budget through PY9 of the phase and achieved above the Phase III compliance reduction target by 41% (performance–goal/goal).

2.12 Findings and Recommendations

Duquesne Light's Phase III activities continue to expand as new programs, such as Residential Whole House Retrofit and Large C&I Demand Response Curtailable, report savings for the first time in the Phase. For example, PY9 energy savings achievements were roughly a third greater than PY8. Navigant evaluated all PY9 program activities to some extent, and Table 18 presents overarching findings and one recommendation for consideration during future evaluations.

Table 18: Summary of Evaluation Recommendations

Evaluation Activity	Finding	Recommendation
Residential program engineering desk review impact evaluation	Navigant completed a comprehensive review of the Duquesne Light tracking system, called PMRS, to confirm alignment with the appropriate TRM inputs and sourced assumptions. This activity involved recalculating energy and demand savings for over 65 residential deemed and partially deemed measures found within the PY9 tracking data. For partially deemed measures where project specific details are needed, Navigant checked savings algorithms to confirm that appropriate calculations and TRM assumptions are sourced. Further, Navigant completed these checks on a quarterly basis so that significant deviations from TRM sources could be raised to Duquesne Light in a timely fashion. For the majority of measures no significant issues were identified. Navigant concluded that Duquesne Light's PMRS tracking system is generally using the TRM correctly.	No recommended action related to this finding.

Evaluation Activity	Finding	Recommendation
Process evaluation telephone surveying	Navigant found that telephone survey completion rates ran lower in PY9 than previous years. Completion rates are the ratio of completed surveys to the sample of contacts available for surveying (e.g., a 10 percent completion rate among 100 contacts means that surveys were completed for 10 contacts). Lower telephone survey completion rates may not be unique to Duquesne Light, but a National trend among consumers given the recent increases in telemarketing scams. Consumers are less willing to pick up the phone from unknown numbers.	The evaluation should investigate alternatives to the traditional telephone surveying. This may include completing web-based surveys, sending advanced letters to participants requesting participation in surveys, providing incentives for survey responses and having CSPs encourage customers to respond when they are contacted. If web-based surveys are considered, collecting participant email addresses would be required, and Duquesne Light would need to understand the tradeoff of costs and burdens against the possible benefits. Web-based surveying could either augment or replace telephone surveying. If in the event that telephone surveying is still deemed to be optimal, providing advanced letters, incentives for participation, and having CSPs notify customers that they may be asked to respond is likely to make participants more willing to take calls and provide valuable feedback to Duquesne Light.

Evaluation Activity	Finding	Recommendation
Review of Phase to Date Achievements	The non-residential program energy savings achieved by Duquesne Light through PY9 of the phase fell short of the utility's non-residential program savings goal, as reflected in its EE&C Plan. Over PY8 and PY9, Duquesne Light achieved 77 percent of its savings goal and expended 73 percent of the EE&C Plan non-residential program budgets. Programs continued to ramp up in PY9 achieving higher savings than in PY8. The Small Commercial Direct Install program has greatly over-achieved planned savings and will no longer be offered. Multifamily Housing Retrofit (MFHR) in particular, and the Midstream Lighting program are significantly below targets. The MFHR program, targeting low-income apartment buildings and contributing to the low-income carve-out goal, has significant challenges reaching this hard-to-reach population, including a long sales cycle. Also, the Midstream Lighting programs are still quite new. The Low-Income Energy Efficiency Program (LIEEP) achieved 140 percent of goals through PY9 and Duquesne Light also achieved 35 percent of the Phase III low-income carve-out goal (14 percentage points originated from Phase II carry-over). However, Navigant notes that the low-income component of the Whole House Retrofit Program (WHRP) did not report savings in PY8 and Phase III activities continue to ramp up for the program. Since Phase II, WHRP has expanded into multifamily buildings as a means to support low-income achievements, but similar to MFHR, low-income apartment buildings present a challenge to reach.	The evaluation team is working closely with Duquesne Light to define the planned PY10 Midstream Lighting process evaluation efforts and potential MFHR research efforts in a way that will best support finding opportunities to energize participation in these programs. The evaluation team will also work closely with Duquesne Light to identify opportunities for LIEEP, particularly as WHRP activities continue to expand. Across the portfolio, additional research may be warranted to investigate if initial planning estimates for these programs are no longer achievable. If this is the case, Duquesne Light should consider examining alternate means to reach Phase III targets for the C&I and Low-Income sectors.

Section 3 Evaluation Results by Program

This section documents the gross impact, net impact, and process evaluation activities conducted in PY9 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, were not completed in PY9 for the Residential Appliance Recycling Program (RARP). Instead, Navigant will use PY8 results and apply them to PY9. Also, evaluations conducted this year for PY9 will inform some PY10 updates to NTG ratios and process related research to identify opportunities for program improvements. Generally, when certain types of research are not conducted in a given year, Navigant will use the previous year's results per the approved Phase III Evaluation Plan.

Figure 11: 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	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				****	****									
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 during PY8, 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.
****Net-to-gross and process evaluation research was planned for the SCDI program in PY9. However, this program was targeted to achieve savings and planned budgets for the Phase and is discontinued as of PY10Q1. Since net-to-gross and process research is focused primarily on providing observations and recommendations which feed into program planning this research was not completed for SCDI in PY9.

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 Duquesne Light's Watt Choices brand. Table 19 identifies the measures rebated during PY9.

Table 19: Duquesne Light PY9 Residential Rebated Measures

Measure
ENERGY STAR® Certified Dehumidifier
ENERGY STAR® Certified Freezer
ENERGY STAR® Certified Refrigerator
ENERGY STAR® Certified Room Air Conditioner
Variable Speed Pool Pump
Smart Strip Surge Protector
Central Air Conditioner (>15 SEER)
Heat Pump (>15 SEER, >8.5 HSPF)
Furnace with High Efficiency Fan Motor
Programmable Thermostat
ENERGY STAR® Certified Ductless Mini-Split Heat Pump
ENERGY STAR® Certified Heat Pump Water Heater (EF >2.0)
Solar Water Heater
Ceiling/Floor Insulation
Wall Insulation
Occupancy Sensor (infrared, ultrasonic detector, hard-wired)

Source: Duquesne Light [7]

REEP also provides measures in the form of energy efficiency kits free of charge to Duquesne Light customers who attend targeted community outreach events or who complete self-paced online home energy audits. In PY9, energy efficiency kits contained light emitting diode (LED) bulbs and two LED night lights, and specifically:

- Apogee LED Kit (for those who completed the online home energy audit): reported savings: 410 kWh
    - Four 9W LEDs
    - Two 11W LEDs
    - Two 15W LEDs
    - Two LED night lights
- 4 bulb LED kit (attended targeted community outreach event): reported savings: 180 kWh

[7] Duquesne Light. Watt Choices. Phase III Rebates. https://www.duquesnelight.com/energy-money-savings/watt-choices/residential. Retrieved October 18, 2018.

    - Two 9W LEDs
    - One 11w LED
    - One 15W LED
- Lamp Giveaways (i.e. single lamp kits)
    - One 11W LED (reported savings: 45 kWh)
    - One 9W LED (reported savings: 36 kWh)
    - One LED Night Light (reported savings: 26 kWh)

In addition to the equipment rebate and efficiency kit program components, a third REEP program component—upstream lighting—provides point of purchase discounts on 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 PY9), 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 Kits 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 received 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 20 presents the participation counts, reported energy and demand savings, and incentive payments for REEP in PY9 by customer segment.

Table 20: REEP Participation and Reported Impacts*

Parameter	Residential (Non-LI) REEP	Residential (Non-LI) REEP Upstream Lighting	Residential (Non-LI) Total
PYTD # Participants	17,085	N/A	17,085
PYRTD MWh/yr	7,730	25,298	33,028
PYRTD MW/yr	1.07	2.56	3.63
PY9 Incentives ($1000)**	$1,145		

*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 PY9 gross impact evaluation activities for REEP for the three components – equipment rebates, efficiency kits, and upstream lighting.

For equipment rebates, the PY9 evaluation relied on two data sources in estimating realization rates for energy and demand savings: a participant survey and an application file review. Findings from both efforts were combined to arrive at the PY9 gross impact results. Navigant surveyed 75 randomly selected participants to verify installation of their reported measures, and then requested the associated applications of those 75 participants. These 75 participants had a combined total of 97 equipment rebate measures, with some participants receiving a rebate for more than one measure. Duquesne Light then sent the team copies of the following:

- Completed 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

The application file review carried out by the team relied on the following verification checklist for deemed or partially deemed savings measures:

- Participant has valid utility account number
- Measure(s) is on approved list and all parameters necessary for calculating savings are present
- Rebate payment date is in the current program period being verified
- Proof of purchase identifies qualifying measure and is dated within the period being verified

- 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. When available, Navigant used a TRM deemed or default value to estimate savings.

For the REEP Kits, Navigant completed a census of the individual measures making up each kit against the TRM for accuracy. The team then completed a survey with 46 participants to confirm separate installation rates of both the LEDs and the nightlights. LED installations and savings were considered verified if participants installed and were operating LEDs or if they indicated that they were stored and would be installed within a year. The TRM's in-service rate (ISR) assumptions were also applied to this count of lamps. The combined findings from the TRM measure review and the participant survey inform the gross impact results.

For upstream lighting, the team also completed a multi-pronged approach to verified gross impact results. First the team 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. Additionally, the team recalculated savings for each lamp and built up to a total savings value for upstream lighting. Total savings were calculated by confirming the default baseline wattage, applying the TRM savings algorithm, and confirming the ENERGY STAR® status of the bulb.

The upstream lighting evaluation also relied on in-store intercepts to estimate the proportions of program bulbs (standard and specialty LEDs) going into residential and non-residential sockets. These in-store intercepts also inform the process evaluation activities and additional details on both efforts can be found in the PY9 Residential Process Evaluation Report. The team completed intercept interviews in 12 stores and interviewed 327 individuals; 210 of these individuals purchased program bulbs. The portion of bulbs going into non-residential sockets experience additional hours of use over residential sockets. Per Duquesne Light's EE&C Plan, Navigant reallocated savings from REEP to the C&I program Express Efficiency (Section 3.6). Additional details on the in-store intercepts and reallocation of savings are provided in Appendix A. For example, the previously-described recalculation of savings for each lamp also accounted for different usage characteristics for the portion of lamps being installed in non-residential sockets.

Table 21 shows the achieved sample sizes for the REEP components. The sample shown for the upstream lighting component relates to the in-store intercept efforts. The upstream lighting component does not specify a participant population size as previously described.

Table 22 and Table 23 show the gross energy and demand results for REEP.

Table 21: REEP Gross Impact Sample Design for PY9

Stratum	Population Size*	Achieved Sample Size	Evaluation Activity
Rebates	1,802	75	Participant surveys and engineering desk reviews/application file reviews
Kits	15,513	46	Participant surveys and engineering desk reviews
Upstream Lighting – Standard LEDs	N/A	120	In-store intercepts and census review of PMRS and detailed CSP records
Upstream Lighting – Standard LEDs	N/A	98	In-store intercepts and census review of PMRS and detailed CSP records
Program Total	**17,315**	**339**	

*Counts differ from Table 20 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; intercept survey participants purchasing both standard and specialty LEDs are counted once in each.

Navigant notes that it only achieved 46 kit surveys of the targeted 75. The team initially assumed that all kit recipients were market rate and that all savings should be associated with REEP. However, following the surveying, Duquesne Light clarified for Navigant that a portion of recipients are low-income and a part of a low-income kit effort. Reclassifications of the survey sample and the population into REEP and LIEEP occurred after surveying. A complete breakdown between market rate and low-income for REEP Kits can be found in the PY9 Process Evaluation Report. Additional details on the LIEEP kits can also be found in Section 3.5.

Table 22: 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	604	120%	0.74	12.2%
Kits	7,126	75%	0.42	9.1%
Standard LED	16,488	95%	0.48	6.3%
Specialty LED	8,810	101%	0.32	7.0%
Program Total	**33,028**	**93%**		**4.1%**

Table 23: 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	0.44	106%	0.43	7.2%
Kits	0.63	74%	0.47	10.1%
Standard LED	1.67	95%	0.48	6.3%
Specialty LED	0.89	101%	0.32	7.0%
Program Total	**3.63**	**94%**		**3.8%**

The following factors led to variations between the reported and verified savings and led to the observed realization rates for the REEP components.

- Equipment Rebates
  - Savings adjusted for 17 of the 97 measures examined via the application file review.
  - Navigant found eight instances 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 (Duquesne Light also deployed a similar process for these instances). The review also identified several 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 to research details online to confirm savings for these applications, but the applications themselves were not sufficient to confirm measure eligibility.
  - Navigant observed that for 10 of 29 central AC units and one air source heat pump, 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. In addition, seven central AC units had SEER values that were rounded up or did not match the invoice in the application.
  - Finally, Navigant's random sample drew five ductless mini-split measures, and one air source heat pump. For each case, Navigant found that application details were limited and required online research. The verified savings differed from

reported savings for each case yielding energy realization rates ranging from 68 percent to 421 percent.

- Efficiency Kits
    - From the TRM review, deemed savings per kit changed only slightly, by an increase in savings of about 1 percent per kit.
    - On average, respondents installed or planned to install within a year roughly 6 of the 8 LEDs included in the kits. This is the largest driver of the REEP Kits realization rate.
- Upstream Lighting
    - Navigant's recalculation of savings using the TRM and baseline bulb wattage assumptions adjusted the realization rate to 103 percent for energy and 103 percent for demand. Changes primarily related to Navigant assuming different baseline wattages for some bulbs.
    - Navigant also reviewed bulbs to confirm ENERGY STAR® compliance, and the team made confirmations for all but 21 model numbers representing approximately two percent of energy and two percent of demand savings that were considered not verified.
    - Finally, Navigant reallocated some savings to the C&I Express Efficiency program based on the in-store intercept findings. Savings for those bulbs going into non-residential sockets increased due to longer runtime hour assumptions.
        - For standard LEDs, Navigant found that 22 of 633 bulbs were installed in multifamily common areas.
        - For specialty LEDs, Navigant found that 25 of 599 bulbs were installed in office and lodging buildings.
        - The removal of these bulbs from REEP resulted in a final realization rates of 97 percent and 97 percent for energy and demand, respectively.
        - Additional details are provided in Appendix A.

Additional details can be found in the accompanying Residential Process Evaluation report as most of the impact evaluation activities occurred in concert with process evaluation activities.

3.1.3 Net Impact Evaluation

In order to determine NTG for REEP, Navigant calculated the free ridership and spillover values for the three individual components of the program. For the equipment rebates and efficiency kits, Navigant utilized a phone survey to gain insight into participants behavior and purchasing habits. Question batteries aligned with guidance from the SWE Framework and developed intention and influence scores. Additionally, Navigant quantified free ridership scores separately for the LED lamps and LED nightlights within the kits. The LED lamp findings also inform the high impact (HIM) research Navigant carried out in PY9. Additional details are provided in the Residential Process Evaluation Report.

For upstream lighting NTG research, Navigant utilized an intercept survey conducted at 12 store locations to estimate free ridership among bulb purchasers. The team also conducted a general population survey that estimated free ridership and spillover. The average free ridership of the two survey efforts plus the general population survey's spillover rate are used to estimate the upstream lighting NTG ratio. Navigant also interviewed retailers and manufacturers but did not receive quantitative data to include in the analysis. Additional details are provided in the Residential Process Evaluation Report.

Table 24 shows the REEP net impact sample design for PY9. In addition, Table 25 shows the net impact evaluation results for PY9.

Table 24: REEP Net Impact Sample Design

Stratum	Stratum Boundaries	Population Size*	Achieved Sample Size	Response Rate
Rebates	All measures	1,802	73	6%
Kits	All measures	15,513	40	6%
Standard LED	All measures	N/A	416	N/A
Specialty LED	All measures	N/A	239	N/A
Program Total		**17,315**	**768**	**N/A**

*Counts differ from Table 20 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; intercept survey participants purchasing both standard and specialty LEDs are counted once in each.

Table 25: REEP Net Impact Evaluation Results

Stratum	PYVTD	Free Ridership	Spillover	NTG Ratio	Relative Precision (@ 85% CL)
Rebates	725	0.62	0.08	0.45	7.0%
Kits	5,321	0.33	0.08	0.75	7.8%
Standard LED	15,603	0.66	0.09	0.43	16.2%
Specialty LED	8,919	0.65	0.09	0.43	18.1%
Program Total	**30,568**	**0.60**	**0.08**	**0.49**	**9.1%**

The equipment rebate free ridership rate from the PY9 evaluation was 62 percent. The efficiency kit free ridership rate from the PY9 evaluation was 33 percent. Navigant examined individual kit components and found free ridership rates of 33 percent and 35 percent for LED light bulbs and nightlights, respectively. The overall kit NTG ratio increased from the previous findings in PY7. This is likely attributable to Duquesne Light's change from CFLs to LEDs.

The upstream lighting component free ridership rate for standard LEDs is 66 based on the average of 62 percent from the in-store intercepts and 70 from the general population survey. Paired with the general population survey's s spillover rate of 9 percent, the standard LED NTG ratio is 43. The spillover rate also informs the specialty LED NTG ratio. Combined with the 65 percent in-store intercept free ridership rate and the 66 percent general population survey free ridership rate, the specialty LED NTG ratio is 43 percent. Finally, the team estimates an NTG ratio of 43 percent for the upstream lighting component of REEP in PY9.

High-Impact Measure Research

Navigant analyzed the LED bulbs within REEP Kits as a high-impact measure (HIM), as part of the PY9 study. This HIM research is a subset of the previously described REEP Kits NTG ratio study. REEP Kits survey respondents were specifically asked free ridership questions about the LEDs they received within the kits. The spillover questions were more general and not specifically targeted to the eight LEDs, but rather the participant experience with the kits (that also included two night lights). Navigant initially targeted a sample of 75. However as previously described, the market rate sample reduced after a portion of participants were reassigned to LIEEP (Section 3.5). Thirty-six respondents who verified their use of the LEDs informed the HIM research, and Table 26 shows the results.

Table 26: REEP Net Impact Evaluation Results

HIM	Free Ridership	Spillover	NTG Ratio
LEDs within REEP Kits	0.33	0.08	0.74

3.1.4 Verified Savings Estimates

In Table 27, 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 PY9. These totals are added to the verified savings achieved in previous program years to calculate the P3TD program impacts.

Table 27: REEP PYTD and P3TD Savings Summary

Savings Type	Energy (MWh/yr)	Demand (MW/yr)
PYRTD	33,028	3.63
PYVTD Gross	30,568	3.42
PYVTD Net	14,833	1.63
RTD	69,713	7.48
VTD Gross	67,671	7.31
VTD Net	40,330	4.30

3.1.5 Process Evaluation

The process evaluation for the REEP program in PY9 included the following activities:

- In-depth interviews with the program manager, CSPs, manufacturers, and retailers
- Program tracking data examinations
- TRM savings calculation review
- Application file reviews (REEP Rebates only)
- Participant surveys

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 PY9 Residential Process Evaluation report that accompanies this report. Highlights of the process evaluation are summarized here:

REEP Rebates:

- Duquesne Light is generally applying TRM savings algorithms and assumptions correctly to rebated measures. Navigant 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 analysis as well.
- Customer satisfaction is high with an average score of 8.6, on a 0-10 scale, with 92 percent of respondents giving a score of 6 or higher.
- Navigant performed an in-depth application file review of 75 PY9 participants who purchased 97 rebated measures. Navigant was able to confirm that for the majority of the sample, the reported energy savings were accurate. The impact realization rates mostly reflect changes from the application file reviews for 17 measures.
- Central air conditioner and air source heat pump savings are based on SEER and

capacity ratings. However, capacity values in program tracking databases are generally rounded to whole ton numbers (e.g., 2.5 ton unit is rounded up to a 3 ton unit). This was seen in 10 out of 29 central AC units and one air source heat pump. The use of these rounded numbers is yielding savings estimates that are roughly ten percent higher than if the actual capacity was used.

- 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 small, sometimes leading to problems reading the reported values when they are included in the application.[8] Navigant's random sample drew five ductless mini-split measures and one air source heat pump. For each case, Navigant found that application details were limited, which required online research. This additional research uncovered, on average, savings that were approximately 240 percent higher than what was reported.

REEP Kits:

- Duquesne Light offered PY9 participants kits containing eight LED lamps and two nightlights. Participants on average only install, or will install within one year, six out of the eight LED bulbs found in the kit.
- Customer satisfaction is high with an average score of 9.4, on a 0-10 scale, with 100 percent of respondents giving a score of 6 or higher. Program satisfaction was graded differently in PY9, to align with other Duquesne Light surveying activities. A direct comparison between PY9 and previous program years is not possible. However, satisfaction scores, especially satisfaction scores related to the items that participants received in their kits, was very high.

REEP Upstream Lighting

- The in-store intercept survey found that 3.5 percent of standard LED and 4.2 percent of specialty LED lamps are being installed in non-residential sockets.
- The evaluation team reviewed the lamp-level program details to confirm that Duquesne Light and its Upstream Lighting CSP are reporting savings details correctly and in accordance with the 2016 TRM for each lamp-specific entry. Overall for PY9, Navigant found that data are tracked appropriately. Minor discrepancies resulted in minor adjustments for both energy and demand savings. Most often, these discrepancies could be traced to Navigant using different baseline bulb wattage assignments than those of the CSP or the Energy Star status of a particular bulb could not be verified.
- The Phase III Upstream Lighting program component has shifted entirely to LEDs and away from CFLs in PY9, with 100 percent of discounted bulbs being LEDs.

[8] Duquesne Light HVAC Rebate Application. https://www.rebate-zone.com/wattchoices/pdf/DBK.pdf

3.1.6 Cost-Effectiveness Reporting

A detailed breakdown of program finances and cost-effectiveness is presented in Table 28. TRC benefits in Table 28 were calculated using gross verified impacts. Net present value (NPV) PYTD costs and benefits are expressed in 2017 dollars. Net present value costs and benefits for P3TD financials are discounted back to 2016.

Table 28: Summary of REEP Finances – Gross Verified

Row #	Cost Category	PYTD ($1,000)		P3TD ($1,000)	
1	EDC Incentives to Participants [1]	$1,145		$2,897	
2	EDC Incentives to Trade Allies	$0		$0	
3	Participant Costs (net of incentives/rebates paid by utilities)	$2,711		$5,653	
4	**Incremental Measure Costs (Sum of rows 1 through 3)**	**$3,856**		**$8,551**	
		EDC	**CSP**	**EDC**	**CSP**
5	Design & Development [2]	$0	$0	$4	$71
6	Administration, Management, and Technical Assistance [3]	$155	$153	$191	$356
7	Marketing [4]	$41	$0	$107	$0
8	Program Delivery [5]	$48	$2,545	$45	$4,605
9	EDC Evaluation Costs	$145		$170	
10	SWE Audit Costs	$58		$167	
11	**Program Overhead Costs (Sum of rows 5 through 10)**	**$3,145**		**$5,716**	
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)**	**$7,001**		**$14,267**	
14	Total NPV Lifetime Electric Energy Benefits	$8,302		$19,403	
15	Total NPV Lifetime Electric Capacity Benefits	$2,651		$5,322	

Row #	Cost Category	PYTD ($1,000)	P3TD ($1,000)
16	Total NPV Lifetime Operation and Maintenance (O&M) Benefits	$3,428	$8,612
17	Total NPV Lifetime Non-Electric Benefits (Fossil Fuel, Water)	-$1,404	-$1,314
18	**Total NPV TRC Benefits [7] (Sum of rows 14 through 17)**	**$12,977**	**$32,024**
19	**TRC Benefit-Cost Ratio [8]**	**1.85**	**2.24**

[1] Includes direct install equipment costs and costs for EE&C kit.
[2] Includes direct costs attributable to plan and to advance the programs.
[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.
[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.

Table 25 presents program financials and cost-effectiveness on a net savings basis.

Table 29: Summary of REEP Finances – Net Verified

Row #	Cost Category	PYTD ($1,000)		P3TD ($1,000)	
1	EDC Incentives to Participants [1]	$1,145		$2,897	
2	EDC Incentives to Trade Allies	$0		$0	
3	Participant Costs (net of incentives/rebates paid by utilities)	$726		$2,251	
4	**Incremental Measure Costs (Sum of rows 1 through 3)**	**$1,871**		**$5,148**	
		EDC	**CSP**	**EDC**	**CSP**
5	Design & Development [2]	$0	$0	$4	$71
6	Administration, Management, and Technical Assistance [3]	$155	$153	$191	$356
7	Marketing [4]	$41	$0	$107	$0
8	Program Delivery [5]	$48	$2,545	$45	$4,605
9	EDC Evaluation Costs	$145		$170	

Row #	Cost Category	PYTD ($1,000)	P3TD ($1,000)
10	SWE Audit Costs	$58	$167
11	**Program Overhead Costs (Sum of rows 5 through 10)**	**$3,145**	**$5,716**
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)**	**$5,016**	**$10,864**
14	Total NPV Lifetime Electric Energy Benefits	$4,029	$11,765
15	Total NPV Lifetime Electric Capacity Benefits	$1,286	$3,157
16	Total NPV Lifetime Operation and Maintenance (O&M) Benefits	$1,663	$5,271
17	Total NPV Lifetime Non-Electric Benefits (Fossil Fuel, Water)	-$681	-$637
18	**Total NPV TRC Benefits [7] (Sum of rows 14 through 17)**	**$6,297**	**$19,556**
19	**TRC Benefit-Cost Ratio [8]**	**1.26**	**1.80**

[1] Includes direct install equipment costs and costs for EE&C kit.
[2] Includes direct costs attributable to plan and to advance the programs.
[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.
[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.

3.1.7 Status of Recommendations

The impact and process evaluation activities in PY9 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:

Kit LEDs: Navigant's participant survey found that among both market rate and low-income

respondents an average of roughly six of eight bulbs per kit were either installed or stored for later installation. Additionally, only 59 percent of respondents installed or planned to install all eight LEDs.

Recommendation:

For future kit distributions, consider kits with fewer than eight LED bulbs. For example, Duquesne Light could offer recipients kits with six LEDs. The effort could first be in the form of a pilot to test the installation habits of customers. Participation surveys could then confirm installation and storage rates and whether customers are installing all bulbs within the kit, achieving a realization rate of 100 percent.

Duquesne Light Status Report:

Duquesne Light is unlikely to pursue this so long as kits serve as a marketing instrument in addition to a savings measure.

Finding:

Navigant verified the ENERGY STAR® status of 95 percent of lamps that represent 98 percent of PY9 savings. ENERGY STAR® certification could not be found for the remainder of the lamps when Navigant conducted a look-back to historical ENERGY STAR® compliance databases and associated savings are excluded from Navigant's verified savings. Navigant did not confirm ineligibility, rather, it could not confirm eligibility.

Recommendation:

CLEAResult, the Upstream Lighting CSP, should capture the ENERGY STAR® identification number within lamp-level details that are shared with Navigant quarterly. Look-back analyses to confirm ENERGY STAR® eligibility can be avoided if ENERGY STAR® status is documented at the time of lamp introduction to the program. The ENERGY STAR® identification number will provide sufficient proof of compliance with ENERGY STAR® requirements. Navigant understands that the CSP has processes in place to confirm lamp eligibility at in-take. Going forward, documentation of the details and outcomes (i.e., lamp status confirmation) of that process should be included with other tracking data details.

Duquesne Light Status Report:

Duquesne Light will task the CSP to document confirmation of ENERGY STAR® eligibility as lamps are entered in the program. Navigant can then make requests for those details for the verification.

Finding:

Survey Findings: Navigant identified several other key findings from the in-store intercept and general population survey:

- Awareness and use of LEDs is high and has increased in the past 3 years: Only 5 percent of customers had not heard of LEDs. All customers who had heard of LEDs had at least a few installed (46 percent of surveyed customers had none installed in PY6).

- Energy Savings was the most commonly reported feature which respondents like about LEDs and the most commonly reported reason for purchasing LEDs as compared to other bulb types.
- Many respondents, at the time of surveying, were not aware of the lifetime of an LED bulb, and after being informed by the interviewer, reported that they are more likely to purchase LEDs now that they understand LED lifetimes.
- Understanding of color availability and energy consumption of LEDs has improved since PY6.
- More than half (58%) of customers are aware of at least one Duquesne Light Energy Efficiency Program.
- Customers are generally satisfied with Duquesne Light and with the Energy Efficiency programming that the utility offers.

Recommendation:

Duquesne Light should continue to advertise the benefits of LED lighting and focus communications on their improved lifetime as compared to baseline bulbs. Opportunities to educate customers remain.

Duquesne Light Status Report:

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 PY9 was ARCA.

A participant in RARP is a customer participating within a given reporting year (e.g., Q1 through Q4 for PY9) 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 30 presents the participation counts, reported energy and demand savings, and incentive payments for RARP in PY9 by customer segment.

Table 30: RARP Participation and Reported Impacts

Parameter	Residential (Non-LI)
PYTD # Participants	2,469
PYRTD MWh/yr	2,703
PYRTD MW/yr	0.30
PY9 Incentives ($1000)	$93

3.2.1 Gross Impact Evaluation

During Phase III, Navigant uses the basic level of verification rigor to confirm impacts for RARP. Navigant conducted primary research for the RARP gross impact evaluation during PY8 and limited its activities for the program during PY9. Generally, the PY9 evaluation relied on two data sources in estimating realization rates for energy and demand savings – a census review of CSP program tracking data and survey results from the PY8 evaluation effort.

The program tracking data review consisted of the following steps:

1. Comparison of CSP tracking data to Duquesne Light participant data for consistency
2. Check of equipment specifications within CSP tracking data to confirm measure eligibility (for example, refrigerators and freezers must be 10 years or older and a minimum of 10 cubic feet in size)

The program tracking data review resulted in no changes for the verified gross energy or demand impacts.

During PY8, Navigant completed surveys with a total of 159 participants who recycled 170 appliances. 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 31 shows the evaluation activities for PY9 RARP gross energy and demand. Table 32 and Table 33 show the gross energy and demand results for RARP, respectively.

Table 31: RARP Gross Impact Sample Design for PY9

Stratum	Population Size*	Achieved Sample Size	Evaluation Activity
Refrigerators	2,082	N/A	Apply PY8 findings
Freezers	486	N/A	Apply PY8 findings
Program Total	**2,568**	**N/A**	

*Strata-specific population counts shown here differ from the program population count of Table 30. Participants who recycled both a refrigerator and a freezer are counted once for the program but counted once within each stratum within this table.

Table 32: 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	2,231	92%	0.19	2.4%
Freezers	473	93%	0.11	2.8%
Program Total	**2,703**	**92%**		**2.0%**

Table 33: 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	0.25	92%	0.19	2.4%
Freezers	0.05	92%	0.09	2.4%
Program Total	**0.30**	**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. These factors, from the PY8 evaluation, are also detailed within the PY8 Annual report.

- Navigant uses the actual date of manufacture for given appliances when applying the TRM algorithms to arrive at gross impacts. That is, the savings estimation, as specified by the TRM, is informed by the date of manufacture. Duquesne Light assumed a certain portion of units would be manufactured before 1990. Adjustments for this consideration drove the energy and demand realization rate to a value below 100 percent.
- Realization rates also changed from 100 percent due to adjustments to the number of units recycled. During PY8, three additional units were verified as recycled.

3.2.2 Net Impact Evaluation

Per Navigant's Evaluation Plan, the team relied on PY8 results for the estimates of participant free ridership and spillover. Navigant plans to conduct net-to-gross research in PY11 to update these estimates. Navigant's free ridership and spillover research aligned to the methodologies required by the SWE within the Framework's Appendix B section.[9] Additionally, Navigant

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

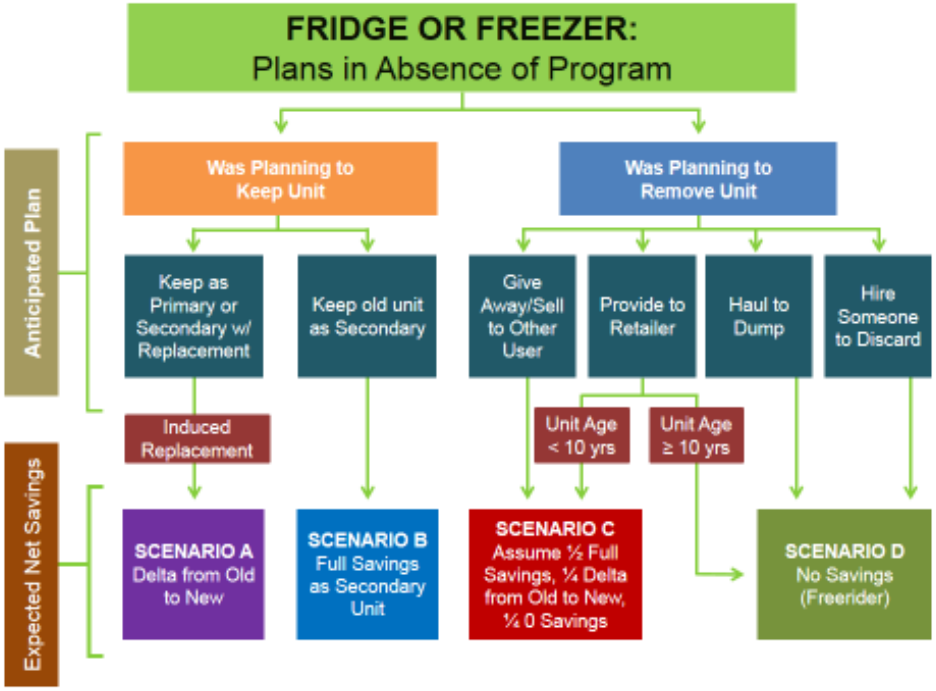
investigated free ridership individually for refrigerators and freezers.

Free Ridership

During PY8, Navigant determined the free ridership for RARP by evaluating participants' responses to 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.
    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 12).

Figure 12: 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 since the TRM does not specify a default value for this variable to include in the TRM's regression equation. The CSP found and reported within its detailed data the year of manufacture from the appliance nameplates.

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 PY8 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, Navigant considered the resulting energy savings as spillover. Navigant applied the SWE methodology from the Framework[10] to PY8 RARP survey responses to determine spillover.

Table 34 clarifies that there is no RARP net impacts sample given that the analysis relies on the PY8 evaluation findings. Table 35 shows the results of the analysis.

Table 34: RARP Net Impact Sample Design

Stratum	Stratum Boundaries	Population Size	Achieved Sample Size	Response Rate
Refrigerators	All Refrigerators	2,082	N/A	N/A
Freezers	All Freezers	486	N/A	N/A
Program Total	All Units	**2,568**	**N/A**	

*Strata-specific population counts shown here differ from the program population count of Table 30. Participants who recycled both a refrigerator and a freezer are counted once for the program but counted once within each stratum within this table.

Table 35: RARP Net Impact Evaluation Results

Stratum	PYVTD	Free Ridership (%)	Spillover (%)	NTG Ratio	Relative Precision (@ 85% CL)
Refrigerators	2,058	0.63	0.07	0.44	15.8%
Freezers	438	0.42	0.01	0.59	8.4%
Program Total	**2,496**	**0.59**	**0.06**	**0.47**	**12.4%**

The RARP NTG ratio is 47 percent. That is informed by the strata-specific results from PY8 and the mix of refrigerators and freezers from PY9. The following provides additional details about the NTG ratio estimates sourced from PY8.

- The RARP free ridership rate from PY8 is 63 percent for refrigerators, 42 percent for freezers, and 59 percent combined for the program when accounting for the PY9 population mix.

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

- 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 identified no high impact measures (HIMs) for RARP in PY9.

3.2.3 Verified Savings Estimates

In Table 36 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 PY9. These totals are added to the verified savings achieved in previous program years to calculate the P3TD program impacts.

Table 36: RARP PYTD and P3TD Savings Summary

Savings Type	Energy (MWh/yr)	Demand (MW/yr)
PYRTD	2,703	0.30
PYVTD Gross	2,496	0.28
PYVTD Net	1,166	0.13
RTD	3,965	0.44
VTD Gross	3,660	0.41
VTD Net	1,709	0.19

3.2.4 Process Evaluation

Navigant conducted a process evaluation for RARP in PY8. Those activities included a participant survey that inform these PY9 evaluation activities. Through discussions with Duquesne Light during PY9, Navigant learned that Duquesne Light and its CSP ARCA continue to implement RARP in a similar fashion to PY8 activities. The PY9 Residential Process Evaluation report that accompanies this report contains additional details about RARP and highlights are summarized here:

Progress Toward Goals. The PY9 RARP exceeded its savings target for PY9, at 142 percent of goal.

Average Age. The average age of all recycled refrigerators within the program for PY9 was 24 years, and the average age of freezers was 26 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 34 percent of refrigerators and 47 percent of freezers were manufactured before 1990.

Average Size. The average size of PY9 recycled refrigerators and freezers was 19 and 15 cubic

feet, respectively.

3.2.5 Cost-Effectiveness Reporting

A detailed breakdown of program finances and cost-effectiveness is presented in Table 37. TRC benefits in Table 37 were calculated using gross verified impacts. Net present value (NPV) PYTD costs and benefits are expressed in 2017 dollars. Net present value costs and benefits for P3TD financials are discounted back to 2016.

Table 37: Summary of RARP Finances – Gross Verified

Row #	Cost Category	PYTD ($1,000)		P3TD ($1,000)	
1	EDC Incentives to Participants [1]	$93		$125	
2	EDC Incentives to Trade Allies	$0		$0	
3	Participant Costs (net of incentives/rebates paid by utilities)	-$93		-$125	
4	**Incremental Measure Costs (Sum of rows 1 through 3)**	**$0**		**$0**	
		EDC	**CSP**	**EDC**	**CSP**
5	Design & Development [2]	$0	$0	$3	$6
6	Administration, Management, and Technical Assistance [3]	$14	$14	$35	$31
7	Marketing [4]	$0	$0	$0	$20
8	Program Delivery [5]	$29	$334	$27	$459
9	EDC Evaluation Costs	$14		$16	
10	SWE Audit Costs	$5		$14	
11	**Program Overhead Costs (Sum of rows 5 through 10)**	**$410**		**$612**	
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)**	**$410**		**$612**	
14	Total NPV Lifetime Electric Energy Benefits	$576		$822	

15	Total NPV Lifetime Electric Capacity Benefits	$173	$243
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)**	**$749**	**$1,065**
19	**TRC Benefit-Cost Ratio [8]**	**1.83**	**1.74**

[1] Includes direct install equipment costs.
[2] Includes direct costs attributable to plan and to advance the programs.
[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.
[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.

Table 38 presents program financials and cost-effectiveness on a net savings basis.

Table 38: Summary of RARP Finances – Net Verified

Row #	Cost Category	PYTD ($1,000)		P3TD ($1,000)	
1	EDC Incentives to Participants [1]	$93		$125	
2	EDC Incentives to Trade Allies	$0		$0	
3	Participant Costs (net of incentives/rebates paid by utilities)	-$93		-$125	
4	**Incremental Measure Costs (Sum of rows 1 through 3)**	$0		$0	
		EDC	**CSP**	**EDC**	**CSP**
5	Design & Development [2]	$0	$0	$3	$6
6	Administration, Management, and Technical Assistance [3]	$14	$14	$35	$31
7	Marketing [4]	$0	$0	$0	$20
8	Program Delivery [5]	$29	$334	$27	$459
9	EDC Evaluation Costs	$14		$16	

Row #	Cost Category	PYTD ($1,000)	P3TD ($1,000)
10	SWE Audit Costs	$5	$14
11	**Program Overhead Costs (Sum of rows 5 through 10)**	$410	$612
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)**	$410	$612
14	Total NPV Lifetime Electric Energy Benefits	$269	$384
15	Total NPV Lifetime Electric Capacity Benefits	$81	$114
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)**	$350	$497
19	**TRC Benefit-Cost Ratio [8]**	**0.85**	**0.81**

[1] Includes direct install equipment costs.
[2] Includes direct costs attributable to plan and to advance the programs.
[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.
[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.

3.2.6 Status of Recommendations

The limited activities around PY9 impact and process evaluations led to the following finding and recommendation from Navigant to Duquesne Light, along with a summary of how Duquesne Light plans to address the recommendation in program delivery.

Finding:

Average Age. 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 PY9 tracking data found that that only 34 percent of refrigerators and 47 percent of freezers were manufactured before 1990.

Recommendation:

Duquesne Light should monitor recycled appliance ages monthly to support planning and forecasting. Monthly tracking can show how equipment ages trend overtime or among different geographies. Readily available information can help Duquesne Light determine if revising its ex ante savings estimates for recycled refrigerators and freezers is appropriate. Alternatively, Duquesne Light could modify its data entry procedure to account for the appliance age for each unit instead of relying on a program level static estimate. Navigant made this same recommendation during PY8. Navigant makes this recommendation again, because the current realization rates for energy and demand savings are 92 percent. An adjustment to the savings estimation method may help Duquesne Light better align reported savings to verified savings.

Duquesne Light Status Report:

Duquesne Light will start monitoring recycled appliance ages on a monthly basis, and Navigant, the utility's evaluator, may be assigned the specific task of compiling and analyzing data. Duquesne Light will decide in the future if changes to reported savings assumptions are warranted once new data are available.

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 stimulates 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 to target high-use residential customers. The current program participation levels include 14,755 customers from the 2012 wave and 43,184 participants from the 2015 wave (based on PY9 monthly averages). Duquesne Light also currently administers the program to 13,150 low-income customers (based on PY9 monthly averages) 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 during the PY8 evaluation as part of a 2016 low-income status rescreening effort conducted by Duquesne Light. These classifications were used to identify any market rate customers that had been reclassified as low-income, and vice versa. For PY9 and after accounting for new program populations (i.e., accounting for move-outs and opt-outs), savings for 2,330 market rate participants were reclassified as low-income. No rescreening has occurred to update reclassifications, and per the PY9 SWE-approved Evaluation Plan, Navigant maintains these reclassifications. The savings from these households, though not included in the low-income wave, contribute to the low-income PY9 savings for LIEEP as shown in Section 3.5. Ultimately with this update and consistent with PY8, 3.5 percent of the 2012 wave savings and 4.2 percent of the 2015 wave savings are reallocated to LI HER savings.

Duquesne Light launched a new low-income HER wave for PY10 starting July 2018. This wave is small with 3,782 participants and 3,778 controls. Navigant completed a randomized control trial (RCT) validation of the wave in September 2018, and the treatment and control groups were found to be randomly allocated. This wave will be evaluated in the PY10 HER evaluation where savings are expected to be low due to a typical 1 to 2-year ramp-up time. Savings will be reported and verified under LIEEP (Section 3.5).

A participant is a customer receiving Home Energy reports during the program year (i.e., PY9). The participant count represents the number of unique participants who received HERs during PY9. The program is an opt-out program in which the CSP, Oracle, enrolls participants in the program based on an 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 39 presents the participation counts, reported energy and demand savings, and incentive payments for HER in PY9. As previously noted, low-income HER participant results are reflected in LIEEP as shown in Section 3.5.

Table 39: HER Participation and Reported Impacts

Parameter	Residential (Non-LI)
PYTD # Participants	55,609
PYRTD MWh/yr	7,376
PYRTD MW/yr	0.84
PY9 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 by adhering to the SWE's guidance described by the Framework.[11] Specifically, the team used a monthly lagged dependent variable (LDV) model, also known as a post-program regression (PPR) model. This 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. The model takes the form shown in Equation 1:

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

Equation 1: LDV Model Specification

$$kWh_{im} = \beta_o + \sum_{m=1}^{12} \beta_{1m} yrmo_m + \sum_{m=1}^{12} \beta_{2m} yrmo_m \cdot kWh_{im-12} + \sum_{m=1}^{12} \beta_{3m} yrmo_m \cdot treatment_{im} + \varepsilon_{im}$$

where

kWh_{im}	is customer *i*'s average daily energy usage in bill *m*.
β_o	is the intercept of the regression equation.
β_{1m}	is the coefficient on the bill year-month *m*.
$yrmo_m$	is the indicator variable equal to one for each year-month in the analysis.
β_{2m}	is the coefficient on the home-specific pre-assignment usage term which is interacted with bill month.
kWh_{im-12}	is customer *i*'s average daily energy usage lagged by 12 months.
β_{3m}	is the estimated treatment effect in kWh per day per customer. This is the main parameter of interest.
$treatment_{im}$	is the treatment indicator variable. Equal to one when the treatment is in effect for the treatment group and zero otherwise.
ε_{im}	is the error term

The LDV model is the preferred model used for reporting savings. As a check on the robustness of the savings estimates, a linear fixed-effects regression (LFER) model was also run. Due to the experimental design of the program, the two models should generate similar results. In the LFER model, average daily consumption by participant and non-participant *i* in billing period *m*, is denoted by kWh_{im}. This is referred to as a fixed-effects model because it includes a household-specific fixed-effects term. Equation 2 formally presents the equation for this model.

Equation 2: Fixed-Effects Regression Model

$$kWh_{im} = \beta_i + \sum_{m=1}^{12} \beta_{1m} yrmo_m + \sum_{m=1}^{12} \beta_{2m} yrmo_m \cdot treatment_{im} + \varepsilon_{im}$$

where

β_i	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.
β_{1m}	is the coefficient on the bill year-month *m.*
β_{2m}	is the estimated treatment effect in kWh per day; the main parameter of interest. Estimated separately for each month and year.

An advantage of the LFER model is that the time-invariant characteristics (observed and unobserved) are excluded from the model through the household fixed-effect term. The drawback of the LFER model is that it is less precise because the household-level fixed effect term relies exclusively on within-customer variation. The explanatory powers of time-invariant characteristics are lost because those terms are eliminated from the model. Navigant found the LFER model corroborated the savings found from the LDV model.

The team deployed specific data management methodologies to handle the preparation of billing data for the regressions. These methodologies are informed, in part, by feedback Navigant received from the SWE during the PY8 evaluations. Monthly billing data was calendarized by expanding the billing periods (which follow variable meter read schedules) to daily data and then collapsing into a common calendar basis. Thus, each month of usage data represents an aggregation of the usage data from the bills that contain data for that month. Estimated reads, which are infrequent for Duquesne Light, were handled by summing the consecutive estimated reads together with the first actual read that followed and dividing that aggregated use across the number of days since the previous actual read. Finally, participants and non-participants that moved out of Duquesne Light territory during PY9 were included in the regression analysis until move-out occurred and monthly billing data ceased. Thus, there is a monotonically decreasing number of participants per month for each cohort.

Navigant calculated participant counts following a standard approach where the last available month of billing data is calculated for each account and the household is assumed to be active for all months prior. This provides a monthly participant count for the program year. To get an overall yearly participant count for PY9, the average of the monthly participant accounts was used.

Table 40 summarizes the sampling strategy for the PY9 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 are utilized in the analysis, as shown in Table 40.

Table 40: HER Gross Impact Sample Design for PY9

Stratum	Population Size	Achieved Sample Size	Evaluation Activity
HER	55,609	55,609	Regression analysis
Program Total	**55,609**	**55,609**	

The verified ex-post energy savings for HER in PY9 were 6,524 MWh, after accounting for double-counted savings with other Duquesne Light energy efficiency programs. Navigant calculated the demand savings by dividing the total energy savings for the year (in MWh) by 8,760 hours. This yields 0.74 MW. A summary of ex-ante HER program energy savings is shown in Table 41. Additional details are also provided in Appendix C.

Table 41: 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	7,376	88%	N/A	0.0%
Program Total	**7,376**	**88%**		**0.0%**

Table 42: 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	0.84	88%	N/A	0.0%
Program Total	**0.84**	**88%**		**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 lower than the CSP's reported estimate
    - Double-counted savings analysis was not completed by the CSP
    - Low-income rescreening transferred 3.5 percent of 2012 wave and 4.2 percent of 2015 wave savings to the low-income HER component

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. Regression details, precisions, and error estimates are provided in Appendix C.

Note that errors are not reflected in Table 41. Instead, Table 41 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 43 conveys that the team did not consider a sample for the net impact analysis per the pervious discussion. Table 44 reflects the net impacts equaling the gross impacts.

Table 43: HER Net Impact Sample Design

Stratum	Stratum Boundaries	Population Size	Achieved Sample Size	Response Rate
HER	N/A	55,609	N/A	N/A
Program Total	**N/A**	**55,609**		**N/A**

Table 44: HER Net Impact Evaluation Results

Target Group or Stratum (if appropriate)	PYVTD	Free Ridership (%)	Spillover (%)	NTG Ratio	Relative Precision (@ 85% CL)
HER	6,524	N/A	N/A	N/A	N/A
Program Total	**6,524**	**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 PY9.

3.3.4 Verified Savings Estimates

In Table 45 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 PY9. These totals are added to the verified savings achieved in previous program years to calculate the P3TD program impacts.

Table 45: HER PYTD and P3TD Savings Summary

Savings Type	Energy (MWh/yr)	Demand (MW/yr)
PYRTD	7,376	0.84
PYVTD Gross	6,524	0.74
PYVTD Net	6,524	0.74
RTD	13,912	1.59
VTD Gross	13,686	1.56
VTD Net	13,686	1.56

3.3.5 Process Evaluation

The HER process evaluation research Navigant conducted during PY9 focused on participant experience with the Home Energy Report, participant satisfaction, and energy awareness. Navigant conducted telephone surveys with a total of 168 HER participants (including 88 low-income participants and 80 market rate participants). A summary of results for both the low-income and market rate participants are presented here while low-income HER energy impact results are reflected in LIEEP and Section 3.5. The PY9 Residential Process Evaluation report contains additional details on the survey findings.

The evaluation did not achieve the targeted number of completes of 120 low-income and 120 market rate participants. The team experienced a high "no contact" rate which contributed to not reaching the target goal of 240 total survey completes. Lower numbers of completed phone surveys among both low-income and market rate participants appeared to be due to overall consumer skepticism of phone solicitation scams. The evaluation team noted study participants were not answering their phones, particularly their home landlines. Survey deposition reports indicated a slightly higher "no contact" rate in PY9 compared to PY7 survey efforts, 16 percent and 14 percent, respectively, and Navigant notes that more call attempts were required during PY9.

The following findings were the key results of the HER process evaluation:

Participant Engagement. Close to 30 percent of all participants noted receiving more than ten reports over the last year and 18 percent recalled thoroughly reading at least three reports, with the number of reports read being slightly higher for market rate participants (21%) than low-income participants (16%). Since PY7, participant awareness of Home Energy Reports has greatly increased in which the majority of PY7 participants could not recall how many reports they had received at that time.

Satisfaction. The majority, 82 percent, of the HER participants are satisfied with their reports. The average satisfaction rating for the Home Energy Report was 8.4 out of a 1 – 10 rating scale.

Program Value. Sixty-two percent of HER participants mentioned that home energy comparisons were the most valuable pieces of information provided to them in their reports. Forty-six percent and 44 percent of low-income and market rate respondents, respectively, said that the comparison of their home's current consumption to previous years was the most valuable information.

Influence on Behavior. The majority of all participants reported taking some action to reduce their energy usage within the past year. Seventy-four percent of market rate participants and 66 percent of low-income participants purchased small energy efficiency equipment, such as efficient light bulbs or power strips. Additionally, 72 percent of low-income participants stated that the Home Energy Reports influenced their actions to reduce energy.

3.3.6. Cost-Effectiveness Reporting

A detailed breakdown of program finances and cost-effectiveness is presented in Table 46. TRC benefits in Table 46 were calculated using gross verified impacts. Net present value (NPV) PYTD costs and benefits are expressed in 2017 dollars. Net present value costs and benefits for P3TD financials are discounted back to 2016.

Table 46: 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]	$0	$0	$3	$9
6	Administration, Management, and Technical Assistance [3]	$22	$21	$45	$46
7	Marketing [4]	$0	$0	$0	$0
8	Program Delivery [5]	$31	$354	$29	$395
9	EDC Evaluation Costs	$20		$23	
10	SWE Audit Costs	$8		$21	
11	**Program Overhead Costs (Sum of rows 5 through 10)**	**$456**		**$570**	
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)**	**$456**		**$570**	
14	Total NPV Lifetime Electric Energy Benefits	$262		$530	
15	Total NPV Lifetime Electric Capacity Benefits	$69		$317	
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)**	**$331**		**$847**	
19	**TRC Benefit-Cost Ratio [8]**	**0.73**		**1.49**	

[1] Includes direct install equipment costs.
[2] Includes direct costs attributable to plan and to 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 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.

Table 47 presents program financials and cost-effectiveness on a net savings basis.

Table 47: 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	**EDC**	**CSP**	**EDC**
5	Design & Development [2]	$0	$0	$0	$0
6	Administration, Management, and Technical Assistance [3]	$22	$21	$22	$21
7	Marketing [4]	$0	$0	$0	$0
8	Program Delivery [5]	$31	$354	$31	$354
9	EDC Evaluation Costs	$20		$23	
10	SWE Audit Costs	$8		$21	
11	**Program Overhead Costs (Sum of rows 5 through 10)**	**$456**		**$570**	
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)**	**$456**		**$570**	

14	Total NPV Lifetime Electric Energy Benefits	$262	$530
15	Total NPV Lifetime Electric Capacity Benefits	$69	$317
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)**	**$331**	**$847**

19	**TRC Benefit-Cost Ratio [8]**	**0.73**	**1.49**

[1] Includes direct install equipment costs.
[2] Includes direct costs attributable to plan and to 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 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.

3.3.6 Status of Recommendations

The impact and process evaluation activities in PY9 led to the following finding and recommendation from Navigant to Duquesne Light, along with a summary of how Duquesne Light plans to address the recommendation in program delivery.

Finding:

Influence on Behavior. The majority of all treatment group participants reported taking some action to reduce their energy usage within the past year, and 74 percent of market rate participants (and 66 percent of low-income participants) purchased small energy efficiency equipment.

Recommendation:

For future Home Energy Reports, consider expanding energy saving tips to include and distinguish short-term, intermediate, and long-term energy efficiency actions encouraging participants towards more energy efficiency improvements. Guidance can distinguish the tips. For example, short-term tips can be simple so that low-cost/no-cost characteristics are conveyed. Long-term tips can balance perceived barriers to adoption (e.g., higher first costs) with multi-year energy consumption benefits and increased home comfort or reduced maintenance.

Duquesne Light Status Report:

Duquesne Light reviews tips annually and seasonally for update opportunities. Over the course of PY10, Duquesne Light will explore the feasibility of incorporating such differentiated tips within the CSP's existing program outreach materials.

3.4 Residential Whole House Retrofit Program

The Residential Whole House Retrofit Program (WHRP) provides resources to residential customers to obtain a residential home energy audit and rebates for the range of eligible measures similar to those included in the REEP Rebates program. The program services offered are generally the same for low-income customers and for market rate (non-low-income) customers. Qualifying low-income customers are eligible to receive an onsite audit and the direct installation of select measures at no charge to the customer. Market rate customers can receive the same audit and direct installation of measures for a fee of $435, with the possibility of receiving up to $250 in rebates for installing recommended measures. Low-income customers are also eligible to receive other major measures, installed at no cost if appropriate, beyond the simpler direct installation measures. These can include replacement refrigerators, for example.

Customers with gas space and water heating receive a “walkthrough” audit, as where customers who have electric space and water heating are eligible to receive a “comprehensive” audit. Duquesne Light is also teaming up with the gas utility within its service territory to serve some customers supplied by both organizations. Similar audits are conducted, and costs are shared by both utilities.

WHRP first launched in Phase II, with the addition of multifamily (MF) buildings included in Phase III. Customers living in MF building dwellings that are individually metered are eligible to participate in the WHRP program (i.e., MF-WHRP). Otherwise, master-metered buildings are referred to the non-residential Multifamily Housing Retrofit (MFHR) program. Some MF-WHRP audits are initiated by customers, but many are initiated by landlords who may also be engaging MFHR. If it is determined that individual dwellings in the building are individually-metered, Duquesne Light transfers those customers to WHRP, for example. For these instances where activities are initiated by landlords and not individual participants, income status is not determined on an individual customer basis. Rather, Duquesne Light obtains records that describe the total portion of the building that is low-income. Savings for all audits completed within the building are then allocated to market rate WHRP and the low-income WHRP component within LIEEP (Section 3.5 of this report). Navigant notes that the MFHR program (Section 3.9 of this report) uses a similar approach to estimate the portion of savings that contribute to the Phase III low-income carve-out goal. Further, given that individual income status is not determined for these instances, no MF-WHRP participant is charged for an audit as a market rate participant. Rather, all participants within the building are treated similarly and receive the audit at no charge from Duquesne Light. However, Navigant notes a significant exception to this approach that relates to the replacement refrigerators implemented through WHRP during PY9: Only participants verified as low-income received replacement refrigerators. No market rate participants received refrigerators. All verified savings associated with refrigerators are assigned to LIEEP and the Phase III low-income carve-out goal.

Given the nature of overlapping WHRP activities across the market rate and low-income segments, descriptions of program implementation activities, evaluation activities, and verification results and findings are generally combined within this report for the market rate

WHRP and the low-income WHRP component within LIEEP. Verified savings are then split between the market rate and low-income programs using the previously-described considerations. The majority of WHRP activities relate to the low-income segment. Navigant notes that reported market rate activities only originate from those MF buildings where a minority of dwelling occupants are not low-income.

Finally, a participant is a customer participating in the program (i.e., receiving an audit) within a given reporting year (e.g., Q1 through Q4 for PY9), represented by a unique participant account number within tracking data. Duquesne Light's tracking data system, PMRS, aggregates WHRP activities and does not track individual audits. Instead, CSP detailed records capture individual audit and direct install activities. These CSP details, after being vetted against PMRS, served as the primary data source for Navigant's evaluation activities.

3.4.1 Participation and Reported Savings by Customer Segment

Table 48 presents the participant counts, reported energy and demand savings, and incentive payments for WHRP in PY9.

Table 48: WHRP Participation and Reported Impacts

Parameter	Residential (Non-LI) WHRP
PYTD # Participants	274
PYRTD MWh/yr	118
PYRTD MW/yr	0.01
PY9 Incentives ($1000)	$0

3.4.2 Gross Impact Evaluation

Navigant conducted gross impact evaluation activities for WHRP in PY9, which was the first time evaluations were carried out for the program during Phase III. The PY9 evaluation relied on a participant survey to verify that the direct installed measures were implemented and that audits occurred for the customers. The survey also gathered information to support process evaluation activities. In addition to surveying, Navigant conducted an engineering desk review of activities and savings for each measure that was directly installed through WHRP. The team completed a savings review against the TRM and the CSP's detailed tracking data that described the measures installed for each participant during their audit. WHRP relies on TRM defaults, where available, to estimate reported savings per measure. Navigant also relied on the TRM defaults and the count of measures installed, as verified. Finally, the engineering desk

review also vetted the allocations of savings to the market rate WHRP and low-income WHRP component within LIEEP.

Table 49 shows the achieved sample size for the market rate WHRP activities. Reported savings for market rate activities only originated from MF-WHRP activities that also included low-income activities. Therefore, the stratum in Table 49 is the same as the LI MF-WHRP stratum in Table 56 that describes LIEEP gross impact sample design. Navigant notes that while the survey verification results are the same across both market rate and low-income participants, the final realization rates for the market rate and low-income participants differ slightly after Navigant reassigned a portion of savings from low-income to market rate (as noted by a comparison of Table 50 and Table 57).

Table 49: WHRP Gross Impact Sample Design for PY9

Stratum	Population Size*	Achieved Sample Size	Evaluation Activity
WHRP	274	25	Participant surveys and engineering desk reviews
Program Total	**274**	25	

*Market rate WHRP population is 274, but the survey population size is 605 after considering the portion of low-income participants that are included in the stratum.

Navigant was not able to achieve its target sample for the stratum. These participants do not enroll themselves in the program but are typically enrolled by their multifamily landlord/building manager. In other words, these participants typically did not initiate or actively pursue the program themselves. As a result, Navigant had difficulty reaching these individuals and convincing them to participate in a telephone survey. Navigant's sample design over-sampled to gain additional insights from participants to support process evaluation research. While the sample target of 75 was not achieved, Navigant did achieve a relative precision below 15 percent for impacts.

Table 50 and Table 51 show the gross energy and demand results for WHPR.

Table 50: WHRP Gross Impact Results for Energy

Stratum	PYRTD MWh/yr	Energy Realization Rate	Sample C_v or Error Ratio	Relative Precision at 85% C.L.
WHRP	118	84%	0.07	2.1%
Program Total	**118**	**84%**		**2.1%**

Table 51: WHRP Gross Impact Results for Demand

Stratum	PYRTD MW/yr	Demand Realization Rate	Sample C_v or Error Ratio	Relative Precision at 85% C.L.
WHRP	0.01	84%	0.14	2.4%
Program Total	**0.01**	**84%**		**2.4%**

The following factors led to the variations between the reported and verified savings, which led to the observed realization rates for WHRP.

Navigant surveyed respondents and found that direct install measures were implemented as reported in most cases. The team found several instances where participants remove/replaced measures or where counts of measures differed from the reported counts (e.g., for LED lights, night lights, or smart strip measures).

Realization rates also reflect adjustments after Navigant reviewed deemed measure savings assumptions against the TRM. The biggest driver for the realization rate change related to adjustments to refrigerator replacement savings (details are included in the LIEEP program results, Section 3.5.2, as this mainly relates to low-income participants). Navigant also previously noted that only low-income participants received refrigerators. However, this specific detail was only determined by Navigant after surveying completed. The team opted against post-stratification to segment refrigerator verification influences from market rate participants given the small sample and the relatively small impact on the program and overall portfolio.

Finally, Navigant reassigned a portion of savings from low-income to market rate. Specifically, Navigant identified nine participants originally reported as low-income but who were also designated as “fee-for-service” within CSP tracking details. This indicates that the participants are market rate and paid for their audits. These reported savings occurred outside of the Table 49 stratum but Navigant grouped savings within that stratum to consolidate reporting. That is, these nine participants were not part of a landlord-initiated MF audit but initiated their own audits.

3.4.3 Net Impact Evaluation

For PY9, Navigant did not complete a net-to-gross assessment for the market rate or low-income portions of WHRP. Low-income participants are assumed to exhibit no free ridership or spillover tendencies and receive a NTG ratio of 1.0. Market rate participants are also not readily identified, so Navigant used a building level split to apportion MF-WHRP audit activities between market rate and low-income. This revealed that the majority of WHRP activities occurred within the low-income market segment.

3.4.4 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 WHRP in PY9. These totals are added to the verified savings achieved in previous program years to calculate the P3TD program impacts.

Table 52: WHRP PYTD and P3TD Savings Summary

Savings Type	Energy (MWh/yr)	Demand (MW/yr)
PYRTD	118	0.01
PYVTD Gross	99	0.01
PYVTD Net	99	0.01
RTD	118	0.01
VTD Gross	99	0.01
VTD Net	99	0.01

3.4.5 Process Evaluation

The WHRP process evaluation was intended to take place in PY8, but due to a lack of participation, PY9 will be the first year that a process evaluation has taken place.

Navigant spoke with the program manager to gain a greater understanding of the program and note any key changes from previous program years. For example, the cost to market rate customer has changed, but stayed the same for low-income. Process evaluation activities occurred in tandem for market rate and low-income participants.

Cost to participant. Qualifying low-income customers are eligible to receive an onsite audit and the direct installation of select measures at no charge to the customer. Market rate customers can receive the same audit and direct installation of measures for a fee of $435. However, market rate customers are only eligible to receive up to $250 in rebates if they install any measures recommended during the onsite audit. This is different from Phase II, in that market rate customers were automatically given a rebate of $250 to buy down the upfront cost of the audit and were not required to install recommended measures to receive the rebate. This change to costs is likely causing the limited market rate participation to-date in Phase III.

Satisfaction. Satisfaction with WHRP, and the associated experiences with the different processes of the program, was high in PY9. Participants gave an average score for “overall experience” with WHRP, on a scale from 0-10, of 9.2.

Additional details on the WHRP process evaluation can be found in the PY9 Residential Process Evaluation report.

3.4.6 Cost-Effectiveness Reporting

A detailed breakdown of program finances and cost-effectiveness is presented in Table 53. Net present value (NPV) PYTD costs and benefits are expressed in 2017 dollars. Net present value costs and benefits for P3TD financials are discounted back to 2016.

Table 53: 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]	$0	$0	$3	$5
6	Administration, Management, and Technical Assistance [3]	$13	$13	$37	$28
7	Marketing [4]	$0	$0	$0	$0
8	Program Delivery [5]	$31	$162	$35	$153
9	EDC Evaluation Costs	$12		$14	
10	SWE Audit Costs	$5		$14	
11	**Program Overhead Costs (Sum of rows 5 through 10)**	**$236**		**$289**	
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)**	**$236**		**$289**	
14	Total NPV Lifetime Electric Energy Benefits	$26		$24	
15	Total NPV Lifetime Electric Capacity Benefits	$8		$7	

16	Total NPV Lifetime Operation and Maintenance (O&M) Benefits	$17	$16
17	Total NPV Lifetime Non-Electric Benefits (Fossil Fuel, Water)	$4	$4
18	**Total NPV TRC Benefits [7] (Sum of rows 14 through 17)**	**$55**	**$51**
19	**TRC Benefit-Cost Ratio [8]**	**0.23**	**0.18**

[1] Includes direct install equipment costs.
[2] Includes direct costs attributable to plan and to advance the programs.
[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.
[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.

Table 54 presents program financials and cost-effectiveness on a net savings basis.

Table 54: 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	**EDC**	**CSP**	**EDC**
5	Design & Development [2]	$0	$0	$0	$0
6	Administration, Management, and Technical Assistance [3]	$13	$13	$13	$13
7	Marketing [4]	$0	$0	$0	$0
8	Program Delivery [5]	$31	$162	$31	$162
9	EDC Evaluation Costs	$12		$14	
10	SWE Audit Costs	$5		$14	

11	**Program Overhead Costs (Sum of rows 5 through 10)**	**$236**	**$289**
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)**	**$236**	**$289**
14	Total NPV Lifetime Electric Energy Benefits	$26	$24
15	Total NPV Lifetime Electric Capacity Benefits	$8	$7
16	Total NPV Lifetime Operation and Maintenance (O&M) Benefits	$17	$16
17	Total NPV Lifetime Non-Electric Benefits (Fossil Fuel, Water)	$4	$4
18	**Total NPV TRC Benefits [7] (Sum of rows 14 through 17)**	**$55**	**$51**
19	**TRC Benefit-Cost Ratio [8]**	**0.23**	**0.18**

[1] Includes direct install equipment costs.
[2] Includes direct costs attributable to plan and to advance the programs.
[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.
[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.

3.4.7 Status Recommendations

The impact and process evaluation activities in PY9 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:

Program Tracking Data: Duquesne Light and the CSP track direct install measure details for each audit completed, and Navigant reviewed savings assumptions, algorithms, and reported installations. Navigant notes that program activities are not recorded at the audit or participant level within Duquesne Light's tracking database, PMRS. Instead, installation activities are

combined, by measure type, at the invoice level. This differs from Phase II activities where PMRS reported each audit as a unique project and individual participants were readily identified.

Recommendation:

Duquesne Light should record WHRP activities within its tracking database, PMRS, at the audit level. These additional details would increase the transparency around program activities and expedite actions related to Act 129 compliance. Audit level details would also aid quality control and the confirmation of accurate savings recording because the data and measurement management systems of PMRS would be leveraged. Using PMRS could be particularly useful as program activities increase during Phase III and the volume of audits increase. Alternatively, audit level measure details could be included for single family audit participants and other customers who self-enroll. WHRP activities completed in multifamily buildings could be handled similar to the Multifamily Housing Retrofits (MFHR) program where whole building savings are entered into PMRS as single projects. Additionally, reporting could be further simplified by reporting all savings, similar to MFHR, to the single program, WHRP. Navigant could then allocate a portion of savings to LIEEP and the low-income carve-out based on the building level splits currently used to allocate market rate and low-income savings. Allocations for expenditures would also need to be considered.

Duquesne Light Status Report:

Duquesne Light will explore this feasibility with its CSP, but likely focus on increase participation instead.

Finding:

Direct install LED lighting contributes the majority of program savings. The CSP's onsite auditors remove baseline lamps from the participant's home and replace them with LEDs. The LED details are captured within tracking data (i.e., 9, 11, or 15 watt), but the baseline details are not. Instead, the program's reported savings rely on the TRM's deemed baseline for the given LED. However, the TRM allows direct install programs to use the actual bulbs replaced as the baseline.

Recommendations:

Duquesne Light should consider capturing the baseline information and using that to calculate energy savings associated with LEDs. It is possible that participants' existing lamps have wattages exceeding the TRM's assumptions. Duquesne Light would need to first understand the tradeoffs between potentially more savings and increased data collection requirements. This could be initially tested with a sample of audits or projects to understand the disposition of baselines before committing a program-level change to data collection.

Duquesne Light Status Report:

Testing with a sample may be possible and can be explored during PY10.

Finding:

The CSP's detailed program tracking data that Duquesne Light uses to report savings and Navigant uses to estimated verified savings excludes participant telephone numbers. Participant

name, address, and account number are recorded.

Recommendations:

Duquesne Light should have its CSP record telephone numbers within the detailed program tracking data to aid Duquesne Light's own customer feedback research as well as evaluation activities that typically rely on telephone surveys. Duquesne Light might also consider capturing email addresses if such a request to participants is considered reasonable.

Duquesne Light Status Report:

Duquesne Light will explore this feasibility with its CSP.

Finding:

Program Overlap. Of the 95 WHRP participants who were surveyed, 38 indicated that they participated in the REEP Kits program component in addition to the WHRP program. Participants can receive LEDs through the WHRP program, and therefore could either be receiving additional LEDs through the kits that may not be used, or the WHRP auditor may not be able to find sockets available for lighting retrofits because they already have LEDs from the kits installed. Although, the Duquesne Light clarified that the kits offer a cross-marketing opportunity and provide a gateway that can lead participants to a WHRP audit.

Recommendation:

As part of Duquesne Light's WHRP onboarding activities, the screening process should determine if customers have already participated in other programs which offer similar measures. Navigant can continue to monitor for this overlap during Phase III.

Duquesne Light Status Report:

No screening planned, and Duquesne Light views this as cross-marketing activities.

Finding:

Navigant found that the EDC Direct Install Refrigerator/Freezer Recycling with Replacement Interim Measure Protocol's (IMP's)[12] algorithm deemed values were not applied nor were the EDC Data Gathered refrigerator specifications for the units recycled through WHRP in PY9. Instead, values from past RARP activities (October 2016 through September 2017) were used.

Recommendations:

In the absence of current EDC Data Gathering, Navigant recommends that the same reported savings used for RARP in PY9 to be used in the IMP's algorithm (e.g., used estimated savings of 1,037.5 kWh per recycled refrigerator). For the verified savings, Navigant used a verified recycled refrigerator savings value of 952.7 kWh per recycled refrigerator, consistent with RARP verified savings. Also, Duquesne Light should capture recycled equipment specifications, as collected in RARP, so that refrigerator ages can be tracked monthly.

Duquesne Light Status Report:

[12] Interim Measure Protocols from PA PUC Evaluation Common Site. https://nmrgroupinc.sharepoint.com

Duquesne Light will explore the feasibility of this data tracking with its CSP.

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 percent of federal poverty income guidelines) in the following program components, as noted in Duquesne Light's EE&C Plan:

- Whole House Retrofit program (LI WHRP)
- Residential Behavioral Savings program (LI HER)
- Multifamily Housing Retrofits program (MFHR)

These market rate counterpart programs are described in other program-specific sections of this report. The programs are additionally offered to low-income customers and referred to as components of the overall LIEEP program.

Participation and reporting of achievements for the Whole House Retrofit program (WHRP) occurred for the first time of the Phase during PY9. Most program activities occurred among low-income participants, and those activities and related evaluation findings are described in Section 3.4.

Beyond the previously-described components, Duquesne Light provides low-income customers with energy efficiency kits at no charge. 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. Navigant initially attributed all kit activities to REEP and this is reflected in the PY9 Preliminary Final Report. Duquesne Light later clarified that a portion of the kits are specifically targeted to low-income participants through the utility's outreach efforts. Therefore, Navigant updated the reported savings within this document to show 3,722 PY9 kits, identified at the participant level, contributing to LIEEP achievements instead of REEP.

Duquesne Light also engaged low-income utility customers through a number low-income-specific community events where it handed out other energy efficiency measures such as kits and LED lamps. 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 measures.

For the 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 (MFHR) program also contributes to the low-income carve-out goal. Specifically, 95 percent[13] 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 PY9 program savings are reflected in the MFHR program section of this report, section 3.9, and not here in the LIEEP section.

[13] Three MFHR projects were completed during PY9. Within two buildings, 100 percent of occupants were low-income; 88 percent of occupants in the third building were low-income. The 95 percent reflects a verified savings-weighted average.

LI HER participation is defined as a customer under the low-income rate class and receiving Home Energy reports during the program year. A total of 13,150 participants were originally included in the low-income wave. However, as discussed in Section 3.3, Navigant identified 2,330 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 PY9 savings for LIEEP. Therefore, the final participant counts for LI HER for PY9 is 15,480 (based on PY9 monthly averages).

For the LI WHRP during PY9, participants are counted the same as the market rate WHRP, by counting each individual participant or audit. Additionally, given that WHRP audits also occur in multifamily buildings where a mix of market rate and low-income audits occur, the income status of individual participants is not known. Navigant used the building-level proportion of low-income tenants to split the total count of participants between the market rate and low-income programs.

For LI Kits, a participant is a customer participating in the program within a given reporting year (e.g., Q1 through Q4 for PY9), represented by a unique participant account number within the tracking system. This is the same as the REEP Kits counting method.

Participation is not counted for other low-income giveaway activities at community events. Instead, Duquesne Light tracks events and the measures given away and not the individual participants who receive them.

3.5.1 Participation and Reported Savings by Customer Segment

Table 55 presents the participation counts, reported energy and demand savings, and incentive payments for LIEEP in PY9 by customer segment. Given the previously-described approach to counting participants, the counts in Table 55 relate to LI HER, LI WHRP, and LI Kits only.

Table 55: LIEEP Participation and Reported Impacts

Parameter	Residential LI Kits	Residential LI WHRP	Residential LI HER	Residential LI Total
PYTD # Participants	4,058	1,311	15,480	20,849
PYRTD MWh/yr	1,828	1,131	1,288	4,246
PYRTD MW/yr	0.15	0.12	0.15	0.43
PY9 Incentives ($1000)	$0	$0	$0	$0

3.5.2 Gross Impact Evaluation

Gross impact evaluations occurred for the LI HER, LI WHRP, and LI Kit components of LIEEP

during PY9. Navigant completed LI HER activities in coordination with the HER market rate counterpart, and applied the same methodologies as detailed in Section 3.3. Similarly, LI WHRP evaluations occurred in coordination with the market rate WHRP activities, as described in Section 3.4. The majority of audit activities occurred among low-income participants, and the split of savings across the market rate and low-income segments is primarily related to the previously-described multi-family building proportional splits. The verification results for the LI Kits relied on the same participant surveying used for REEP Kits and described in Section 3.1, and Navigant estimated a separate realization rate for LI Kits from REEP Kits. This realization rate is also applied to the remaining measures associated with giveaways at community events.

Table 56 shows the LIEEP sample design for PY9. LIEEP components are not stratified except for LI WHRP. LI WHRP (and the market rate component, WHRP) audits are offered through two efforts: audits originating from customers enrolling in the program (WHRP), and audits originating from landlords/building managers of multifamily buildings (MF-WHRP). Navigant stratified by these activities and surveyed participants separately. Additional LI WHRP activities occurred within multifamily buildings that were not included in sampling, where Duquesne Light and its CSPs engaged more closely with landlords/building managers of multifamily buildings. Navigant could not identify the tenants of these individually metered dwellings within tracking data and applied the MF-WHRP verification results to this stratum.

Table 57 and Table 58 show the energy and demand gross impact results for LIEEP, respectively.

Table 56: LIEEP Gross Impact Sample Design for PY9

Stratum	Population Size	Achieved Sample Size	Evaluation Activity
LI Kits	4,058	29	Participant surveys and engineering desk reviews
LI HER	15,480	15,480	Regression analysis
LI WHRP	978	70	Participant surveys and engineering desk reviews
LI MF-WHRP	331*	25	Participant surveys and engineering desk reviews
LI WHRP Other	2	0	None
Program Total	**20,849**	**15,604**	

*Low-income WHRP population is 331, but the survey population size is 605 after considering the portion of market rate participants that are included in the stratum.

Navigant was not able to achieve its target sample for the LI MF-WHRP stratum. These participants do not initiate program participation but are typically enrolled by their multifamily

landlord/building manager. As a result, Navigant had difficulty reaching these individuals and convincing them to participate in a telephone survey. Navigant's sample design over-sampled to gain additional insights from participants to support process evaluation research. Navigant did not achieve the sample target of 75 but did achieve a relative precision below 15 percent for impacts.

The verified ex-post energy savings for LI HER in PY9 were 1,531 MWh after adjusting for double-counted savings with other Duquesne Light energy efficiency programs. LI HER demand savings are calculated by dividing the energy savings by 8,760 hours. This is consistent with PY8 and guidance from the Framework. LI HER demand savings were 0.17 MW.

For the remaining strata, the verified ex-post energy savings reflect adjustments based on a review of savings estimates against TRM algorithms and assumptions as well as verification of installations for the participants who were surveyed.

Navigant did not sample the LI WHRP Other stratum. A relative precision of 100 percent is conservatively assumed for the statistical analysis.

Table 57: 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	1,828	73%	0.40	10.9%
LI HER	1,288	119%	N/A	N/A
LI WHRP	672	80%	0.40	6.9%
LI MF-WHRP	414	82%	0.07	2.1%
LI WHRP Other	45	82%	N/A	100%
Program Total	**4,246**	**89%**		**6.8%**

Table 58: 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	0.15	73%	0.47	12.9%
LI HER	0.15	119%	N/A	N/A
LI WHRP	0.07	80%	0.24	7.2%
LI MF-WHRP	0.05	82%	0.08	2.4%
LI WHRP Other	0.01	82%	N/A	100%
Program Total	**0.43**	**91%**		**7.2%**

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

The energy realization rate for LI HER is 119 percent. Navigant found that energy savings per participant home were verified at slightly lower than the CSP's reported estimate. Before re-balancing low-income individuals from the market rate HER wave (see Section 3.3), the realization rate was 98 percent. Reallocating a portion of savings (272 MWh) from the market rate HER wave to the low-income HER wave increased the realization rate above 100 percent.

The realization rates for LI Kits primarily reflects the fact that participants are not installing all eight LEDs or all two LED nightlights provided within the kits within a year of receiving them. Navigant found that, on average, that respondents installed or plan to install within a year roughly six of the eight LED lights provided. This reflects the verified installation rate and the driver for the 74 percent energy and 72 percent demand realization rates.

The realization rates for the WHRP strata are in alignment and suggest that there are generally no differences in verification across the implementation efforts. Navigant surveyed respondents and found that direct install measures were implemented as reported in most cases. The team found several instances where participants remove/replaced measures (17 LED lights, night lights, or smart strip measures) or where counts of measures differed from the reported counts (5 LED lights, night lights, smart strip, faucet aerators, or low flow showerhead measures). Realization rates also reflect adjustments after Navigant reviewed deemed measure savings assumptions against the TRM and the EDC Direct Install Refrigerator/Freezer Recycling with Replacement Interim Measure Protocol's (IMP's)[14] algorithm. Navigant found that for these refrigerators, deemed values were not applied nor were the EDC Data Gathered refrigerator specifications for the units recycled through WHRP in PY9. Instead, Navigant used values from past RARP activities (October 2016 through September 2017). For the verified savings,

[14] Interim Measure Protocols from PA PUC Evaluation Common Site. https://nmrgroupinc.sharepoint.com

Navigant used a verified recycled refrigerator savings value of 952.7 kWh per recycled refrigerator, consistent with RARP verified savings from PY9. Specifications for refrigerators recycled through WHRP were not available for the evaluation.[15] This adjustment to recycled and replaced refrigerators is the primary drive for the realization rate being below 100 percent.

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. Regression details, precisions, and error estimates are provided in Appendix C.

Note that errors are not reflected in Table 57. Instead, Table 57 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.

3.5.3 Net Impact Evaluation

Navigant assumes that no free ridership or spillover activity occurred among the low-income participants of LIEEP in PY9. This assumption is consistent with SWE guidance. Additionally, LI HER gross impacts equal net impacts given the nature of the RCT approach (see Section 3.3 for a detailed explanation). Table 59 conveys that no net impact sampling occurred for PY9. Table 60 shows the resulting net-to-gross (NTG) ratios and conveys that gross impacts equal net impacts or that the NTG ratio is assumed to equal 1.00.

[15] Recycled refrigerator savings estimates rely on the TRM's deemed values. The TRM's algorithm also calls for the portion of recycled refrigerators manufactured before 1990. This value is not deemed but needs to be sourced from program data. In the absence of WHRP-specific data and for consistency, Navigant relied on the PY8 RARP verified recycled refrigerator savings that account for the year of manufacture. This same value also informs the PY9 RARP recycled refrigerator savings estimate.

Table 59: LIEEP Net Impact Sample Design

Stratum	Stratum Boundaries	Population Size	Achieved Sample Size	Response Rate
LI Kits	All measures	4,058	N/A	N/A
LI HER	All measures	15,480	N/A	N/A
LI WHRP	Participant initiated audits	978	N/A	N/A
LI MF-WHRP	Landlord initiated audits	331	N/A	N/A
LI WHRP Other	Other WHRP activities	2	N/A	N/A
Program Total	**All measures**	**20,849**	**N/A**	**N/A**

Table 60: LIEEP Net Impact Evaluation Results

Stratum	PYVTD	Free Ridership (%)	Spillover (%)	NTG Ratio	Relative Precision (@ 85% CL)
LI Kits	1,343	N/A	N/A	1.00	N/A
LI HER	1,531	N/A	N/A	1.00	N/A
LI WHRP	536	N/A	N/A	1.00	N/A
LI MF-WHRP	340	N/A	N/A	1.00	N/A
LI WHRP Other	37	N/A	N/A	1.00	N/A
Program Total	**3,787**	**N/A**	**N/A**	**1.00**	**N/A**

High-Impact Measure Research

Navigant identified no high impact measures (HIMs) for LIEEP in PY9.

3.5.4 Verified Savings Estimates

In Table 61 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 PY9. These totals are added to the verified savings achieved in previous program years to calculate the P3TD program impacts.

Table 61: LIEEP PYTD and P3TD Savings Summary

Savings Type	Energy (MWh/yr)	Demand (MW/yr)
PYRTD	4,246	0.43
PYVTD Gross	3,787	0.39
PYVTD Net	3,787	0.39
RTD	5,378	0.55
VTD Gross	4,995	0.52
VTD Net	4,951	0.52

3.5.5 Process Evaluation

Navigant conducted process evaluation research for all LIEEP components during PY9. The team completed participant surveys for LI HER, LI Kits, and LI WHRP strata in addition to interviews with key program personnel and reviews of program tracking database structures. Process evaluation activities occurred in tandem with the market rate counterpart programs. Details on activities and findings can be found in the related program-specific sections of this report, and further information is provided in the PY9 Residential Process Evaluation Report.

3.5.6 Cost-Effectiveness Reporting

A detailed breakdown of program finances and cost-effectiveness is presented in Table 62. TRC benefits in Table 62 were calculated using gross verified impacts. Net present value (NPV) PYTD costs and benefits are expressed in 2017 dollars. Net present value costs and benefits for P3TD financials are discounted back to 2016.

Table 62: 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]	$0	$0	$6	$27
6	Administration, Management, and Technical Assistance [3]	$66	$65	$89	$144

7	Marketing [4]	$6	$0	$6	$0
8	Program Delivery [5]	$32	$981	$35	$1,054
9	EDC Evaluation Costs	$62		$71	
10	SWE Audit Costs	$26		$69	
11	**Program Overhead Costs (Sum of rows 5 through 10)**	**$1,238**		**$1,501**	
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)**	**$1,238**		**$1,501**	
14	Total NPV Lifetime Electric Energy Benefits	$851		$881	
15	Total NPV Lifetime Electric Capacity Benefits	$208		$241	
16	Total NPV Lifetime Operation and Maintenance (O&M) Benefits	$80		$75	
17	Total NPV Lifetime Non-Electric Benefits (Fossil Fuel, Water)	$14		$13	
18	**Total NPV TRC Benefits [7] (Sum of rows 14 through 17)**	**$1,152**		**$1,210**	
19	**TRC Benefit-Cost Ratio [8]**	**0.93**		**0.81**	

[1] Includes direct install equipment costs and costs for EE&C kits.
[2] Includes direct costs attributable to plan and advance the programs. Note: The design of the HERs program should be included here, while the actual development and mailing of HERs would be attributable to Program Delivery.
[3] Includes rebate processing, tracking system, general administration, program management, general management and legal, and technical assistance. Any common portfolio costs that are allocated across programs should be shown in this row.
[4] Includes the marketing CSP and marketing costs by program CSPs.
[5] Direct program implementation costs. Labor, fuel, and vehicle operation costs for appliance recycling and direct install programs. For behavioral programs, this includes the printing and postage of HERs.
[6] Total TRC Costs includes Total EDC Costs and Participant Costs.
[7] Total TRC Benefits equals the sum of Total Lifetime Electric and Non-Electric Benefits. Benefits include: avoided supply costs, including the reduction in costs of electric energy, generation, transmission, and distribution capacity, and natural gas valued at marginal cost for periods when there is a load reduction. 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.

Table 63 presents program financials and cost-effectiveness on a net savings basis.

Table 63: 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]	$0	$0	$6	$27
6	Administration, Management, and Technical Assistance [3]	$66	$65	$89	$144
7	Marketing [4]	$6	$0	$6	$0
8	Program Delivery [5]	$32	$981	$35	$1,054
9	EDC Evaluation Costs	$62		$71	
10	SWE Audit Costs	$26		$69	
11	**Program Overhead Costs (Sum of rows 5 through 10)**	**$1,238**		**$1,501**	
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)**	**$1,238**		**$1,501**	
14	Total NPV Lifetime Electric Energy Benefits	$851		$878	
15	Total NPV Lifetime Electric Capacity Benefits	$208		$239	
16	Total NPV Lifetime Operation and Maintenance (O&M) Benefits	$80		$75	
17	Total NPV Lifetime Non-Electric Benefits (Fossil Fuel, Water)	$14		$13	
18	**Total NPV TRC Benefits [7] (Sum of rows 14 through 17)**	**$1,152**		**$1,205**	

19	**TRC Benefit-Cost Ratio [8]**	**0.93**	**0.80**

[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.

3.5.7 Status of Recommendations

Navigant's process evaluation activities for LIEEP during PY9 occurred in tandem with each component's market rate counterpart. Findings and recommendations are included in those previous program section for the given market rate component. Additional details can also be found in the PY9 Residential Process Evaluation Report.

3.6 Commercial Efficiency/Express Efficiency programs

As noted in Duquesne Light's Phase III EE&C Plan filing,[16] "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 (Express Efficiency and Commercial Efficiency) have been grouped together for evaluation purposes 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 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 reliable source of information about their energy use and ways to save energy, reduce operating costs, lower carbon emissions, and improve 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 PY9), 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 64 presents the participation counts, reported energy and demand savings, and incentive payments for the two programs in PY9, by customer segment/program.

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

Table 64: CEP/EXP Participation and Reported Impacts

Parameter	Small C&I (Non-GNI)	Large C&I (Non-GNI)	Total
PYTD # Participants	298	49	347
PYRTD MWh/yr	10,818	8,653	19,471
PYRTD MW/yr	1.73	1.01	2.74
PY9 Incentives ($1000)	$670	$453	$1,123

3.6.2 Gross Impact Evaluation

Navigant did not evaluate the Express Efficiency or the Commercial Efficiency program in PY9, as detailed in the Evaluation Plan approved by the SWE. For PY9, Navigant utilized the verification results from PY8 and applied them to the PY9 ex-ante numbers. Navigant performed 14 site visits and phone verifications during the PY9 evaluation period, the results of which will be combined with those from PY10 and applied to the PY10 and PY11 ex ante numbers for CEP and EXP.

Table 65: CEP/EXP Gross Impact Results for Energy

Stratum	PYRTD MWh/yr	Energy Realization Rate	PYVTD MWh/yr	Sample C_v or Error Ratio	Relative Precision at 90% C.L.*
Commercial/Express - Large	1,574	99%	1,551	0.00	0.0%
Commercial/Express - Medium	6,282	99%	6,243	0.01	0.7%
Commercial/Express - Small	11,615	98%	11,402	0.05	1.6%
Standard LED (cross-sector Upstream Lighting)**	0	N/A	3,070	13.26	200.7%
Specialty LED (cross-sector Upstream Lighting)**	0	N/A	528	7.38	184.8%
Program Total	**19,471**	**117%****	**22,794**		**27.3%**

*Commercial Efficiency/Express Efficiency was sampled targeting 90/15 for PY8.
**Cross sector sales from the REEP Upstream Lighting program to commercial customers are included in the CEP/EXP program group. The methodology and results are detailed in Appendix A. These savings which are included in verified but not reported values contribute to higher realization rate.

Table 66: CEP/EXP Gross Impact Results for Demand

Stratum	PYRTD MW/yr	Demand Realization Rate	PYVTD MW/yr	Sample C_v or Error Ratio	Relative Precision at 90% C.L.*
Commercial/Express - Large	0.16	128%	0.20	0.00	0.0%
Commercial/Express - Medium	0.75	100%	0.74	0.00	0.2%
Commercial/Express - Small	1.84	101%	1.87	0.09	3.1%
Standard LED (cross-sector Upstream Lighting)**	0.00	N/A	0.38	13.26	200.7%
Specialty LED (cross-sector Upstream Lighting)**	0.00	N/A	0.11	7.38	184.8%
Program Total	**2.74**	**120%****	**3.30**		**21.0%**

*Commercial Efficiency/Express Efficiency was sampled targeting 90/15 for PY8.
**Cross sector sales from the REEP Upstream Lighting program to commercial customers are included in the CEP/EXP program group. The methodology and results are detailed in Appendix A. These savings which are included in verified but not reported values contribute to higher realization rate.

Factors affecting the CEP and EXP realization rates are detailed in Navigant's PY8 report.

3.6.3 Net Impact Evaluation

In PY9, the evaluation team assessed free ridership using a customer self-report approach following the SWE framework.[17] 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.[18]

[17] SWE Guidance memorandum GM-024: Common Approach for Measuring Free riders for Downstream Programs, October 4, 2013.
[18] 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:

Equation 3: Total Net to Gross Ratio

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

Navigant attempted to survey a census of all unique decision makers across the program. In some case a unique decision maker was responsible for multiple projects and multiple accounts. Each unique decision maker was asked about one project and up to three measures. The sample design and achieved sample size are shown in Table 67.

Table 67: CEP/EXP Net Impact Sample Design

Stratum	Stratum Boundaries	Population Size	Achieved Sample Size	Response Rate
EXP Participants	All unique decision makers	163	20	12%
CEP Participants	All unique decision makers	24	4	17%

The resulting NTG ratio is applied to the total gross savings for the EXP and CEP programs. A summary of the NTG results is included below in Table 68.

Table 68: CEP/EXP Net Impact Evaluation Results

Target Group	Estimated Free Ridership	Estimated Participant Spillover	NTG Ratio	Relative Precision (@ 85% CL)
CEP/EXP	0.40	0.00	0.60	4.4%
Standard LED (cross-sector Upstream Lighting)	0.66	0.09	0.43	16.2%
Specialty LED (cross-sector Upstream Lighting)	0.65	0.09	0.43	18.1%
Total	**0.44**	**0.01**	**0.57**	**4.1%**

High-Impact Measure Research

Navigant reviewed the PY9 non-residential program activities and identified 4-foot LED linear replacement lamps. Since an attempted census was completed for the surveys, Navigant focused survey questions on this particular measure with respondents who installed the measure to obtain statistically significant data relative to this HIM.

In total, 15 participants responded to the battery of free ridership questions specific to the 4-foot

LED linear replacement lamps. The NTG results for these respondents are shown in Table 68.

Table 69: PY9 NTG Results – 4-foot LED Linear Replacement Lamps

Respondents	Number of Respondents	FR	NTG
4-foot LED Linear Replacement Lamps	15	33%	67%

3.6.4 Verified Savings Estimates

Navigant applied the realization rates and net-to-gross ratios in Table 70 to the reported energy and demand savings estimates to calculate the verified savings estimates for the CEP and EXP in PY9. These totals are added to the verified savings achieved in previous program years to calculate the P3TD program impacts.

Table 70: EXP/CEP PYTD and P3TD Savings Summary

Savings Type	Energy (MWh/yr)	Demand (MW/yr)
PYRTD	19,471	2.74
PYVTD Gross	22,794	3.30
PYVTD Net	13,017	1.89
RTD	26,353	3.44
VTD Gross	29,556	4.01
VTD Net	16,784	2.29

3.6.5 Process Evaluation

In PY9, the Navigant team attempted to complete surveys with all Commercial Energy Efficiency Education and Express Efficiency program participants to estimate the net-to-gross effects of the program (i.e., free ridership and spillover) and to assess program satisfaction. Results of the process evaluation components of the survey have been aggregated to the C&I level to assess overall satisfaction and to identify areas of improvement.

Navigant also completed interviews with Trade Allies as part of the PY9 process evaluation. Trade allies included individuals that participated in one of Duquesne Light's C&I energy efficiency programs in PY8 or PY9 as a contractor, energy equipment supplier and/or other building system professional. The objective of the interview was to obtain feedback from trade allies about their participation in Duquesne Light's C&I energy efficiency programs. The interviews focused on the participation process, benefits, and barriers of these programs from

the perspective of a trade ally.

3.6.6 Cost-Effectiveness Reporting

A detailed breakdown of program finances and cost-effectiveness is presented in Table 70 and Table 72. TRC benefits in Table 70 and Table 72 were calculated using gross verified impacts. Net present value (NPV) PYTD costs and benefits are expressed in 2017 dollars. Net present value costs and benefits for P3TD financials are discounted back to 2016.

Table 71: Summary of Express Efficiency Program Finances – Gross Verified

Row #	Cost Category	PYTD ($1,000)		P3TD ($1,000)	
1	EDC Incentives to Participants [1]	$670		$765	
2	EDC Incentives to Trade Allies	$0		$0	
3	Participant Costs (net of incentives/rebates paid by utilities)	-$220		$36	
4	**Incremental Measure Costs (Sum of rows 1 through 3)**	**$450**		**$801**	
		EDC	**CSP**	**EDC**	**CSP**
5	Design & Development [2]	$0	$0	$3	$36
6	Administration, Management, and Technical Assistance [3]	$117	$115	$132	$215
7	Marketing [4]	$0	$0	$0	$0
8	Program Delivery [5]	$38	$810	$407	$757
9	EDC Evaluation Costs	$109		$119	
10	SWE Audit Costs	$43		$98	
11	**Program Overhead Costs (Sum of rows 5 through 10)**	**$1,232**		**$1,767**	
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)**	**$1,682**		**$2,568**	

14	Total NPV Lifetime Electric Energy Benefits	$6,013	$7,047
15	Total NPV Lifetime Electric Capacity Benefits	$2,400	$2,746
16	Total NPV Lifetime Operation and Maintenance (O&M) Benefits	$641	$671
17	Total NPV Lifetime Non-Electric Benefits (Fossil Fuel, Water)	-$855	-$799
18	**Total NPV TRC Benefits [7] (Sum of rows 14 through 17)**	**$8,199**	**$9,663**
19	**TRC Benefit-Cost Ratio [8]**	**4.88**	**3.76**

[1] Includes direct install equipment costs.
[2] Includes direct costs attributable to plan and to advance the programs.
[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.
[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.

Table 71 and Table 73 presents program financials and cost-effectiveness on a net savings basis.

Table 72: Summary of Express Efficiency Program Finances – Net Verified

Row #	Cost Category	PYTD ($1,000)		P3TD ($1,000)	
1	EDC Incentives to Participants [1]	$670		$766	
2	EDC Incentives to Trade Allies	$0		$0	
3	Participant Costs (net of incentives/rebates paid by utilities)	-$421		-$320	
4	**Incremental Measure Costs (Sum of rows 1 through 3)**	**$249**		**$445**	
		EDC	**CSP**	**EDC**	**CSP**
5	Design & Development [2]	$0	$0	$3	$36
6	Administration, Management, and Technical Assistance [3]	$117	$115	$132	$215
7	Marketing [4]	$0	$0	$0	$0

8	Program Delivery [5]	$38	$810	$407	$757
9	EDC Evaluation Costs	$109		$119	
10	SWE Audit Costs	$43		$98	
11	**Program Overhead Costs (Sum of rows 5 through 10)**	**$1,232**		**$1,767**	
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)**	**$1,482**		**$2,212**	
14	Total NPV Lifetime Electric Energy Benefits	$3,337		$3,913	
15	Total NPV Lifetime Electric Capacity Benefits	$1,331		$1,525	
16	Total NPV Lifetime Operation and Maintenance (O&M) Benefits	$356		$372	
17	Total NPV Lifetime Non-Electric Benefits (Fossil Fuel, Water)	-$474		-$444	
18	**Total NPV TRC Benefits [7] (Sum of rows 14 through 17)**	$4,549		$5,366	
19	**TRC Benefit-Cost Ratio [8]**	**3.07**		**2.43**	

[1] Includes direct install equipment costs.
[2] Includes direct costs attributable to plan and to advance the programs.
[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.
[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.

Table 73: Summary of Commercial Efficiency Program Finances – Gross Verified

Row #	Cost Category	PYTD ($1,000)	P3TD ($1,000)
1	EDC Incentives to Participants [1]	$453	$603

2	EDC Incentives to Trade Allies	$0		$0	
3	Participant Costs (net of incentives/rebates paid by utilities)	-$123		$519	
4	**Incremental Measure Costs (Sum of rows 1 through 3)**	**$330**		**$1,121**	
		EDC	**CSP**	**EDC**	**CSP**
5	Design & Development [2]	$0	$0	$3	$41
6	Administration, Management, and Technical Assistance [3]	$100	$98	$118	$216
7	Marketing [4]	$0	$0	$0	$0
8	Program Delivery [5]	$30	$479	$28	$786
9	EDC Evaluation Costs	$94		$108	
10	SWE Audit Costs	$38		$102	
11	**Program Overhead Costs (Sum of rows 5 through 10)**	**$839**		**$1,401**	
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)**	**$1,169**		**$2,522**	
14	Total NPV Lifetime Electric Energy Benefits	$4,036		$5,319	
15	Total NPV Lifetime Electric Capacity Benefits	$1,227		$1,430	
16	Total NPV Lifetime Operation and Maintenance (O&M) Benefits	$581		$557	
17	Total NPV Lifetime Non-Electric Benefits (Fossil Fuel, Water)	-$420		-$393	
18	**Total NPV TRC Benefits [7] (Sum of rows 14 through 17)**	$5,424		$6,913	
19	**TRC Benefit-Cost Ratio [8]**	**4.64**		**2.74**	

[1] Includes direct install equipment costs.
[2] Includes direct costs attributable to plan and to advance the programs.
[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.
[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.

Table 74: Summary of Commercial Efficiency Program Finances – Net Verified

Row #	Cost Category	PYTD ($1,000)		P3TD ($1,000)	
1	EDC Incentives to Participants [1]	$453		$603	
2	EDC Incentives to Trade Allies	$0		$0	
3	Participant Costs (net of incentives/rebates paid by utilities)	-$255		$34	
4	**Incremental Measure Costs (Sum of rows 1 through 3)**	**$198**		**$637**	
		EDC	**CSP**	**EDC**	**CSP**
5	Design & Development [2]	$0	$0	$3	$41
6	Administration, Management, and Technical Assistance [3]	$100	$98	$118	$216
7	Marketing [4]	$0	$0	$0	$0
8	Program Delivery [5]	$30	$479	$28	$786
9	EDC Evaluation Costs	$94		$108	
10	SWE Audit Costs	$38		$102	
11	**Program Overhead Costs (Sum of rows 5 through 10)**	**$839**		**$1,401**	
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)**	**$1,037**		**$2,038**	
14	Total NPV Lifetime Electric Energy Benefits	$2,414		$3,118	

15	Total NPV Lifetime Electric Capacity Benefits	$734	$843
16	Total NPV Lifetime Operation and Maintenance (O&M) Benefits	$347	$333
17	Total NPV Lifetime Non-Electric Benefits (Fossil Fuel, Water)	-$251	-$235
18	**Total NPV TRC Benefits [7] (Sum of rows 14 through 17)**	**$3,244**	**$4,059**

19	**TRC Benefit-Cost Ratio [8]**	**3.13**	**1.99**

[1] Includes direct install equipment costs.
[2] Includes direct costs attributable to plan and to advance the programs.
[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.
[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.

3.6.7 Status of Recommendations

The impact and process evaluation activities in PY9 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. These recommendations apply across all C&I programs.

Finding:

Bill/energy savings and rebates were reported as the top benefits to the program. However, participants also noted that burdensome paperwork, program complexity, and measures not qualifying for the program hinder their participation. Several trade allies also felt that that Duquesne Light could further streamline its program requirements and reduce the amount of paperwork that needs to be submitted.

Recommendation:

Duquesne Light should consider streamlining and standardizing paperwork across programs to reduce program complexity and participants' administrative burden. In particular, some projects require paperwork for two separate programs based on product eligibility. Duquesne Light should work with the implementation contractors to identify ways to streamline while still maintaining the split of products between the midstream lighting and other C&I programs.

Duquesne Light Status Report:

Duquesne Light will explore opportunities to streamline with its CSPs but given the requirement

to have products eligible for only one program, it may not be possible to reduce the number of application forms required. Further training of the CSPs and distributors may alleviate the perceived complexities.

Finding:

Although all Trade Allies recommended the program to customers, most did not report using marketing materials provided by Duquesne Light and a handful stated they were unaware of marketing materials from the utility. This supports the finding in the participant survey which determined that most participants are not aware of marketing materials (over 50% of respondents stated they were unaware of any marketing materials).

Recommendation:

If difficulties arise in the future with meeting participation targets, Duquesne Light should increase program marketing and more closely align marketing with customer preferences of digital and radio ads, printed flyers, and targeted emails further encouraging distributors and manufacturers to market the program.

Duquesne Light Status Report:

Duquesne Light tracks participation regularly and will re-evaluate marketing plans if required in the future.

Finding:

Several surveyed participants requested the addition of new program offerings, including additional lighting options, drivers and motors, induction heaters, and more training. Many Trade Allies also made requests to add or adjust technologies offered through the program, especially for lighting measures.

Recommendation:

If difficulties arise in the future with meeting participation targets, Duquesne Light should determine the savings potential and feasibility of adding additional technologies or offerings to the programs. These may include more lighting measures, drivers and motors, induction heaters, non-monetary incentives, larger monetary benefits and training opportunities. For lighting, Duquesne Light should reevaluate product offerings regularly as the lighting market is transitioning quickly.

Duquesne Light Status Report:

Duquesne Light tracks participation regularly and will re-evaluate product offerings if required in the future.

Finding:

When asked to rank the ease and/or difficulty of making certain decisions related to participating, such as identifying opportunities, estimating costs or savings, or deciding to install a measure, the factors which received the lowest rating (indicating they were elements participants found more difficult) were obtaining internal approval and estimating energy savings and costs.

Recommendation:

Duquesne Light should consider adding services to support program components that involve difficult decision-making, including training materials or support for estimating energy savings and costs and approaches or support for persuading upper management to invest in EE equipment. These services may include providing one-on-one consultations, informational materials, and/or streamlined training materials to clarify instructions.

Duquesne Light Status Report:

Duquesne Light will continue to work with CSPs to identify any additional support which may be helpful to customers.

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. During PY9, CLEAResult acquired Ecova, and took over as the CSP for this program. 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 PY9).

3.7.1 Participation and Reported Savings by Customer Segment

Table 75 presents the participation counts, reported energy and demand savings, and incentive payments for the Midstream Lighting program in PY9 by customer segment.

Table 75: Midstream Lighting Participation and Reported Impacts

Parameter	Small C&I (Non-GNI)	Large C&I (Non-GNI)	Total
PYTD # Participants	245	158	403
PYRTD MWh/yr	1,329	1,159	2,488
PYRTD MW/yr	0.23	0.22	0.45
PY9 Incentives ($1000)	$104	$118	$222

3.7.2 Gross Impact Evaluation

Navigant divided the Large and Small programs into two strata each for the purposes of sampling and defined a “project” as a unique customer name/invoice upload date combination, as this grouped the purchases by both location and time. Table 75 provides the resulting population and sampling sizes.

Navigant or its subcontractor, Karpinski Engineering, performed site visits for all the Midstream Lighting sites sampled for PY9, as required by the SWE. None of the projects in the population for PY9 met the 750,000-kWh metering threshold, so all projects were Verification Only.

Table 76: Midstream Lighting Gross Impact Sample Design for PY9

Stratum	Population Size[19]	Achieved Sample Size	Evaluation Activity
SNUP - Small	213	9	Verification Only Visit
SNUP - Large	32	13	Verification Only Visit
LNUP - Small	129	11	Verification Only Visit
LNUP - Large	29	10	Verification Only Visit
Total	**403**	**43**	

Table 77: 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.
SNUP - Small	610	115%	0.36	19.4%
SNUP - Large	718	161%	0.42	18.0%
LNUP - Small	380	330%	1.01	47.4%
LNUP - Large	780	152%	0.55	27.2%
Program Total	**2,488**	**173%**		**15.7%**

Navigant did not meet the 85/15 threshold for PY9 (15.7%), nor did it meet the 90/10 threshold for the PY8-PY9 combine analysis (11.3%). The use of customer-reported hours of use led to varying project realization rates, clustering around 100 percent and 300 percent, which impacted stratum C_v. Many customers installed bulbs in 24/7/365 areas (e.g., lobbies, elevators, and security lights) leading to high realization rates at eight sites given that there is no "24/7" building type option. Navigant and their subcontractor also had difficulties scheduling site visits given that some listed contacts knew little about the installations and those with knowledge could not always be reached.

To address this next year, Navigant plans to make the following adjustments:

- Navigant will design the sample to mitigate for varying hours of use and impacts on C_v. Navigant also notes that the CSP is changing the HOU options to "Interior," "Exterior," or "24/7."

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

- Navigant will select an alternate sample point for each site in the primary sample, rather than selecting a smaller number of alternate sites for each stratum. This should ease the process of pulling alternative sites for this program if the primary site proves difficult to schedule or knowledgeable contacts are not available.

Table 78: 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.
SNUP - Small	0.11	94%	0.50	26.5%
SNUP - Large	0.12	143%	0.48	20.5%
LNUP - Small	0.07	301%	0.69	32.5%
LNUP - Large	0.14	167%	0.61	30.5%
Program Total	**0.45**	**164%**		**14.3%**

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

- **In Service Rate (ISR):** CLEAResult (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=6) had a lower ISR.
- **HOU:** As a new element of the evaluation year, Navigant updated HOU based on customer-reported HOU for all sites where schedules could be confirmed, rather than only those sites with a savings >20kW. This impacted more than half of the midstream sites (n=23) and led to most of the overall increase in realization rate for this program. Navigant found that many customers (n=8) are prioritizing areas with 24/7 usage for bulb replacement, which increases the energy savings from these installations by as much as 400% for some sites.
- **Building Type:** Navigant adjusted the building type for several of the sites (n=5) where there were no set schedules and normal HOU verification was not possible (e.g. hotel guest rooms). This changed the HOU and CF for these sites leading to an increase in savings for all five sites.

3.7.3 Net Impact Evaluation

Net-to-gross (NTG) factors for the midstream lighting program was estimated based on results from the PY8 telephone survey of program participants.

The overall net impacts were determined by post stratifying the PY8 sample into large, medium

and small projects as shown in Table 79. The results are shown below in Table 80.

Table 79: Midstream Lighting Net Impact Sample Design (PY8 analysis)

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 80: Midstream Lighting Net Impact Evaluation Results (PY8 Results)

Target Group or Stratum (if appropriate)	Free Ridership (%)	Spillover (%)	NTG Ratio	Relative Precision (@ 85% CL)
Large	0.09	0	0.91	16.7%
Medium	0.14	0	0.86	7.4%
Small	0.29	0	0.71	10.2%
Program Total	**0.12**	**0**	**0.88**	**5.2%**

High-Impact Measure Research

Navigant did not conduct NTG research or HIM analysis in PY9.

3.7.4 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 Midstream Lighting in PY9. These totals are added to the verified savings achieved in previous program years to calculate the P3TD program impacts.

Table 81: Midstream Lighting PYTD and P3TD Savings Summary

Savings Type	Energy (MWh/yr)	Demand (MW/yr)
PYRTD	2,488	0.45
PYVTD Gross	4,300	0.74
PYVTD Net	3,805	0.66
RTD	4,416	0.77
VTD Gross	7,303	1.26
VTD Net	6,462	1.12

3.7.5 Process Evaluation

An in-depth process evaluation was completed for this program in PY8. No additional process evaluation findings were made in PY9.

3.7.6 Cost-Effectiveness Reporting

A detailed breakdown of program finances and cost-effectiveness is presented in Table 82 and Table 84. TRC benefits in Table 82 and Table 84 were calculated using gross verified impacts. Net present value (NPV) PYTD costs and benefits are expressed in 2017 dollars. Net present value costs and benefits for P3TD financials are discounted back to 2016.

Table 82: Summary of Small/Medium Midstream Program Finances – Gross Verified

Row #	Cost Category	PYTD ($1,000)		P3TD ($1,000)	
1	EDC Incentives to Participants [1]	$104		$184	
2	EDC Incentives to Trade Allies	$0		$0	
3	Participant Costs (net of incentives/rebates paid by utilities)	$36		-$3	
4	**Incremental Measure Costs (Sum of rows 1 through 3)**	**$140**		**$182**	
		EDC	**CSP**	**EDC**	**CSP**
5	Design & Development [2]	$0	$0	$3	$13
6	Administration, Management, and Technical Assistance [3]	$31	$30	$51	$66
7	Marketing [4]	$0	$0	$0	$0
8	Program Delivery [5]	$30	$6	$28	$6
9	EDC Evaluation Costs	$28		$32	

10	SWE Audit Costs	$12	$31
11	**Program Overhead Costs (Sum of rows 5 through 10)**	**$137**	**$230**
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)**	**$277**	**$412**
14	Total NPV Lifetime Electric Energy Benefits	$446	$955
15	Total NPV Lifetime Electric Capacity Benefits	$172	$376
16	Total NPV Lifetime Operation and Maintenance (O&M) Benefits	$248	$386
17	Total NPV Lifetime Non-Electric Benefits (Fossil Fuel, Water)	-$84	-$79
18	**Total NPV TRC Benefits [7] (Sum of rows 14 through 17)**	**$782**	**$1,639**
19	**TRC Benefit-Cost Ratio [8]**	**2.82**	**3.98**

[1] Includes direct install equipment costs.
[2] Includes direct costs attributable to plan and to advance the programs.
[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.
[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.

Table 83 and Table 85 presents program financials and cost-effectiveness on a net savings basis.

Table 83: Summary of Small/Medium Midstream Program Finances – Net Verified

Row #	Cost Category	PYTD ($1,000)	P3TD ($1,000)
1	EDC Incentives to Participants [1]	$104	$184

2	EDC Incentives to Trade Allies	$0		$0	
3	Participant Costs (net of incentives/rebates paid by utilities)	$20		-$24	
4	**Incremental Measure Costs (Sum of rows 1 through 3)**	**$124**		**$161**	
		EDC	**CSP**	**EDC**	**CSP**
5	Design & Development [2]	$0	$0	$3	$13
6	Administration, Management, and Technical Assistance [3]	$31	$30	$51	$66
7	Marketing [4]	$0	$0	$0	$0
8	Program Delivery [5]	$30	$6	$28	$6
9	EDC Evaluation Costs	$28		$32	
10	SWE Audit Costs	$12		$31	
11	**Program Overhead Costs (Sum of rows 5 through 10)**	**$137**		**$230**	
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)**	**$261**		**$391**	
14	Total NPV Lifetime Electric Energy Benefits	$394		$845	
15	Total NPV Lifetime Electric Capacity Benefits	$152		$333	
16	Total NPV Lifetime Operation and Maintenance (O&M) Benefits	$220		$342	
17	Total NPV Lifetime Non-Electric Benefits (Fossil Fuel, Water)	-$75		-$70	
18	**Total NPV TRC Benefits [7] (Sum of rows 14 through 17)**	**$692**		**$1,450**	
19	**TRC Benefit-Cost Ratio [8]**	**2.65**		**3.71**	

[1] Includes direct install equipment costs.
[2] Includes direct costs attributable to plan and to advance the programs.
[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.
[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.

Table 84: Summary of Large Midstream Program Finances – Gross Verified

Row #	Cost Category	PYTD ($1,000)		P3TD ($1,000)	
1	EDC Incentives to Participants [1]	$118		$219	
2	EDC Incentives to Trade Allies	$0		$0	
3	Participant Costs (net of incentives/rebates paid by utilities)	$32		-$20	
4	**Incremental Measure Costs (Sum of rows 1 through 3)**	**$150**		**$199**	
		EDC	**CSP**	**EDC**	**CSP**
5	Design & Development [2]	$0	$0	$3	$30
6	Administration, Management, and Technical Assistance [3]	$73	$73	$92	$159
7	Marketing [4]	$0	$0	$0	$0
8	Program Delivery [5]	$30	$184	$28	$330
9	EDC Evaluation Costs	$68		$78	
10	SWE Audit Costs	$28		$74	
11	**Program Overhead Costs (Sum of rows 5 through 10)**	**$456**		**$795**	
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)**	**$606**		**$994**	
14	Total NPV Lifetime Electric Energy Benefits	$568		$1,065	

15	Total NPV Lifetime Electric Capacity Benefits	$284	$490
16	Total NPV Lifetime Operation and Maintenance (O&M) Benefits	$266	$453
17	Total NPV Lifetime Non-Electric Benefits (Fossil Fuel, Water)	-$107	-$100
18	**Total NPV TRC Benefits [7] (Sum of rows 14 through 17)**	**$1,011**	**$1,907**
19	**TRC Benefit-Cost Ratio [8]**	**1.67**	**1.92**

[1] Includes direct install equipment costs.
[2] Includes direct costs attributable to plan and to advance the programs.
[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.
[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.

Table 85: Summary of Large Midstream Program Finances – Net Verified

Row #	Cost Category	PYTD ($1,000)		P3TD ($1,000)	
1	EDC Incentives to Participants [1]	$118		$219	
2	EDC Incentives to Trade Allies	$0		$0	
3	Participant Costs (net of incentives/rebates paid by utilities)	$15		-$43	
4	**Incremental Measure Costs (Sum of rows 1 through 3)**	**$133**		**$176**	
		EDC	**CSP**	**EDC**	**CSP**
5	Design & Development [2]	$0	$0	$3	$30
6	Administration, Management, and Technical Assistance [3]	$73	$73	$92	$159
7	Marketing [4]	$0	$0	$0	$0
8	Program Delivery [5]	$30	$184	$28	$330
9	EDC Evaluation Costs	$68		$78	

10	SWE Audit Costs	$28	$74
11	**Program Overhead Costs (Sum of rows 5 through 10)**	**$456**	**$795**
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)**	**$589**	**$971**
14	Total NPV Lifetime Electric Energy Benefits	$503	$943
15	Total NPV Lifetime Electric Capacity Benefits	$251	$434
16	Total NPV Lifetime Operation and Maintenance (O&M) Benefits	$235	$401
17	Total NPV Lifetime Non-Electric Benefits (Fossil Fuel, Water)	-$95	-$89
18	**Total NPV TRC Benefits [7] (Sum of rows 14 through 17)**	**$895**	**$1,688**
19	**TRC Benefit-Cost Ratio [8]**	**1.52**	**1.74**

[1] Includes direct install equipment costs.
[2] Includes direct costs attributable to plan and to advance the programs.
[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.
[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.

3.7.7 Status of Recommendations

The impact evaluation activities in PY9 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:

Many of the sites (19) installed the program bulbs in locations with significantly greater hours of use than deemed by the building type. These bulbs were installed in either 24/7 or exterior

locations.

Recommendation:

Navigant recommends that the CSP provide the option of “Exterior” or “24/7” as a building type in the program application forms which are filled in by customers to collect building type data. This would provide a more accurate estimate of savings for the program.

Duquesne Light Status Report:

CLEAResult is binning HOU into three options for PY10, “Interior,” “Exterior,” and “24/7” on program materials which will address the issue.

Finding:

Navigant found two sites (and received similar feedback in PY8) where customers installed then removed lights because they found that the lights flickered when the bulbs were on dimmer switches. This reduced the realization rate for these sites.

Recommendation:

Navigant recommends that the CSP provides materials to the distributors to educate them on which bulb types are suitable for locations where dimming is required. There may be bulbs in the program that are more suitable for dimmer switches than others. Navigant recommends these be pointed out by the CSP to the customers.

Duquesne Light Status Report:

Duquesne Light will work with CLEAResult to determine if additional materials or training are required.

Finding:

Navigant found three sites where the customers had been unable to install the lights where they had originally planned to do so. The customers were unsure if it was within program rules to install the lights in a different location in the same building, as the program materials make it clear that the lights should not be moved.

Recommendation:

Navigant recommends that the CSP clarify that installing lights in a different area of the same building can be allowed. The equipment should not be moved to another address and it should be installed only in appropriate space types so that hours of use estimates are accurate. The CSP should provide sufficient guidance to customers on changes so that savings remain eligible.

Duquesne Light Status Report:

Duquesne Light will work with CLEAResult to determine if additional documentation is required to clarify eligibility.

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. Building owners do not pay the electric bills, so they are not motivated to upgrade equipment to save energy, and the 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 PY9), 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 86 presents the participation counts, reported energy and demand savings, and incentive payments for the SCDI program in PY9 by customer segment.

Table 86: SCDI Program Participation and Reported Impacts

Parameter	Small C&I (Non-GNI)
PYTD # Participants	94
PYRTD MWh/yr	6,264
PYRTD MW/yr	0.88
PY9 Incentives ($1000)	$0

3.8.2 Gross Impact Evaluation

Navigant did not evaluate the SCDI program in PY9, as detailed in the Evaluation Plan approved by the SWE. For PY9, Navigant utilized the verification results from PY8 and applied them to the PY9 ex-ante numbers. This program is likely to see limited or no participation and savings in the remainder of Phase III, since the target savings and budget have been achieved.

Table 87: 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	1,976	99%	0.12	15.3%
SCDI - Medium	3,255	96%	0.05	13.8%
SCDI - Small	1,032	96%	0.12	9.3%
Program Total	**6,264**	**97%**		**4.5%**

Table 88: 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	0.22	102%	0.05	6.9%
SCDI - Medium	0.54	103%	0.02	4.9%
SCDI - Small	0.12	99%	0.01	1.0%
Program Total	**0.88**	**102%**		**1.6%**

Factors affecting the SCDI realization rates are detailed in Navigant's PY8 report.

3.8.3 Net Impact Evaluation

Based on the Phase III evaluation plan, net-to-gross and process evaluation research was planned for the SCDI program in PY9. However, this program was set to meet its targets and exhaust budget this year. Some projects were reported in Q1 of PY10, but no further activity is expected. Since net-to-gross and process research is focused primarily on providing observations and recommendations which feed into program planning, and the program will not be offered moving forward in Phase III, this research was not completed for SCDI in PY9. As a result, NTG values reported from PY6 research are used here.[20]

In PY6, the evaluation team assessed free ridership using a customer self-report approach following the SWE framework.[21] 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.[22]

The NTG was then calculated based on the generic formulation illustrated in Equation 4:

Equation 4. 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 89.

Table 89: SCDI Program Net Impact Results

Target Group	Estimated Free Ridership	Estimated Participant Spillover	NTG Ratio	Relative Precision (@ 85% CL)
SCDI Total	**1%**	**0%**	**99%**	**1.9%**

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

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

High-Impact Measure Research

Navigant did not conduct NTG research or HIM analysis for SCDI in PY9.

3.8.4 Verified Savings Estimates

In Table 90 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 PY9. These totals are added to the verified savings achieved in previous program years to calculate the P3TD program impacts.

Table 90: SCDI PYTD and P3TD Savings Summary

Savings Type	Energy (MWh/yr)	Demand (MW/yr)
PYRTD	6,264	0.88
PYVTD Gross	6,093	0.90
PYVTD Net	6,050	0.89
RTD	9,890	1.24
VTD Gross	9,655	1.27
VTD Net	9,587	1.26

3.8.5 Process Evaluation

A detailed process evaluation was planned for the SCDI program in PY9. However, this program was set to meet its targets and exhausted budget this year. Since process evaluation research is focused primarily on providing observations and recommendations which feed into program planning, and the program will not be offered after PY10Q1 in Phase III, this research was not completed.

3.8.6 Cost-Effectiveness Reporting

A detailed breakdown of program finances and cost-effectiveness is presented in Table 91. TRC benefits in Table 91 were calculated using gross verified impacts. Net present value (NPV) PYTD costs and benefits are expressed in 2017 dollars. Net present value costs and benefits for P3TD financials are discounted back to 2016.

Table 91: 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]	$0	$0	$3	$21
6	Administration, Management, and Technical Assistance [3]	$51	$50	$70	$110
7	Marketing [4]	$0	$0	$0	$0
8	Program Delivery [5]	$28	$1,433	$26	$2,172
9	EDC Evaluation Costs	$48		$55	
10	SWE Audit Costs	$20		$52	
11	**Program Overhead Costs (Sum of rows 5 through 10)**	**$1,630**		**$2,508**	
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)**	**$1,630**		**$2,508**	
14	Total NPV Lifetime Electric Energy Benefits	$2,776		$4,021	
15	Total NPV Lifetime Electric Capacity Benefits	$1,027		$1,349	
16	Total NPV Lifetime Operation and Maintenance (O&M) Benefits	$0		$12	
17	Total NPV Lifetime Non-Electric Benefits (Fossil Fuel, Water)	-$267		-$249	
18	**Total NPV TRC Benefits [7] (Sum of rows 14 through 17)**	**$3,536**		**$5,132**	
19	**TRC Benefit-Cost Ratio [8]**	**2.17**		**2.05**	

[1] Includes direct install equipment costs.
[2] Includes direct costs attributable to plan and to advance the programs.
[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.

[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.

Table 92 presents program financials and cost-effectiveness on a net savings basis.

Table 92: 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]	$0	$0	$3	$21
6	Administration, Management, and Technical Assistance [3]	$51	$50	$70	$110
7	Marketing [4]	$0	$0	$0	$0
8	Program Delivery [5]	$28	$1,433	$26	$2,172
9	EDC Evaluation Costs	$48		$55	
10	SWE Audit Costs	$20		$52	
11	**Program Overhead Costs (Sum of rows 5 through 10)**	**$1,630**		**$2,508**	
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)**	**$1,630**		**$2,508**	
14	Total NPV Lifetime Electric Energy Benefits	$2,756		$3,992	

15	Total NPV Lifetime Electric Capacity Benefits	$1,020	$1,340
16	Total NPV Lifetime Operation and Maintenance (O&M) Benefits	$0	$12
17	Total NPV Lifetime Non-Electric Benefits (Fossil Fuel, Water)	-$265	-$248
18	**Total NPV TRC Benefits [7] (Sum of rows 14 through 17)**	**$3,512**	**$5,096**

19	**TRC Benefit-Cost Ratio [8]**	**2.15**	**2.03**

[1] Includes direct install equipment costs.
[2] Includes direct costs attributable to plan and to advance the programs.
[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.
[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.

3.8.7 Status of Recommendations

Navigant limited its impact and process evaluation activities for the SCDI in PY9 and have no recommendations at this time.

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 PY9), 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 93 presents the participation counts, reported energy and demand savings, and incentive payments for MFHR program in PY9, by customer segment.

Table 93: MFHR Program Participation and Reported Impacts

Parameter	Small C&I (Non-GNI)*
PYTD # Participants	3
PYRTD MWh/yr	107
PYRTD MW/yr	0.01
PY9 Incentives ($1000)	$17

*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

Navigant did not evaluate the Multifamily Housing Retrofit program in PY9. For PY9, Navigant utilized the verification results from PY8 and applied them to the PY9 ex-ante numbers for Multifamily as detailed in the Evaluation Plan approved by the SWE.

Table 94: 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	107	95%	0.00	0.0%
Total	**107**	**95%**		**0.0%**

Table 95: 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	0.01	93%	0.00	0.0%
Total	**0.01**	**93%**		**0.0%**

3.9.3 Net Impact Evaluation

In PY9, the evaluation team assessed free ridership for the MFHR program using a customer self-report approach following the SWE framework.[23] 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.[24]

The NTG was then calculated based on the generic formulation illustrated in Equation 5:

Equation 5. Total Net to Gross Ratio

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

An attempted census was completed for all unique decision makers across the program in PY9. In some case a unique decision maker was responsible for multiple projects and multiple accounts. Each unique decision maker was asked about one project and up to three measures. The NTG results from the other GNI programs (PAPP and CEEP) which have similar delivery channels and target audiences were combined with the MFHR results given the low number of respondents. The sample design and achieved sample size are shown in Table 96.

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

Table 96: GNI Net Impact Sample Design

Stratum	Stratum Boundaries	Population Size	Achieved Sample Size	Response Rate
MFHR	All unique decision makers	2	1	50%
CEEP	All unique decision makers	19	2	11%
PAPP	All unique decision makers	52	13	25%

The resulting overall NTG ratio is applied to the total gross savings for the multifamily program. A summary of the PY9 NTG results is included below in Table 97.

Table 97: MFHR Program Net Impact Evaluation Results

Target Group	Estimated Free Ridership	Estimated Participant Spillover	NTG Ratio	Relative Precision (@ 85% CL)
MFHR/CEEP/PAPP	0.55	0.00	0.45	32.8%

See Navigant's PY9 C&I Process Evaluation Report for Duquesne Light for more detail regarding the NTG analysis.

High-Impact Measure Research

Results of the High-Impact Measures research for the C&I programs (4-foot linear LEDs) is outlined in section 3.6.3.

3.9.4 Verified Savings Estimates

In Table 98 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 PY9. These totals are added to the verified savings achieved in previous program years to calculate the P3TD program impacts.

Table 98: MFHR PYTD and P3TD Savings Summary

Savings Type	Energy (MWh/yr)	Demand (MW/yr)
PYRTD	107	0.01
PYVTD Gross	101	0.01
PYVTD Net	46	0.01
RTD	265	0.03
VTD Gross	252	0.03
VTD Net	153	0.02

3.9.5 Process Evaluation

In PY9, the Navigant team attempted to complete surveys with all Multifamily program participants (there were only two unique decision makers) to estimate the net-to-gross effects of the program (i.e., free ridership and spillover) and to assess program satisfaction. Results of the process evaluation components of the survey have been aggregated to the C&I level to assess overall satisfaction and to identify areas of improvement.

Navigant also completed interviews with Trade Allies as part of the PY9 process evaluation. Trade allies included individuals that participated in one of Duquesne Light's C&I energy efficiency programs in PY8 or PY9 as a contractor, energy equipment supplier and/or other building system professional. The objective of the interview was to obtain feedback from trade allies about their participation in Duquesne Light's C&I energy efficiency programs. The interviews focused on the participation process, benefits, and barriers of these programs from the perspective of a trade ally.

3.9.6 Cost-Effectiveness Reporting

A detailed breakdown of program finances and cost-effectiveness is presented in Table 99. TRC benefits in Table 99 were calculated using gross verified impacts. Net present value (NPV) PYTD costs and benefits are expressed in 2017 dollars. Net present value costs and benefits for P3TD financials are discounted back to 2016.

Table 99: Summary of MFHR Program Finances – Gross Verified

Row #	Cost Category	PYTD ($1,000)	P3TD ($1,000)
1	EDC Incentives to Participants [1]	$17	$49
2	EDC Incentives to Trade Allies	$0	$0
3	Participant Costs (net of incentives/rebates paid by utilities)	$18	$52
4	**Incremental Measure Costs (Sum of rows 1 through 3)**	**$35**	**$101**

		EDC	CSP	EDC	CSP
5	Design & Development [2]	$0	$0	$5	$19
6	Administration, Management, and Technical Assistance [3]	$47	$46	$66	$100
7	Marketing [4]	$0	$0	$0	$0
8	Program Delivery [5]	$28	$209	$26	$295
9	EDC Evaluation Costs	$44		$50	
10	SWE Audit Costs	$18		$48	
11	**Program Overhead Costs (Sum of rows 5 through 10)**	**$392**		**$609**	
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)**	**$427**		**$710**	
14	Total NPV Lifetime Electric Energy Benefits	$48		$72	
15	Total NPV Lifetime Electric Capacity Benefits	$14		$18	
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)**	**$62**		**$90**	
19	**TRC Benefit-Cost Ratio [8]**	**0.15**		**0.13**	

[1] Includes direct install equipment costs.
[2] Includes direct costs attributable to plan and to advance the programs.
[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.
[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.

Table 98 presents program financials and cost-effectiveness on a net savings basis.

Table 100: Summary of MFHR Program Finances – Net Verified

Row #	Cost Category	PYTD ($1,000)		P3TD ($1,000)	
1	EDC Incentives to Participants [1]	$17		$49	
2	EDC Incentives to Trade Allies	$0		$0	
3	Participant Costs (net of incentives/rebates paid by utilities)	-$1		$15	
4	**Incremental Measure Costs (Sum of rows 1 through 3)**	**$16**		**$63**	
		EDC	**CSP**	**EDC**	**CSP**
5	Design & Development [2]	$0	$0	$5	$19
6	Administration, Management, and Technical Assistance [3]	$47	$46	$66	$100
7	Marketing [4]	$0	$0	$0	$0
8	Program Delivery [5]	$28	$209	$26	$295
9	EDC Evaluation Costs	$44		$50	
10	SWE Audit Costs	$18		$48	
11	**Program Overhead Costs (Sum of rows 5 through 10)**	**$392**		**$609**	
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)**	**$408**		**$672**	
14	Total NPV Lifetime Electric Energy Benefits	$22		$40	
15	Total NPV Lifetime Electric Capacity Benefits	$6		$9	
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)**	**$28**	**$49**

19	**TRC Benefit-Cost Ratio [8]**	**0.07**	**0.07**

[1] Includes direct install equipment costs.
[2] Includes direct costs attributable to plan and to advance the programs.
[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.
[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.

3.9.7 Status of Recommendations

Findings and recommendations reported in the CEP/EXP Section 3.6.7 apply for the MFHR program as well.

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 by 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 PY9), 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 101 presents the participation counts, reported energy and demand savings, and incentive payments for the Industrial Program in PY9 by customer segment.

Table 101: Industrial Efficiency Program Participation and Reported Impacts

Parameter	Large C&I (Non-GNI)
PYTD # Participants	25
PYRTD MWh/yr	16,050
PYRTD MW/yr	1.17
PY9 Incentives ($1000)	$758

3.10.2 Gross Impact Evaluation

The sample design for the Industrial Program used the stratified ratio estimator approach (Lohr 1999)[25]. The approach is similar to that used for the residential programs except 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 measure 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 measures 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.

Because of the size and complexity of industrial projects, which often consist of large numbers of line items, Navigant samples the industrial program at the measure level, rather than at the

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

project level.

For the PY9 evaluation, Navigant sampled measures from both PY8 and PY9, and has combined the results from those two years into one realization rate, which is applied to PY9 and will be used for PY10.

Table 102: Industrial Efficiency Gross Impact Sample Design for PY8/9

Stratum	Population Size[26]	Achieved Sample Size	Evaluation Activity
Industrial - Large	3	3	Verification Only Visit, Verification and Trending Visit
Industrial - Medium	21	10	Verification Only Visit, Verification and Trending Visit
Industrial - Small	200	13	Verification Only Visit, Verification and Trending Visit, Phone Verification
Total	**224**	**26**	

Table 103: Industrial Efficiency Program Gross Impact Results for Energy

Stratum	PYRTD MWh/yr	Energy Realization Rate (PY8/PY9 Combined)	Sample C_v or Error Ratio	Relative Precision at 90% C.L.
Industrial - Large	10,344	97%	0.00	0.0%
Industrial - Medium	5,043	113%	0.24	14.0%
Industrial - Small	662	108%	1.63	80.7%
Program Total	**16,050**	**103%**		**5.6%**

[26] Participant counts when sampling reflect the total number of measures rather than the total number of participants.

Table 104: Industrial Efficiency Program Gross Impact Results for Demand

Stratum	PYRTD MW/yr	Demand Realization Rate (PY8/PY9 Combined)	Sample C_v or Error Ratio	Relative Precision at 90% C.L.
Industrial - Large	0.30	92%	0.00	0.0%
Industrial - Medium	0.74	117%	0.47	27.3%
Industrial - Small	0.13	116%	0.190	127.5%
Program Total	**1.17**	**110%**		**22.0%**

Three large projects, one from PY8 and two from PY9, dominated the savings for the Industrial program in this evaluation period, accounting for over 80 percent of the savings. One project alone, with an ex ante savings of 8.3GWh, accounted for nearly half the two-year savings. These three projects had the largest impact on the overall Industrial Program realization rate.

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

- **Data Availability:** One large customer, responsible for two of the biggest industrial projects, provided significantly more data for analysis than was available for the ex-ante calculations. This data indicated a seasonality to production that was not evident with the ex-ante data. Refining the analysis based on this seasonality reduced the realization rate slightly for one project but increased it for the other.
- **Baseline Fixtures:** One site had the incorrect baseline fixtures indicated. The project file indicated that the baseline fixtures were 400W metal halides. On site, Navigant confirmed that these were low-bay, 250W metal halide fixtures. This reduced the realization rate for this site to approximately 50%.
- **Custom Calculations:** One large air compressor project had ex ante calculations that estimated CFM from kW trend data, then translated the CFM back to kW after a bin analysis. Since the trend data did not vary significantly during the trending period, the ex post analysis utilized the kW data directly. This, combined with reducing the savings from the new dryer (which had been double counted), led to an overall increase in energy savings of approximately 10%, but reduced the demand savings.

3.10.3 Net Impact Evaluation

In PY9, the evaluation team assessed free ridership for the industrial efficiency program using a customer self-report approach following the SWE framework.[27] This approach used a survey

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

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.[28]

The NTG was then calculated based on the generic formulation illustrated in Equation 6:

Equation 6. Total Net to Gross Ratio

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

An attempted census was completed for all unique decision makers across the program in PY9. In some case a unique decision maker was responsible for multiple projects and multiple accounts. Each unique decision maker was asked about one project and up to three measures. The sample design and achieved sample size are shown in Table 105.

Table 105: Industrial Net Impact Sample Design

Stratum	Stratum Boundaries	Population Size	Achieved Sample Size	Response Rate
Industrial Participants	All unique decision makers	19	6	32%

The resulting overall NTG ratio is applied to the total gross savings for the industrial efficiency program. A summary of the PY9 NTG results is included below in Table 106.

Table 106: Industrial Efficiency Program Net Impact Evaluation Results

Target Group	Estimated Free Ridership	Estimated Participant Spillover	NTG Ratio	Relative Precision (@ 85% CL)
Industrial	69%	0%	31%	6.0%

The SWE methodology led to much higher free ridership (and lower NTG) than found in previous years. This was true for many of DLC's C&I programs, but the impact was most significant for the Industrial program. Given the small achieved sample size there is some uncertainty around the estimate. In addition, many respondents reported that while the Duquesne Light program was influential in their decision process in earlier program years, they now have a better understanding of the potential energy savings and would complete the same efficient project scope regardless of the program availability or availability of the Duquesne Light

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

rebates. This suggests that the programs may be transforming the market which is not easily quantified through the SWE methodology. In future years, Navigant recommends using advanced letters and incentives to encourage higher survey completion rates, as well as additional questions to explore market transformation and allow for a better understanding of the program impacts. See Navigant's PY9 C&I Process Evaluation Report for Duquesne Light for more detail regarding the NTG analysis.

High-Impact Measure Research

Results of the High-Impact Measures research for the C&I programs (4-foot linear LEDs) is outlined in section 3.6.3.

3.10.4 Verified Savings Estimates

In Table 107 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 PY9. These totals are added to the verified savings achieved in previous program years to calculate the P3TD program impacts.

Table 107: Industrial Program PYTD and P3TD Savings Summary

Savings Type	Energy (MWh/yr)	Demand (MW/yr)
PYRTD	16,050	1.17
PYVTD Gross	16,491	1.29
PYVTD Net	5,047	0.40
RTD	20,701	1.76
VTD Gross	21,118	1.87
VTD Net	8,213	0.79

3.10.5 Process Evaluation

In PY9, the Navigant team attempted to complete surveys with all Industrial Efficiency program participants to estimate the net-to-gross effects of the program (i.e., free ridership and spillover) and to assess program satisfaction. Results of the process evaluation components of the survey have been aggregated to the C&I level to assess overall satisfaction and to identify areas of improvement.

Navigant also completed interviews with Trade Allies as part of the PY9 process evaluation. Trade allies included individuals that participated in one of Duquesne Light's C&I energy efficiency programs in PY8 or PY9 as a contractor, energy equipment supplier and/or other building system professional. The objective of the interview was to obtain feedback from trade allies about their participation in Duquesne Light's C&I energy efficiency programs. The interviews focused on the participation process, benefits, and barriers of these programs from the perspective of a trade ally.

3.10.6 Cost-Effectiveness Reporting

A detailed breakdown of program finances and cost-effectiveness is presented in Table 108. TRC benefits in Table 108 were calculated using gross verified impacts. Net present value (NPV) PYTD costs and benefits are expressed in 2017 dollars. Net present value costs and benefits for P3TD financials are discounted back to 2016.

Table 108: Summary of Industrial Program Finances – Gross Verified

Row #	Cost Category	PYTD ($1,000)		P3TD ($1,000)	
1	EDC Incentives to Participants [1]	$758		$865	
2	EDC Incentives to Trade Allies	$0		$0	
3	Participant Costs (net of incentives/rebates paid by utilities)	$394		$431	
4	**Incremental Measure Costs (Sum of rows 1 through 3)**	**$1,152**		**$1,296**	
		EDC	**CSP**	**EDC**	**CSP**
5	Design & Development [2]	$0	$0	$4	$69
6	Administration, Management, and Technical Assistance [3]	$166	$164	$180	$359
7	Marketing [4]	$0	$0	$0	$0
8	Program Delivery [5]	$30	$384	$28	$681
9	EDC Evaluation Costs	$155		$178	
10	SWE Audit Costs	$62		$168	
11	**Program Overhead Costs (Sum of rows 5 through 10)**	**$961**		**$1,668**	
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)**	**$2,113**		**$2,964**	
14	Total NPV Lifetime Electric Energy Benefits	$8,212		$9,947	
15	Total NPV Lifetime Electric Capacity Benefits	$1,505		$2,059	

16	Total NPV Lifetime Operation and Maintenance (O&M) Benefits	$92	$115
17	Total NPV Lifetime Non-Electric Benefits (Fossil Fuel, Water)	-$310	-$290
18	**Total NPV TRC Benefits [7] (Sum of rows 14 through 17)**	**$9,499**	**$11,831**
19	**TRC Benefit-Cost Ratio [8]**	**4.50**	**3.99**

[1] Includes direct install equipment costs.
[2] Includes direct costs attributable to plan and to advance the programs.
[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.
[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.

Table 109 presents program financials and cost-effectiveness on a net savings basis.

Table 109: Summary of Industrial Program Finances – Net Verified

Row #	Cost Category	PYTD ($1,000)		P3TD ($1,000)	
1	EDC Incentives to Participants [1]	$758		$865	
2	EDC Incentives to Trade Allies	$0		$0	
3	Participant Costs (net of incentives/rebates paid by utilities)	-$405		-$386	
4	**Incremental Measure Costs (Sum of rows 1 through 3)**	**$353**		**$480**	
		EDC	**CSP**	**EDC**	**CSP**
5	Design & Development [2]	$0	$0	$4	$69
6	Administration, Management, and Technical Assistance [3]	$166	$164	$180	$359
7	Marketing [4]	$0	$0	$0	$0
8	Program Delivery [5]	$30	$384	$28	$681
9	EDC Evaluation Costs	$155		$178	
10	SWE Audit Costs	$62		$168	

11	**Program Overhead Costs (Sum of rows 5 through 10)**	**$961**	**$1,668**
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)**	**$1,314**	**$2,147**
14	Total NPV Lifetime Electric Energy Benefits	$2,513	$3,901
15	Total NPV Lifetime Electric Capacity Benefits	$461	$876
16	Total NPV Lifetime Operation and Maintenance (O&M) Benefits	$28	$46
17	Total NPV Lifetime Non-Electric Benefits (Fossil Fuel, Water)	-$95	-$89
18	**Total NPV TRC Benefits [7] (Sum of rows 14 through 17)**	**$2,907**	**$4,735**
19	**TRC Benefit-Cost Ratio [8]**	**2.21**	**2.20**

[1] Includes direct install equipment costs.
[2] Includes direct costs attributable to plan and to advance the programs.
[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.
[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.

3.10.7 Status of Recommendations

In addition to the over-arching C&I process evaluation recommendations identified in section 3.6.7, Navigant has made the following recommendation to Duquesne Light based on the impact evaluation activities:

Finding:

Navigant found that the CSP used less data than recommended for analysis for one large and one medium custom Industrial project. In one project, the CSP used only two months of post-retrofit data, which missed a seasonal component of the energy savings. In the other, the CSP had only two weeks of pre- and post-retrofit data. In each case, including additional data when verifying the savings through the evaluation altered the savings of the site.

Recommendation:

For custom projects, where predictive variables such as weather are unavailable, Navigant recommends that the CSP collect and use at least one year of data (pre and post) to provide a more accurate estimate of the project impacts.

Duquesne Light Status Report:

Duquesne Light will request that when available, the CSP collects and utilizes one year of data in the savings analysis for projects.

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. The PAPP 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 PY9), 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 110 presents the participation counts, reported energy and demand savings, and incentive payments for PAPP in PY9 by customer segment.

Table 110: PAPP Participation and Reported Impacts

Parameter	PAPP (GNI)
PYTD # Participants	71
PYRTD MWh/yr	5,599
PYRTD MW/yr	0.65
PY9 Incentives ($1000)	$236

3.11.2 Gross Impact Evaluation

Navigant did not evaluate PAPP in PY9 as per the Evaluation Plan approved by the SWE. For PY9, Navigant utilized the verification results from PY8 and applied them to the PY9 ex-ante numbers. Navigant performed 13 site visits and phone verifications during the PY9 evaluation period, the results of which will be rolled up in PY10 and applied to the PY10 and PY11 ex ante numbers for PAPP. The PY8 verification results are applied to the PY9 reported savings.

Table 111: 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	4,123	97%	0.08	6.3%
PAPP - Small	1,476	112%	0.22	9.7%
Program Total	**5,599**	**101%**		**4.7%**

Table 112: 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	0.48	96%	0.16	12.8%
PAPP - Small	0.16	67%	1.49	66.4%
Program Total	**0.65**	**88%**		**15.2%**

3.11.3 Net Impact Evaluation

In PY9, the evaluation team assessed free ridership for the PAPP program using a customer self-report approach following the SWE framework.[29] 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

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

also asked program participants a battery of questions to quantitatively assess spillover, in accordance with the SWE's guidance memorandum on this activity.[30]

The NTG was then calculated based on the generic formulation illustrated in Equation 7:

Equation 7. Total Net to Gross Ratio

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

An attempted census was completed for all unique decision makers across the program in PY9. In some case a unique decision maker was responsible for multiple projects and multiple accounts. Each unique decision maker was asked about one project and up to three measures. The NTG results from the other GNI programs (MFHR and CEEP) which have similar delivery channels and target audiences were combined with the PAPP results given the low number of respondents. The sample design and achieved sample size are shown in Table 113.

Table 113: GNI Net Impact Sample Design

Stratum	Stratum Boundaries	Population Size	Achieved Sample Size	Response Rate
MFHR	All unique decision makers	2	1	50%
CEEP	All unique decision makers	19	2	11%
PAPP	All unique decision makers	52	13	25%

The resulting overall NTG ratio is applied to the total gross savings for the PAPP program. A summary of the PY9 NTG results is included below in Table 114.

Table 114: PAPP Program Net Impact Evaluation Results

Target Group	Estimated Free Ridership	Estimated Participant Spillover	NTG Ratio	Relative Precision (@ 85% CL)
PAPP, MFHR, CEEP	0.55	0.00	0.45	32.8%

See Navigant's PY9 C&I Process Evaluation Report for Duquesne Light for more detail regarding the NTG analysis.

High-Impact Measure Research

Results of the High-Impact Measures research for the C&I programs (4-foot linear LEDs) is outlined in section 3.6.3.

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

3.11.4 Verified Savings Estimates

In Table 115 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 PY9. These totals are added to the verified savings achieved in previous program years to calculate the P3TD program impacts.

Table 115: PAPP PYTD and P3TD Savings Summary

Savings Type	Energy (MWh/yr)	Demand (MW/yr)
PYRTD	5,599	0.65
PYVTD Gross	5,631	0.57
PYVTD Net	2,562	0.26
RTD	9,393	1.01
VTD Gross	9,476	0.89
VTD Net	5,655	0.52

3.11.5 Process Evaluation

In PY9, the Navigant team attempted to complete surveys with all PAPP program participants to estimate the net-to-gross effects of the program (i.e., free ridership and spillover) and to assess program satisfaction. Results of the process evaluation components of the survey have been aggregated to the C&I level to assess overall satisfaction and to identify areas of improvement.

Navigant also completed interviews with Trade Allies as part of the PY9 process evaluation. Trade allies included individuals that participated in one of Duquesne Light's C&I energy efficiency programs in PY8 or PY9 as a contractor, energy equipment supplier and/or other building system professional. The objective of the interview was to obtain feedback from trade allies about their participation in Duquesne Light's C&I energy efficiency programs. The interviews focused on the participation process, benefits, and barriers of these programs from the perspective of a trade ally.

3.11.6 Cost-Effectiveness Reporting

A detailed breakdown of program finances and cost-effectiveness is presented in Table 116. TRC benefits in Table 116 were calculated using gross verified impacts. Net present value (NPV) PYTD costs and benefits are expressed in 2017 dollars. Net present value costs and benefits for P3TD financials are discounted back to 2016.

Table 116: Summary of PAPP Finances – Gross Verified

Row #	Cost Category	PYTD ($1,000)	P3TD ($1,000)
1	EDC Incentives to Participants [1]	$236	$370

2	EDC Incentives to Trade Allies	$0		$0	
3	Participant Costs (net of incentives/rebates paid by utilities)	$424		$825	
4	**Incremental Measure Costs (Sum of rows 1 through 3)**	**$660**		**$1,194**	
		EDC	**CSP**	**EDC**	**CSP**
5	Design & Development [2]	$0	$0	$4	$38
6	Administration, Management, and Technical Assistance [3]	$92	$92	$108	$201
7	Marketing [4]	$0	$0	$0	$0
8	Program Delivery [5]	$28	$262	$26	$928
9	EDC Evaluation Costs	$86		$98	
10	SWE Audit Costs	$34		$93	
11	**Program Overhead Costs (Sum of rows 5 through 10)**	**$594**		**$1,497**	
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)**	**$1,254**		**$2,691**	
14	Total NPV Lifetime Electric Energy Benefits	$2,730		$4,296	
15	Total NPV Lifetime Electric Capacity Benefits	$665		$977	
16	Total NPV Lifetime Operation and Maintenance (O&M) Benefits	$119		$194	
17	Total NPV Lifetime Non-Electric Benefits (Fossil Fuel, Water)	-$143		-$134	
18	**Total NPV TRC Benefits [7] (Sum of rows 14 through 17)**	**$3,371**		**$5,333**	
19	**TRC Benefit-Cost Ratio [8]**	**2.69**		**1.98**	

[1] Includes direct install equipment costs.
[2] Includes direct costs attributable to plan and to advance the programs.

[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.
[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.

Table 117 presents program financials and cost-effectiveness on a net savings basis.

Table 117: Summary of PAPP Finances – Net Verified

Row #	Cost Category	PYTD ($1,000)		P3TD ($1,000)	
1	EDC Incentives to Participants [1]	$236		$370	
2	EDC Incentives to Trade Allies	$0		$0	
3	Participant Costs (net of incentives/rebates paid by utilities)	$64		$375	
4	**Incremental Measure Costs (Sum of rows 1 through 3)**	**$300**		**$745**	
		EDC	**CSP**	**EDC**	**CSP**
5	Design & Development [2]	$0	$0	$4	$38
6	Administration, Management, and Technical Assistance [3]	$92	$92	$108	$201
7	Marketing [4]	$0	$0	$0	$0
8	Program Delivery [5]	$28	$262	$26	$928
9	EDC Evaluation Costs	$86		$98	
10	SWE Audit Costs	$34		$93	
11	**Program Overhead Costs (Sum of rows 5 through 10)**	**$594**		**$1,497**	
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)**	**$894**		**$2,242**	

14	Total NPV Lifetime Electric Energy Benefits	$1,242	$2,563
15	Total NPV Lifetime Electric Capacity Benefits	$303	$568
16	Total NPV Lifetime Operation and Maintenance (O&M) Benefits	$54	$117
17	Total NPV Lifetime Non-Electric Benefits (Fossil Fuel, Water)	-$65	-$61
18	**Total NPV TRC Benefits [7] (Sum of rows 14 through 17)**	**$1,534**	**$3,188**

19	**TRC Benefit-Cost Ratio [8]**	**1.71**	**1.42**

[1] Includes direct install equipment costs.
[2] Includes direct costs attributable to plan and to advance the programs.
[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.
[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.

3.11.7 Status of Recommendations

The findings and recommendations outlined in the CEP/EXP program Section 3.8.7 also apply for the PAPP program.

3.12 Community Education Program

The Community Education Energy Efficiency Program (CEEP), launched in PY8, is 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.

Schools which do not participate in the training or Conservation Action Plan portion of the program may also participate by having rebated equipment installed or custom projects developed and deployed.

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

Table 118: CEEP Participation and Reported Impacts

Parameter	CEEP (GNI)
PYTD # Participants	33
PYRTD MWh/yr	1,372
PYRTD MW/yr	0.18
PY9 Incentives ($1000)	$89

3.12.2 Gross Impact Evaluation

Navigant did not evaluate the Community Education program in PY9, as detailed in the Evaluation Plan approved by the SWE. For PY9, Navigant utilized the verification results from PY8 and applied them to the PY9 ex-ante numbers.

Table 119: 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	885	100%	0.00	0.0%
Community Ed - Small	486	112%	0.08	8.1%
Program Total	**1,372**	**104%**		**2.6%**

Table 120: 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	0.11	101%	0.00	0.0%
Community Ed - Small	0.07	86%	0.14	13.3%
Program Total	**0.18**	**95%**		**3.7%**

Factors affecting the Community Education realization rates are detailed in Navigant's PY8 report.

3.12.3 Net Impact Evaluation

In PY9, the evaluation team assessed free ridership for the CEEP program using a customer self-report approach following the SWE framework.[31] 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.[32]

The NTG was then calculated based on the generic formulation illustrated in Equation 8:

Equation 8. Total Net to Gross Ratio

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

An attempted census was completed for all unique decision makers across the program in PY9. In some case a unique decision maker was responsible for multiple projects and multiple accounts. Each unique decision maker was asked about one project and up to three measures. The NTG results from the other GNI programs (MFHR and PAPP) which have similar delivery channels and target audiences were combined with the CEEP results given the low number of respondents. The sample design and achieved sample size are shown in Table 121.

Table 121: GNI Net Impact Sample Design

Stratum	Stratum Boundaries	Population Size	Achieved Sample Size	Response Rate
MFHR	All unique decision makers	2	1	50%
CEEP	All unique decision makers	19	2	11%
PAPP	All unique decision makers	52	13	25%

The resulting overall NTG ratio is applied to the total gross savings for the CEEP program. A summary of the PY9 NTG results is included below in Table 122.

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

Table 122: CEEP Program Net Impact Evaluation Results

Target Group	Estimated Free Ridership	Estimated Participant Spillover	NTG Ratio	Relative Precision (@ 85% CL)
GNI	0.55	0.00	0.45	32.8%

See Navigant's PY9 C&I Process Evaluation Report for Duquesne Light for more detail regarding the NTG analysis.

High-Impact Measure Research

Results of the High-Impact Measures research for the C&I programs (4-foot linear LEDs) is outlined in section 3.6.3.

3.12.4 Verified Savings Estimates

In Table 123 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 PY9. These totals are added to the verified savings achieved in previous program years to calculate the P3TD program impacts.

Table 123: CEEP PYTD and P3TD Savings Summary

Savings Type	Energy (MWh/yr)	Demand (MW/yr)
PYRTD	1,372	0.18
PYVTD Gross	1,426	0.17
PYVTD Net	649	0.078
RTD	2,455	0.41
VTD Gross	2,541	0.39
VTD Net	1,546	0.26

3.12.5 Process Evaluation

In PY9, the Navigant team attempted to complete surveys with all CEEP program participants to estimate the net-to-gross effects of the program (i.e., free ridership and spillover) and to assess program satisfaction. Results of the process evaluation components of the survey have been aggregated to the C&I level to assess overall satisfaction and to identify areas of improvement.

Navigant also completed interviews with Trade Allies as part of the PY9 process evaluation. Trade allies included individuals that participated in one of Duquesne Light's C&I energy efficiency programs in PY8 or PY9 as a contractor, energy equipment supplier and/or other building system professional. The objective of the interview was to obtain feedback from trade

allies about their participation in Duquesne Light's C&I energy efficiency programs. The interviews focused on the participation process, benefits, and barriers of these programs from the perspective of a trade ally.

Navigant also completed interviews with CEEP school program participants. These are individuals who are an employee of a school that participated in the Duquesne's CEEP program in PY8 or PY9 (2016-2017) and were involved with the program as a trainer for students or as an administrator for the program. The objective of the interview was to obtain feedback from program participants about the program process, benefits, and barriers in relation to Duquesne Light's CEEP. Given these objectives, Navigant designed the interview guide to allow for "free-flowing" conversations between the evaluation team and participants to pursue relevant issues and topics.

3.12.6 Cost-Effectiveness Reporting

A detailed breakdown of program finances and cost-effectiveness is presented in Table 124. TRC benefits in Table 124 were calculated using gross verified impacts. Net present value (NPV) PYTD costs and benefits are expressed in 2017 dollars. Net present value costs and benefits for P3TD financials are discounted back to 2016.

Table 124: Summary of CEEP Finances – Gross Verified

Row #	Cost Category	PYTD ($1,000)		P3TD ($1,000)	
1	EDC Incentives to Participants [1]	$89		$160	
2	EDC Incentives to Trade Allies	$0		$0	
3	Participant Costs (net of incentives/rebates paid by utilities)	$54		$445	
4	**Incremental Measure Costs (Sum of rows 1 through 3)**	**$143**		**$605**	
		EDC	**CSP**	**EDC**	**CSP**
5	Design & Development [2]	$0	$0	$3	$9
6	Administration, Management, and Technical Assistance [3]	$22	$21	$25	$48
7	Marketing [4]	$0	$0	$0	$0
8	Program Delivery [5]	$8	$313	$7	$392
9	EDC Evaluation Costs	$20		$23	
10	SWE Audit Costs	$8		$22	
11	**Program Overhead Costs (Sum of rows 5 through 10)**	**$392**		**$529**	

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)**	**$535**	**$1,134**
14	Total NPV Lifetime Electric Energy Benefits	$716	$1,222
15	Total NPV Lifetime Electric Capacity Benefits	$194	$425
16	Total NPV Lifetime Operation and Maintenance (O&M) Benefits	$44	$172
17	Total NPV Lifetime Non-Electric Benefits (Fossil Fuel, Water)	-$82	-$77
18	**Total NPV TRC Benefits [7] (Sum of rows 14 through 17)**	**$872**	**$1,742**
19	**TRC Benefit-Cost Ratio [8]**	**1.63**	**1.54**

[1] Includes direct install equipment costs.
[2] Includes direct costs attributable to plan and to advance the programs.
[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.
[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.

Table 125 presents program financials and cost-effectiveness on a net savings basis.

Table 125: Summary of CEEP Finances – Net Verified

Row #	Cost Category	PYTD ($1,000)	P3TD ($1,000)
1	EDC Incentives to Participants [1]	$89	$160
2	EDC Incentives to Trade Allies	$0	$0
3	Participant Costs (net of incentives/rebates paid by utilities)	-$24	$280
4	**Incremental Measure Costs (Sum of rows 1 through 3)**	**$65**	**$440**

		EDC	CSP	EDC	CSP
5	Design & Development [2]	$0	$0	$3	$9
6	Administration, Management, and Technical Assistance [3]	$22	$21	$25	$48
7	Marketing [4]	$0	$0	$0	$0
8	Program Delivery [5]	$8	$313	$7	$392
9	EDC Evaluation Costs	$20		$23	
10	SWE Audit Costs	$8		$22	
11	**Program Overhead Costs (Sum of rows 5 through 10)**	**$392**		**$529**	
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)**	**$457**		**$969**	
14	Total NPV Lifetime Electric Energy Benefits	$326		$749	
15	Total NPV Lifetime Electric Capacity Benefits	$88		$279	
16	Total NPV Lifetime Operation and Maintenance (O&M) Benefits	$20		$124	
17	Total NPV Lifetime Non-Electric Benefits (Fossil Fuel, Water)	-$37		-$35	
18	**Total NPV TRC Benefits [7] (Sum of rows 14 through 17)**	**$397**		**$1,116**	
19	**TRC Benefit-Cost Ratio [8]**	**0.87**		**1.15**	

[1] Includes direct install equipment costs.
[2] Includes direct costs attributable to plan and to advance the programs.
[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.
[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.

3.12.7 Status of Recommendations

In addition to the recommendations outlined in the CEP/EXP Section 3.6.7, Navigant has included the following findings and recommendations for CEEP based on the participating school contact interviews.

Finding:

When asked for constructive feedback on the program materials, respondents had a variety of suggestions, mainly about amount of materials and content. Two of the participants felt that the amount of curriculum provided was overwhelming and requested training on the materials before they implemented them in class. One respondent thought the videos were too long, another requested that the program include additional interactive activities, and a third felt that the Excel sheet provided as part of the program was inappropriate for their students' age (because they did not know how to use it).

Recommendation:

For the CEEP program, training materials should be re-examined and potentially tailored to ensure that they are age appropriate. They should also be tailored to ensure that they provide students with guidance on how to identify energy efficiency opportunities most commonly found in school settings.

Duquesne Light Status Report:

The implementation contractor (MCR) has been reviewing and updating training materials in response to the feedback.

Finding:

All CEEP school representative respondents noted that they did not have the authority to follow up on installing the measures outlined in the plan. The four that had students present to the principal said the principal ultimately had this authority. Likewise, the teacher that sent the plan to the superintendent said that the superintendent held the authority for implementing measures outlined in the plan. Most were unaware of the decision-making process for installing measures, although they assumed cost was a major factor. Only two of the five respondents reported installing energy efficient measures and both had only installed lighting measures.

Recommendation:

Duquesne Light should re-examine the training and Conservation Action Plan elements of the CEEP program design to ensure that decision-makers, such as principals and superintendents, are engaged early-on to obtain buy-in for measures identified in the Conservation Action Plan. For instance, Duquesne Light can facilitate meetings with decision-makers and teachers to discuss how the program works and potential options for actions once the students create the Conservation Action Plan. These meetings can serve the dual purpose of persuading decision-makers to install measures while also educating schools about the participation process and material content.

Duquesne Light Status Report:

MCR has been developing relationships with the school and school board decision makers

throughout the program ramp-up. These relationships will continue to develop and a process for involving these decision makers in the Conservation Plan review will be evaluated.

3.13 Large Curtailable Load Program

The Duquesne Large Curtailable Load (LCL) program is a C&I DR program designed to engage large Duquesne Light C&I customers in demand reduction during the utility system's peak hours. Enerlogics, Duquesne's curtailment services provider (CSP), contracts with individual businesses located in the Duquesne Light territory to provide demand response when Act 129 events are called. Act 129 demand response events are triggered by PJM's day-ahead load forecast. When the day-ahead forecast is above 96% of the peak load forecast for the year, a demand response event is initiated for the following day. Participating customers contracted by the CSP may choose to opt out of some events or some hours of events.

There are specific conditions that will trigger DR events during Phase III. The Phase III Implementation Order and subsequent Clarification Order provided clear instructions to EDCs about which hours would be used to measure DR performance (i.e., when to call DR events):

1. Curtailment events shall be limited to the months of June through September.
2. Curtailment events shall be called for the first 6 days 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 each year of the program.
3. Each curtailment event shall last 4 consecutive hours.
4. Each curtailment event shall be called such that it will occur during the day's forecasted peak hour(s) above 96% of PJM's 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.
6. The reductions attributable to a 4-consecutive-hour curtailment event will be based on the average megawatt reduction achieved during each hour of an event.
7. Compliance will be determined based on the average megawatt reductions achieved from events called in the last 4 years of the Phase III program.
8. In their plans, the Electricity Distribution Companies (EDCs) must demonstrate that the EDC program cost to acquire megawatts from customers who participate in PJM's ELRP is no more than half the cost to acquire megawatts from customers in the same rate class that are not participating in PJM's ELRP.

There were several important operational details that were not addressed explicitly in the Phase III Implementation Order or the Clarification Order. The SWE, TUS, and EDCs have discussed these issues collectively and reached consensus on the following clarifications.

- To support wholesale energy market operations, PJM provides an hourly load forecast online that is updated every 15 minutes.[33] A subset of the 96 daily forecasts are archived

[33] http://www.pjm.com/markets-and-operations/energy/real-time/7-day-load-forecast.aspx

by PJM.[34] EDCs should use the 9:45 a.m. forecast as the forecast of record when determining whether the following day will be an Act 129 DR event or not.

- The 96% threshold and resulting Act 129 event dispatch determinations will rely solely on Table B-1 of the January PJM Load Forecast Report called for in the Phase III Clarification Order.
- Act 129 DR events are limited to non-holiday weekdays.

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

3.13.1 Participation and Reported Savings by Customer Segment

Table 126 presents the participation counts, reported peak demand savings, and EDC expenditures for the LCL program in PY9 by customer segment.

Table 126: LCL Participation and Reported Impacts

Parameter	Small C&I (Non-GNI)	Large C&I (Non-GNI)	GNI	Total
PYTD # Participants	4	35	35	74
PYRTD MW/yr	0.36	39.82	11.08	51.26
PY9 Incentives ($1000)	$6	$430	$215	$651

3.13.2 Gross Impact Evaluation

This section of the report provides a summary of Navigant's approach for evaluating impacts in PY9, as well as some interim outputs (i.e., impacts by strata).

[34] http://www.pjm.com/markets-and-operations/ops-analysis/historical-load-forecasts.aspx

Navigant used two different approaches for estimating program impacts on a customer-by-customer basis:

- **CBL:** The standard 4-of-5 customer baseline (CBL) with a weather sensitivity adjustment (WSA).[35] This is the approach used by the CSP for determining settlement.
- **Regression:** A single-customer linear regression.

The approach selected for each customer was determined based on the testing procedure described in the evaluation plan and approved by the SWE. This is also described below.

The remainder of this section is divided into the following three subsections:

- **Testing & Selection of Appropriate Impact Estimation Approach.** A summary of the test regime used by Navigant to determine which of two potential evaluation approaches is most appropriate for each participating customer.
- **Impact Estimation.** Details of the two approaches to be used for estimating impacts.
- **Impact Findings and Lessons.** Summary tables of impacts by approach type, lessons learned and additional actions to be taken for the PY10 program evaluation.

Testing & Selection of Appropriate Impact Estimation Approach

In PY9, Navigant tested two impact estimation approaches for each customer using 2016 data (a summer in which no Act 129 events occurred). The approach that most successfully predicts actual customer demand during simulated events in the summer of 2016 was the one applied to that customer for the evaluation of PY9 (2017) impacts.

The test procedure is as follows:

Step 1: Simulate DR Events for PY2016.

Simulated 2016 events were developed for the summer of 2016 based on the archive of 9:45 AM forecast of PJM system demand for the next day, and the event-triggering criteria outlined above. When the 9:45 AM forecast of PJM system demand for the following day includes an estimated peak demand that is more than the 2016 PJM RTO summer peak demand forecast, that day becomes a simulated event day.

Step 2: Estimate Baseline Using CBL.

Use the CSP CBL (the 4-of-5 PJM CBL for economic curtailment, adjusted for weather effects using the WSA factors). A baseline is estimated for all the hours of the 2016 simulated events. The CBL is calculated following all SWE requirements (e.g., exclusion of PJM Emergency or Economic DR events from five-day CBL window).

Step 3: Estimate Impacts (Baseline) Using Regression

Transform the participant data by setting demand in all hours of simulated events in

[35] PJM, *Weather Sensitive Adjustment Using the WSA Factor Method*, accessed November 2017 http://www.pjm.com/~/media/markets-ops/demand-response/dsr-weather-sensitive-adjustment-using-wsa-factor-method.ashx
See "Example 3" in this document for a detailed example of how the factors are applied.

2016 equal to zero. For each customer apply these data to the model specification in the section below to estimate "impacts" (i.e., baseline) during these simulated events.

Step 4: Calculate Out-of-Sample Accuracy

For the two approaches, calculate the sum of squared errors (i.e., the difference between the predicted baseline average event demand and actual average event demand) for each participant.

Step 5: Assign Approach for PY9 (Summer 2017)

Whichever approach delivers the most accurate result becomes the 2017 evaluation approach for the given participant.

Impact Estimation

This section outlines the impact estimation approach. Navigant will use one of two approaches for estimating impacts for each customer (selected based on the testing procedure above): either the Enerlogics 4-of-5 CBL, or an individual customer regression.

Customer Baseline (CBL)

The CSP CBL that was tested is a standard "4-of-5" customer baseline supplemented using WSA factors to account for differences in weather on the event days and on the days included in the CBL look-back window. The baseline is estimated in following fashion:

1. **Remove Non-Qualifying Days.** Remove all weekends and public holidays, Act 129 event days, and, as per section 6.2.2.1.5 of the Phase III Evaluation Framework, all PJM Emergency and Economic events.
2. **Identify Look-Back Window.** Identify the five-day window of qualifying days preceding the event
3. **Calculate Non-Event Day Demand in Event Window.** Calculate the average participant demand during the event window (e.g., 1pm to 5pm) for each of the five qualifying non-event days in the look-back window. This delivers five averages, one for each day.
4. **Drop Low Day**. The non-event day with the lowest average event window demand is dropped.
5. **Calculate Unadjusted CBL.** The event-specific CBL – the baseline – values are estimated to be the average demand, by hour of day, in the four non-event days not dropped, from within the look-back window.
6. **Apply WSA Factors and Adjust Baseline**. Use the approach outlined in detail in "Example 2" of the PJM WSA document cited above to account for differences between average non-event-day look-back window temperature and event-day temperature. Produce final, adjusted CBLs

Calculate Impacts. Impacts are simply the difference between the adjusted baseline and the actual demand during the event hours in which the given customer participated (i.e., did not opt out).

Linear Regression

Navigant used hourly meter-level data for all participants.[36] Where multiple meters were provided for a single customer, data were aggregated to a single time-series. The estimation set included only demand observations on non-holiday weekdays in the DR season (June through September). Each event's notification day was also filtered out of the data. None of the LCL participants were also participants in the PJM Economic DR program in PY9, but had some been subject to these events, the days on which those events occurred (for the given customer) would also have been dropped.

Equation 9 shows the regression deployed for each customer:

Equation 9: LCL Regression

$$y_t = \alpha + \sum_{h=1}^{24} \beta_{h,1} hour_{h,t} + \sum_{h=1}^{24} \beta_{h,2} hour_{h,t} CDH65_t + \sum_{m=1}^{4} \sum_{h=1}^{24} \beta_{h,m,3} hour_{h,t} Month_{m,t} + \sum_{d=1}^{5} \sum_{h=1}^{24} \beta_{h,d,4} hour_{h,t} DoW_{h,t} + \sum_{c=1}^{C} \gamma_c C_{c,t} + \varepsilon_t$$

Where:

y_t = The given customer's demand in hour of sample *t*.

$hour_{q,t}$ = Twenty-four dummy variables capturing the hours of the day. Equal to one where hour *t* is the *q*-th hour of the day, and zero otherwise.

$CDH65_t$ = The cooling degree hours observed by the given customer in hour of sample *t*. Weather data to be obtained from the NOAA for the Pittsburgh International Airport.

$Month_{m,t}$ = Four dummy variables capturing the month. Equal to one when hour of sample *t* falls in month *m*, and zero otherwise.

$DoW_{d,t}$ = Five dummy variables capturing the day of the week. Equal to one when hour of sample *t* falls in day of the week *d* and zero otherwise.

$C_{c,t}$ = C number of dummy variables that capture the individual event periods for which the given customer meter participated.[37] The number of variables is equal to the number of hourly periods in which the given participant meter elected to participate in Act 129 events.

[36] Data were provided at quarter-hour frequency, but to match the frequency of the impacts reported by the CSP all of the analysis took place at the hourly level.

[37] As per the memorandum from the Phase III SWE team of 2017-04-26 ("Frequently Asked Questions Regarding Act 129 Demand Response"), participating meters may elect to participate for only some of the event hours, providing they submit their planned participation prior to the beginning of an event.

Equal to one when hour of sample *t* falls in the *c*-th event hour of the summer of 2017 and zero otherwise. Each dummy variable takes a value of one only once in the time series.

α, β, γ = Are all uniquely estimable parameters of the regression equation estimating (in each case) the conditional mean effect of the variable to which it is attached on the dependent variable y_t.

Impact Findings and Lessons Learned

The reported and verified impacts grouped by the two approaches are summarized in Table 127. These are followed by a few key lessons learned, a recommendation for the Duquesne Light CSP, and a brief outline of key differences in the approach to be used for the PY10 evaluation.

Table 127: Large Curtailable Load Program Gross Impact Evaluation Design for PY9

Stratum	Population Size	PYRTD MW	Evaluation Approach
CBL	37	12.82	4-of-5 CBL with WSA Adjustment[38]
Regression[39]	37	38.45	Linear regression
Program Total	**74**	**51.26**	

Table 128 presents the gross verified impacts for LCL by stratum for PY9.

[38] Note that for one customer site the Duquesne calculated settlement amounts (reported impacts) using only the 4-of-5 CBL without applying the WSA factor adjustment.
[39] The strata were defined by Navigant based on the testing protocol above. Reported impacts, calculated by Duquesne Light's CSP are all estimated using a 4-of-5 CBL (most with a WSA adjustment). The CSP did not estimate impacts using regression analysis.

Table 128: LCL Gross Impact Results for Demand

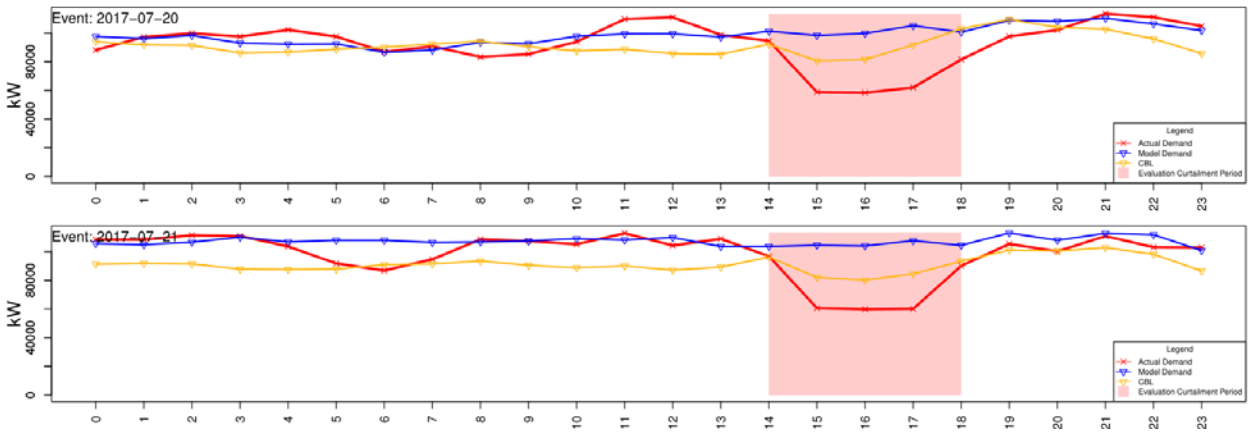
Stratum	PYRTD MW	Demand Realization Rate	PYVTD MW	Relative Precision at 90% C.L.
CBL	12.82	96%	12.26	8%
Regression[40]	38.45	122%	46.79	15%
Program Total	**51.26**	**115%**	**59.06**	**12%**

The most important factor driving the difference between the reported and verified impacts is the deviation between verified and reported impacts associated with the customer delivering the largest contribution to program DR. The customer in question is responsible for just over half of the program's verified DR achievement in PY9.

The difference between reported and verified impacts for this customer on the first event was relatively small, but for the final two events, the regression baseline delivered impacts nearly twice those that had been reported by the CSP.

This disparity is driven by the fact that for this customer the CBL is significantly biased downward for those final two events. This is clearly visible in the plotted baselines and actuals shown in Figure 13 below. In this plot, the red line shows the observed customer demand, the blue line shows the regression-based baseline, and the yellow line shows the CBL. Note how the CBL troughs downward during the event, and that it appears to be consistently lower than the pre-event demand on the third event.

Figure 13: Large Customer Account Baseline Comparison – Events 2 and 3



[40] See previous footnote.

The reason for this downward bias is the fact that the CBL is based only on the information from four days preceding the event, whereas the regression baseline leverages information from the whole summer. This makes the regression baseline less sensitive to infrequent (but large) shifts in customer demand provoked by the customer's response to potential 5CP PJM peak periods. In the days prior to the second and third event, this customer was curtailing its demand during the Act 129 event window in anticipation of these hours being potential 5CP hours (used to determine a portion of that customer's contribution to system costs). Because the CBL depends exclusively on four days preceding the event, this 5CP response significantly depresses the baseline.

In contrast, the regression baseline is much less sensitive to customer 5CP response since it uses data and estimated relationships from across the entire summer to estimate the baseline, and it also excludes from the estimation set the notification day for Act 129 events, in this case also a 5CP day.

3.13.3 Process Evaluation

Navigant did not complete a process evaluation for LCL during PY9.

3.13.4 Cost-Effectiveness Reporting

A detailed breakdown of program finances and cost-effectiveness is presented in Table 129. TRC benefits in Table 129 were calculated using gross verified impacts. Net present value (NPV) PYTD costs and benefits are expressed in 2017 dollars. Net present value costs and benefits for P3TD financials are discounted back to 2016.

Table 129: Summary of LCL Finances – Gross Verified

Row #	Cost Category	PYTD ($1,000)		P3TD ($1,000)	
1	EDC Incentives to Participants [1]	$651		$609	
2	EDC Incentives to Trade Allies	$0		$0	
3	Participant Costs (net of incentives/rebates paid by utilities)	-$163		-$152	
4	**Incremental Measure Costs (Sum of rows 1 through 3)**	**$488**		**$457**	
		EDC	**CSP**	**EDC**	**CSP**
5	Design & Development [2]	$0	$0	$5	$44
6	Administration, Management, and Technical Assistance [3]	$106	$105	$104	$230
7	Marketing [4]	$0	$0	$0	$0

8	Program Delivery [5]	$8	$794	$7	$951
9	EDC Evaluation Costs	$99		$114	
10	SWE Audit Costs	$40		$107	
11	**Program Overhead Costs (Sum of rows 5 through 10)**	**$1,152**		**$1,563**	
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)**	**$1,640**		**$2,019**	
14	Total NPV Lifetime Electric Energy Benefits	$0		$0	
15	Total NPV Lifetime Electric Capacity Benefits	$5,442		$5,090	
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)**	**$5,442**		**$5,090**	
19	**TRC Benefit-Cost Ratio [8]**	**3.32**		**2.52**	

[1] Includes direct install equipment costs.
[2] Includes direct costs attributable to plan and to advance the programs.
[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.
[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.

Table 130 presents program financials and cost-effectiveness on a net savings basis.

Table 130: Summary of LCL Finances – Net Verified

Row #	Cost Category	PYTD ($1,000)		P3TD ($1,000)	
1	EDC Incentives to Participants [1]	$651		$609	
2	EDC Incentives to Trade Allies	$0		$0	
3	Participant Costs (net of incentives/rebates paid by utilities)	-$163		-$152	
4	**Incremental Measure Costs (Sum of rows 1 through 3)**	**$488**		**$457**	
		EDC	**EDC**	**CSP**	**EDC**
5	Design & Development [2]	$0	$0	$0	$0
6	Administration, Management, and Technical Assistance [3]	$106	$105	$106	$105
7	Marketing [4]	$0	$0	$0	$0
8	Program Delivery [5]	$8	$794	$8	$794
9	EDC Evaluation Costs	$99		$114	
10	SWE Audit Costs	$40		$107	
11	**Program Overhead Costs (Sum of rows 5 through 10)**	**$1,152**		**$1,563**	
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)**	**$1,640**		**$2,019**	
14	Total NPV Lifetime Electric Energy Benefits	$0		$0	
15	Total NPV Lifetime Electric Capacity Benefits	$5,442		$5,090	
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)**	**$5,442**		**$5,090**	

19	**TRC Benefit-Cost Ratio [8]**	**3.32**	**2.52**

[1] Includes direct install equipment costs.
[2] Includes direct costs attributable to plan and to advance the programs.
[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.
[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.

3.13.5 Status of Recommendations

The LCL impact evaluation activities in PY9 led to the following findings and recommendations from Navigant to Duquesne Light, along with a summary of how Duquesne Light plans to address the recommendations.

Finding:

A single customer provided over half of the achieved DR in PY9. This means that annually-achieved program DR will be very sensitive to the performance of this single customer, potentially exposing Duquesne Light to risk; should this participant exit the program Duquesne Light may have difficulty reaching its annual Act 129 target.

Recommendation:

Navigant would recommend that Duquesne either satisfy itself that the risk of changing operations by this very large program contributor is very small, or actively recruit additional participants to assure itself of a more diverse portfolio of large power users contributing DR.

Duquesne Light Status Report:

Duquesne Light is reviewing the participant mix with its CSP (Enerlogics).

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 131 and Section 2.11. For example, the low-income customer segment is a subset of Duquesne Light's residential tariff(s) and therefore not listed in Table 131.

Table 131: EE&C Plan Expenditures by Cost-Recovery Category[41] ($1,000)

Cost Recovery Sector	Rate Classes Included	PYTD Spending	P3TD Spending
Residential	RS, RH, RA	$6,707	$12,127
Small/Medium Commercial	GS, GM, GMH	$4,178	$6,353
Small/Medium Industrial	GM, GMH	$512	$780
Large Commercial	GL, GLH, L	$2,521	$4,743
Large Industrial	GL, GLH, L, HVPS	$3,686	$5,232
Portfolio Total		**$17,604**	**$29,235**

Certain PY9 costs are reallocated to reflect the portion of Upstream Lighting program LEDs being installed in non-residential sockets. As a result, Table 131 differs from the version shown in the July Preliminary Final report. Specifically, $355 are moved from Residential to Small/Medium Commercial. Details are provided in Appendix A.

Additionally, $16 from PY9 and $4 from PY8 are reallocated from Large Commercial to Small/Medium Commercial. Costs from the Large Curtailable Load program were initially included in the Large Commercial and Large Industrial sectors only. Updates were made in Table 131 to align with some participants who are Small C&I.

[41] Includes SWE costs

Appendix A. **Upstream Lighting Cross Sector Sales**

Based on in-store intercept surveys, Navigant estimates that 3.7 percent of bulbs purchased through the Duquesne Watts Choice program (residential upstream lighting component of REEP) are installed in non-residential locations. This 3.7 percent estimate is based on a weighted average of responses received for standard bulbs (3.5% cross sector) and specialty bulbs (4.2% cross sector). In past years when Navigant found cross sector sales (PY4) the team had also adjusted for variations between weekday and weekend sales. At the time, the program CSP had estimates that the weekend sales percentage was approximately 70 percent (i.e., of all lighting sales occurring during any given week, 70 percent occur on Saturday and Sunday). As part of the retailer interviews completed in PY9, Navigant asked retailers to report their estimated sales split between weekday and weekends. Only one retailer was able to provide an estimate and they indicated that weekend sales was approximately 30 percent. The other retailers were not able to provide this data. Given that this contradicts what the CSP estimates and that there are not enough data points to develop a strong case for differences in sales, Navigant has not made any adjustments for weekend versus weekday sales.

Table 132 shows the results of the cross-sector sales research that inform PY9 verified results.

Table 132: Estimation of Percentage of LEDs Being Installed in Non-Residential Settings, Based on Intercept Survey Results

Bulb Type	Total No. of Bulbs	Total No. Respondents	Total Residential Bulbs	Total Non-Residential Bulbs	% Non-Residential
Standard LED	633	120	611	22	3.5%
Specialty LED	599	98	574	25	4.2%

All upstream lighting activities are assigned to REEP by Duquesne Light as reflected in reported savings. Lighting installed in non-residential locations, as verified by Navigant, are reassigned to the C&I Express Efficiency program, as prescribed by Duquesne Light's EE&C Plan. The realization rates in the previous program specific sections (Section 3.1 for REEP and Section 3.6 for Express Efficiency) reflect these lamp reassignments and savings adjustments related to different operating characteristics. Upstream lighting installed in non-residential locations experience higher energy savings and larger demand reductions due to longer hours of use and higher coincidence factors, respectively. Table 133 shows the final allocation of lamps and costs for upstream lighting after cross-sector installations are considered. Table 134 shows similar allocations for energy and demand savings in addition to adjustments resulting from verification activities.

Table 133: Final Allocations for Residential Upstream Lighting Lamps and Costs

Program	Bulb Type	Reported: Lamp Counts	Verified: Lamp Counts	Reported: Incentives ($1,000)	Verified: Incentives ($1,000)	Reported: Admin Costs ($1,000)	Verified: Admin Costs ($1,000)
REEP	Standard LED	407,790	393,617	$455	$439	$2,540	$2,215
REEP	Specialty LED	179,514	172,022	$349	$335		
Express Efficiency	Standard LED	0	14,173	$0	$16	$0	$325
Express Efficiency	Specialty LED	0	7,492	$0	$15		
Total		**587,304**	**587,304**	**$804**	**$804**	**$2,540**	**$2,540**

Table 134: Residential Upstream Lighting Savings Summary

Program	Bulb Type	PYRTD MWh/yr	PYVTD MWh/yr	PYRTD MW/yr	PYVTD MW/yr
REEP	Standard LED	16,488	15,603	1.67	1.58
REEP	Specialty LED	8,810	8,919	0.89	0.90
Express Efficiency	Standard LED	0	3,070	0	0.38
Express Efficiency	Specialty LED	0	528	0	0.11
Total		**25,298**	**28,121**	**2.56**	**2.98**

Appendix B. **Site Inspection Summary**

Table 135 provides a summary of the PY9 site visit activities carried out for the evaluation.

Table 135: PY9 Site Visit Summary

Program	Inspection Firm	Number of Inspections Conducted	Number of Sites with Discrepancies from Reported Values	Summary of Common Discrepancies
Nonresidential Upstream Lighting	Navigant, Karpinski Engineering	43	43*	Bulb Counts, HOU, Control Type, Interaction Factor
Industrial	Navigant, Karpinski Engineering	27	13	HOU based on metering and customer reports, Baseline Wattage, Seasonal production differences
TOTAL		**70**	**56**	

*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 136 through Table 139 show the regression results details for the two waves that comprise the HER program and the single wave representing the LI HER component of LIEEP.

Table 136: Active Participant Counts by Wave

Month	2015 Low-Income	2012 Market Rate	2015 Market Rate
Jun 2017	14,203	15,067	44,908
Jul 2017	14,010	15,003	44,498
Aug 2017	13,819	14,939	44,135
Sep 2017	13,618	14,869	43,756
Oct 2017	13,378	14,807	43,480
Nov 2017	13,146	14,748	43,175
Dec 2017	12,957	14,702	42,904
Jan 2018	12,796	14,659	42,682
Feb 2018	12,679	14,634	42,494
Mar 2018	12,554	14,593	42,315
Apr 2018	12,415	14,553	42,074
May 2018	12,222	14,489	41,786

Table 137: Wave Regression Savings Details

Month	2015 Low-Income		2012 Market Rate		2015 Market Rate	
	Treatment Coefficient	Cluster Robust Standard Error	Treatment Coefficient	Cluster Robust Standard Error	Treatment Coefficient	Cluster Robust Standard Error
Jun 2017	-0.31	0.13	-0.43	0.11	-0.31	0.09
Jul 2017	-0.30	0.15	-0.27	0.14	-0.39	0.10
Aug 2017	-0.18	0.14	-0.24	0.12	-0.31	0.09
Sep 2017	-0.12	0.12	-0.24	0.11	-0.28	0.08
Oct 2017	-0.18	0.12	-0.32	0.09	-0.31	0.07
Nov 2017	-0.26	0.17	-0.42	0.11	-0.41	0.08
Dec 2017	-0.43	0.21	-0.51	0.15	-0.37	0.10
Jan 2018	-0.25	0.21	-0.54	0.16	-0.36	0.11
Feb 2018	-0.22	0.18	-0.54	0.13	-0.41	0.09
Mar 2018	-0.38	0.19	-0.41	0.13	-0.35	0.09
Apr 2018	-0.48	0.15	-0.40	0.11	-0.31	0.08
May 2018	-0.31	0.14	-0.36	0.11	-0.38	0.09

Table 138: Wave Regression Savings Percent Details

Month	2015 Low-Income		2012 Market Rate		2015 Market Rate	
	Treatment Coefficient	Absolute Precision	Treatment Coefficient	Absolute Precision	Treatment Coefficient	Absolute Precision
Jun 2017	1.32%	1.14%	1.16%	0.60%	1.11%	1.18%
Jul 2017	1.14%	1.15%	0.65%	0.63%	1.19%	1.16%
Aug 2017	0.76%	1.17%	0.64%	0.64%	1.10%	1.18%
Sep 2017	0.60%	1.20%	0.78%	0.67%	1.15%	1.23%
Oct 2017	0.90%	1.22%	1.15%	0.66%	1.46%	1.27%
Nov 2017	1.16%	1.45%	1.41%	0.72%	1.80%	1.38%
Dec 2017	1.56%	1.46%	1.36%	0.80%	1.35%	1.47%
Jan 2018	0.86%	1.44%	1.41%	0.84%	1.31%	1.49%
Feb 2018	0.92%	1.48%	1.67%	0.81%	1.72%	1.50%
Mar 2018	1.64%	1.56%	1.36%	0.87%	1.60%	1.62%
Apr 2018	2.32%	1.44%	1.47%	0.79%	1.51%	1.51%
May 2018	1.47%	1.30%	1.13%	0.68%	1.55%	1.39%

Table 139: Wave Monthly Regression Savings (MWh/yr)*

Month	2015 Low-Income	2012 Market Rate	2015 Market Rate
Jun 2017	130.81	194.85	420.40
Jul 2017	129.79	127.88	535.96
Aug 2017	75.83	109.24	424.08
Sep 2017	48.77	108.34	362.23
Oct 2017	73.13	147.80	422.33
Nov 2017	102.71	187.24	525.85
Dec 2017	174.42	231.07	494.08
Jan 2018	98.37	245.46	477.78
Feb 2018	79.44	219.73	484.33
Mar 2018	149.36	185.00	465.08
Apr 2018	178.78	175.04	386.35
May 2018	116.82	160.92	486.22

**Savings are prior to any overlap adjustments or reassignments for low-income identification.*

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.

Table 140 shows the upstream reduction factors. Table 141 shows how adjustments are applied to the regression results to arrive at the final verified savings values. Table 141 also incorporates the market segment reclassifications for certain participants, as described in Section 3.3, in addition to demand impacts.

Table 140: Upstream Adjustment Factors

Years Since Cohort Inception	Default Upstream Reduction Factor	Waves
1	0.75%	-
2	1.50%	-
3	2.25%	2015 LI, 2015 MR
4 and beyond	3.00%	2012 MR

Table 141: Savings Adjustments and Final Savings

Wave	Regression Savings (MWh/yr)	Downstream Dual Participation Savings (MWh/yr)	Upstream Dual Participation Savings (MWh/yr)	Market Segment Reclassifications (MWh/yr)	Net Savings (MWh/yr)	Demand Savings (MW/yr)
2015 Low-Income	1,358.25	-70.86	-28.97	272.46	1,530.88	0.175
2012 Market Rate	2,092.55	-178.61	-57.42	-64.98	1,791.54	0.205
2015 Market Rate	5,484.70	-430.98	-113.71	-207.48	4,732.53	0.540