



ComEd Income Eligible Impact Evaluation Report

Energy Efficiency / Demand Response Plan:
Plan Year 9 Bridge Period (PY9)

Presented to
Commonwealth Edison Company

DRAFT

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1. INTRODUCTION

This report presents the results of the impact evaluation of ComEd's PY9 bridge period Income Eligible Programs. It presents a summary of the energy and demand impacts for the Residential Retrofit: Weatherization, Residential Retrofit: Single Family Retrofits, Chicago Bungalow Association, Residential Retrofit: Elevate Savers Multifamily Elevate Energy, and Affordable Housing New Construction programs. The report contains relevant measure savings, impact analysis methodology, program structure details, and findings and recommendations for each program. Navigant presents these findings and recommendations with the understanding that the bridge period programs and data requirements are changing substantially in 2018. The PY9 bridge period covers June 2, 2017 through December 31, 2017.

Navigant notes that residential retrofit programs that have corresponding PY9 pilot programs that ran from June 1, 2016 – June 1, 2017 (Residential Retrofit: Single Family Retrofits (CBA) and Elevate Savers Multifamily Elevate Energy) are also included in this bridge period report, due to similarities in the data and program design of the pilot and DCEO programs.

Savings and analysis methodologies are presented by program in the following sections.

2. IHWAP PROGRAM

2.1 Program Description

Residential Retrofit: Weatherization (IHWAP)

- Provides energy efficiency upgrades to income qualified homeowners in the ComEd/Peoples Gas/North Shore Gas/Nicor Gas service territory
- The program measures include attic insulation, wall insulation, air leakage reduction with blower door guided sealing work and crawl space insulation

2.2 Program Savings

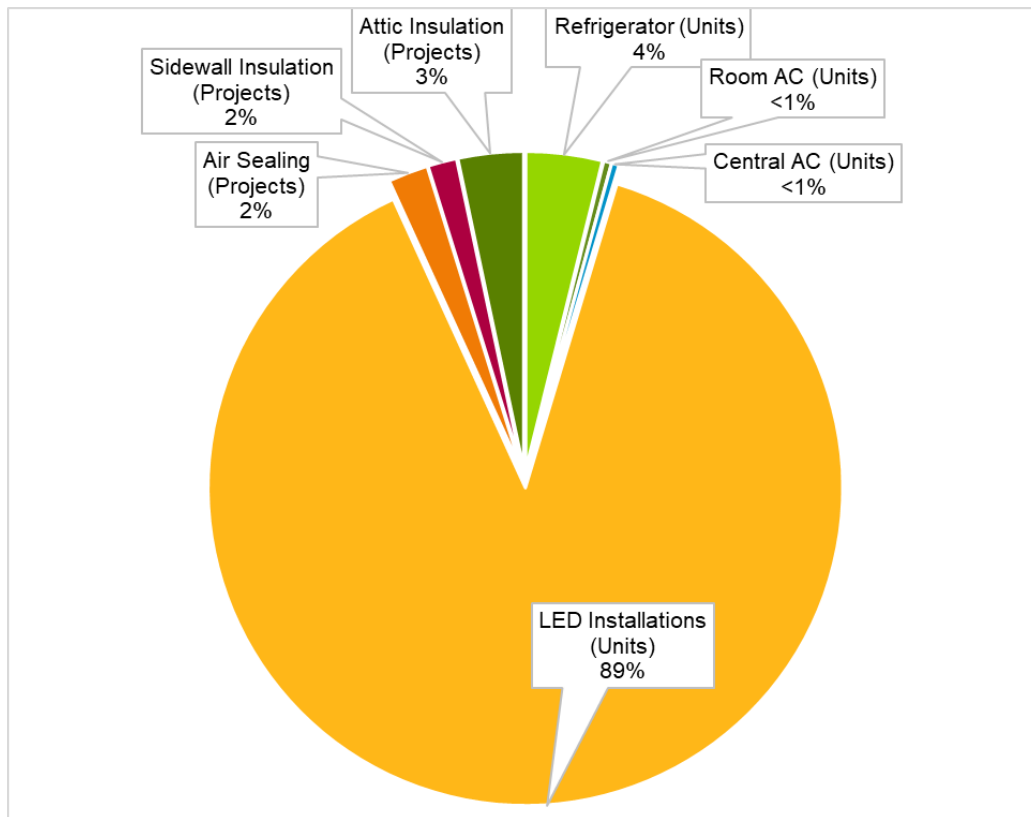
PY9 participants and measures are shown in the following tables and graphs.

Table 2-1. PY9 Bridge Period IHWAP Volumetric Findings Detail

Participation	Program Overall
Participants*	318
Unique Projects†	318
Total Measures	10,620
Number of Installations/Project	33.4
Refrigerator (Units)	412
Room AC (Units)	43
Central AC (Units)	40
LED Installations (Units)	9,399
Air Sealing (Projects)	216
Sidewall Insulation (Projects)	156
Attic Insulation (Projects)	354

* Participants are defined as unique ComEd account numbers
 † Unique projects are defined as unique project IDs
 Source: ComEd tracking data and Navigant team analysis.

Figure 2-1. PY9 Bridge Period IHWAP Percentage of Measures Installed by Type



Source: Evaluation Analysis

Table 2-2 summarizes the IHWAP incremental energy and demand savings achieved in PY9.

Table 2-2. PY9 Bridge Period IHWAP Total Annual Incremental Savings

Savings Category	Energy Savings (kWh)	Demand Savings (kW)	Peak Demand Savings (kW)
Ex Ante Gross Savings	711,715	NA	NA
Program Gross Realization Rate	113%	NA	NA
Verified Gross Savings	801,872	839	187
Program Net-to-Gross Ratio (NTGR)	1.00	1.00	1.00
Verified Net Savings	801,872	839	187

Source: ComEd tracking data and Navigant team analysis.

2.3 IHWAP Program Savings by Measure

The IHWAP program includes seven measures as shown in Table 2-3. LED installations, refrigerators, and air sealing contributed the most savings at 49 percent, 21 percent, and 11 percent of overall program savings, respectively.

Table 2-3. PY9 Bridge Period IHWAP Energy Savings by Measure

End Use Type	Research Category	Ex Ante Gross Savings (kWh)	Verified Gross Realization Rate	Verified Gross Savings (kWh)	NTGR *	Verified Net Savings (kWh)	Technical Measure Life	Persistence	Effective Useful Life (EUL)†
Appliance	Refrigerator	125,322	137%	171,845	1.00	171,845	NA	NA	12
Appliance	Room AC	47,113	34%	16,144	1.00	16,144	NA	NA	12
HVAC	Central AC	28,399	154%	43,865	1.00	43,865	NA	NA	18
Lighting	LED Installations	60,605	651%	394,661	1.00	394,661	NA	NA	10
Shell	Air Sealing	262,760	32%	85,030	1.00	85,030	NA	NA	15
Shell	Sidewall Insulation	120,059	33%	40,057	1.00	40,057	NA	NA	25
Shell	Attic Insulation	67,457	75%	50,269	1.00	50,269	NA	NA	25
Total‡		711,715	113%	801,872	1.00	801,872			

* A deemed value. The TRM v6 deems NTG at 1.0 for Income Eligible programs.

† EUL is a combination of technical measure life and persistence.

‡ Values may not sum due to rounding.

Source: ComEd tracking data and Navigant team analysis.

Table 2-4. PY9 Bridge Period IHWAP Demand Savings by Measure

End Use Type	Research Category	Ex Ante Gross Demand Reduction (kW)	Verified Gross Realization Rate	Verified Gross Demand Reduction (kW)	NTGR*	Verified Net Demand Reduction (kW)
Appliance	Refrigerator	NA	NA	20	1.00	20
Appliance	Room AC	NA	NA	55	1.00	55
HVAC	Central AC	NA	NA	63	1.00	63
Lighting	LED Installations	NA	NA	535	1.00	535
Shell	Air Sealing	NA	NA	89	1.00	89
Shell	Sidewall Insulation	NA	NA	37	1.00	37
Shell	Attic Insulation	NA	NA	40	1.00	40
Total†		NA	NA	839	1.00	839

* A deemed value. The TRM v6 deems NTG at 1.0 for Income Eligible programs.

† Values may not sum due to rounding.

Source: ComEd tracking data and Navigant team analysis.

Table 2-5. PY9 Bridge Period IHWAP Peak Demand Savings by Measure

End Use Type	Research Category	Ex Ante Gross Peak Demand Reduction (kW)	Verified Gross Realization Rate	Verified Gross Peak Demand Reduction (kW)	NTGR*	Verified Net Peak Demand Reduction (kW)
Appliance	Refrigerator	NA	NA	26	1.00	26
Appliance	Room AC	NA	NA	16	1.00	16
HVAC	Central AC	NA	NA	29	1.00	29
Lighting	LED Installations	NA	NA	38	1.00	38
Shell	Air Sealing	NA	NA	42	1.00	42
Shell	Sidewall Insulation	NA	NA	17	1.00	17
Shell	Attic Insulation	NA	NA	19	1.00	19
Total†		NA	NA	187	1.00	187

* A deemed value. The TRM v6 deems NTG at 1.0 for Income Eligible programs.

† Values may not sum due to rounding.

Source: ComEd tracking data and Navigant team analysis.

2.4 IHWAP Program Impact Analysis Findings and Recommendations

2.4.1 Impact Parameter Estimates

The implementer provided program tracking data and a workbook for Navigant’s review. Navigant relied on the following files for ex ante savings:

- Final PY9 tracking file: “ComEd IHWAP Export_2152018_Final.xlsx”
- Final PY9 workbook: “ComEd - EEP Bridge - 02-15-18.xlsx”

Table 2-6 summarizes the parameters and references used in the verified gross and net savings calculations. Navigant calculated savings for each measure following algorithms defined by the Illinois TRM version 5.0.

Table 2-6. IHWAP Verified Gross Savings Parameters

Gross Savings Input Parameters	Value	Deemed* or Evaluated?
Quantity (Units)	Varies	Evaluated
NTGR	1.00	Deemed
Refrigerator (kWh/unit)	417.1	Deemed
Room AC (kWh/unit)	Varies	Deemed
Central AC (kWh/unit)	Varies	Deemed
LED Installations (kWh/unit)	Varies	Deemed
Air Sealing (kWh/unit)	Varies	Deemed
Sidewall Insulation (kWh/unit)	Varies	Deemed
Attic Insulation (kWh/unit)	Varies	Deemed

* State of Illinois Technical Reference Manual version 5.0 from <http://www.ilsag.info/technical-reference-manual.html>.

2.4.2 Impact Findings and Recommendations

Verified Gross Impacts and Realization Rate

Finding 1. The PY9 IHWAP program achieved 801,872 kWh of verified gross energy savings, 839 kW of verified gross demand reduction, and 187 kW of verified gross peak demand reduction. The overall verified gross program realization rate for energy savings was 113%. Navigant calculated gross demand savings and peak demand savings in compliance with the PJM reporting requirements, but the realization rates for gross demand savings and peak demand savings are NA as the implementer did not track gross demand reduction.

Recommendation 1. Navigant recommends that the implementer track gross demand reduction and peak gross demand reduction to comply with PJM Reporting.

Verified Net Impacts and NTGR

Finding 2. The evaluation used a deemed net-to-gross (NTG) value of 1.00¹ for the IHWAP program in PY9 to calculate verified net savings of 801,872 kWh, verified net demand reduction of 839 kW and verified net peak demand reduction of 187 kW.

Tracking Data Review

Finding 3. The implementer did not calculate individual savings for each project and measure, but rather reported ex ante savings for each measure as an average of savings per project from the previous program year. The source cited was “Evaluation of Low Income Residential Retrofit Program, June 2015 through May 2016” prepared for IL DCEO. Navigant was unable to replicate average savings using the draft report available on the IL SAG website. Average savings from the previous program year are not indicative of savings in the current program year.

¹ The TRM v6 deems NTG at 1.0 for Income Eligible programs.

Recommendation 2. Navigant recommends the implementer calculate unique savings for each project and measure based on the guidelines in the IL TRM to better estimate ex ante savings.

Finding 4. The implementer provided a supplementary workbook with data gathered for each project. Navigant used these data as measure-specific inputs in the IL TRM algorithms. However, the workbook did not include data for five projects that had air sealing, attic insulation, sidewall insulation, refrigerator, and LED measures installed. Navigant applied the average realization rate for each measure calculated from projects with workbook data to calculate verified savings for these projects without workbook data.

Recommendation 3. Navigant recommends the implementer record measure-specific data for all completed projects.

Finding 5. Navigant found that Project IDs did not follow a standard format and did not correspond for matching projects between the tracking data and the supplementary workbook. Navigant mapped measure-specific project data in the supplementary workbook to the tracking data based on the project address and when necessary, another project-specific parameter such as square footage of insulation installed for attic insulation measures.

Recommendation 4. Navigant recommends the implementer use a consistent format for project IDs across all program data sets to ensure that each project has a unique and consistent identifier.

Impact Analysis

Finding 6. Navigant found variability in realization rates at the measure level. Recommendations 5-13 below are brief summaries; measure-level and other impact analysis recommendation details are included in the IHWAP Impact Analysis .

Recommendation 5. Navigant recommends the implementers consider home type in ex ante savings calculation and follow the EIA's definition of single family and multi-family homes.

Recommendation 6. Navigant recommends the implementer consistently use TRM deemed inputs and savings for refrigerators based on the appropriate product category.

Recommendation 7. Navigant recommends the implementer either put in quality control measures to ensure that proper building types are recorded for each project or provide documentation for multiple refrigerators installed in a single family home.

Recommendation 8. Navigant recommends the implementer confirm that existing units are program-eligible and that efficient existing units are not replaced with less-efficient units.

Recommendation 9. Navigant recommends the implementer put quality control measures in place to ensure that recorded values for AC units are accurate.

Recommendation 10. Navigant recommends the implementer consistently use TRM deemed inputs to calculate energy savings for central air conditioners and programmable thermostats.

Recommendation 11. Navigant recommends the implementer provide both more specific data on types of LED bulbs and installed fixtures and product specification sheets where available.

Recommendation 12. Navigant recommends the implementer calculate savings for 2.5-story buildings based on a conservative approximation of 2-story buildings to allow for TRM algorithm-based savings ex ante reporting and ex post verification.

Recommendation 13. Navigant recommends the implementer put quality control measures in place to ensure that recorded R values of old and new insulation are accurate.

Program Participation

Finding 7. The program had 318 participants in PY9, distributed 10,620 measures, and completed 318 projects.

2.5 IHWAP Impact Analysis Detail

2.5.1 Home Type

The implementer did not consider home type in reported savings calculations. The PY9 bridge period tracking data listed four different building types: single family, mobile home, 2-4 units, and 11+ units. Navigant followed nationally-recognized definitions in the EIA 2015 Residential Energy Consumption Survey² to classify buildings as single family and multifamily.

The EIA single-family home definition is: “A housing unit either detached from or attached to another housing unit that typically provides living space for one household or family. Housing units that are connected side-by-side by a wall that extends ground to roof are considered single-family attached units (i.e., a townhouse, row house, or duplex.) A mobile home is not classified as a single-family home.”

The EIA multi-family home definition is: “A self-contained housing unit that occupies only part of a multi-family residential building that has two or more housing units. Apartments may be owned by an owner/occupier or rented by tenants. This category includes condominium apartments (i.e. individually owned apartments), basement apartments, or other residential structures where units are stacked vertically. Housing units that are connected side-by-side by a wall that extends ground to roof are considered single-family attached units (i.e., a townhouse, row house, or duplex.) RECS categorizes apartments into those that are in buildings with two to four units—this category also includes houses originally intended for occupancy by one household (or for some other use) that have since been converted to separate dwellings for two to four households—and that are buildings with five or more units.”

Based on the above definition, Navigant treated single family and mobile homes as single family and 2-4 units and 11+ units as multifamily for the purposes of applying savings algorithms in the PY9 bridge period.

Recommendation 5. Navigant recommends the implementers consider home type in ex ante savings calculation and follow the EIA’s definition of single family and multi-family homes.

2.5.2 Refrigerator

Refrigerators have a 137 percent realization rate and represent 21 percent of overall program savings. Navigant verified higher savings for refrigerators based on IL TRM algorithms for product category 3: refrigerator freezers – automatic defrost with top-mounted freezer without through-the-door ice service.

Recommendation 6. Navigant recommends the implementer consistently use TRM deemed inputs and savings for refrigerators based on the appropriate product category.

Navigant also found that tracking data listed multiple refrigerators installed in many single family homes. Navigant noted that it is unlikely for a single family home to have more than two refrigerators but these buildings may have in fact been multi-family buildings. Navigant did not make changes to the data.

Recommendation 7. Navigant recommends the implementer either put in quality control measures to ensure that proper building types are recorded for each project or provide documentation for multiple refrigerators installed in a single family home.

² <https://www.eia.gov/consumption/residential/terminology.php#s>

2.5.3 Room AC

Room AC units have a 34 percent realization rate and represent two percent of overall program savings. Navigant applied early replacement algorithms in IL TRM v5.0 Section 5.1.7 and calculated unit level realization rates between -2 percent and 61 percent. Navigant found for nine percent of projects that the installed room AC unit had a lower SEER than the existing AC unit. These projects had unit-level realization rates below zero.

Recommendation 8. Navigant recommends the implementer confirm that existing units are program-eligible and that efficient existing units are not replaced with less-efficient units.

Navigant also found that the recorded data for existing AC unit size varied widely between 5,000 and 108,000 Btu/hr. Navigant calculated realization rates below 10 percent for AC unit sizes on the low end of that range and realization rates above 50 percent for AC unit sizes on the high end of that range. Navigant noted that AC units on the upper end of the range are not likely to be found in single family homes. Navigant did not make changes to the data.

Recommendation 9. Navigant recommends the implementer put quality control measures in place to ensure that recorded values for AC units are accurate.

2.5.4 Central AC

Central AC units have a 154 percent realization rate and represent five percent of overall program savings. Central AC savings are the sum of savings from the early replacement of a central AC unit as well as a programmable thermostat. Navigant applied algorithms in IL TRM v5.0 Sections 5.3.3 and 5.3.11.

Recommendation 10. Navigant recommends the implementer consistently use TRM deemed inputs to calculate energy savings for central air conditioners and programmable thermostats.

2.5.5 LED Installations

LED installations have a 651 percent realization rate of and represent 49 percent of overall program savings. The implementer did not specify what types of LED bulbs or fixtures were installed in each project and did not provide product specifications for Navigant's review. Navigant relied on both existing wattage and new wattage data listed in the project workbook and deemed values from IL TRM v5.0 Section 5.5.8.

Recommendation 11. Navigant recommends the implementer provide both more specific data on types of LED bulbs and installed fixtures and product specification sheets where available.

2.5.6 Air Sealing

Air sealing has a 32 percent realization rate and represents 11 percent of overall program savings. The implementer recorded each building's number of stories to inform TRM parameters 'N_cool' and 'N_heat.' 'N_cool' and 'N_heat' are conversion factors from leakage at 50 Pascal to leakage at natural conditions for cooling and heating savings, respectively. The number of stories was 2.5 in nine percent of projects but the TRM does not deem N_cool and N_heat values for buildings with 2.5 stories. Navigant conservatively estimated savings for these cases by rounding down to the nearest TRM specified value, two stories.

Recommendation 12. Navigant recommends the implementer calculate savings for 2.5-story buildings based on a conservative approximation of 2-story buildings to allow for TRM algorithm-based savings ex ante reporting and ex post verification.

2.5.7 Attic and Sidewall Insulation

Attic insulation has a 75 percent realization rate and represents six percent of overall program savings. Sidewall insulation has a 33 percent realization rate and represents five percent of overall program savings. When reviewing data for insulation measures, Navigant found data entry errors in which the R value of old insulation was higher than that of new insulation. Navigant switched the old and new insulation R values where reasonable.

Recommendation 13. Navigant recommends the implementer put quality control measures in place to ensure that recorded R values of old and new insulation are accurate.

2.6 IHWAP TRC Detail

Table 2-7 below shows the total resource cost savings summary for the IHWAP Program.

Table 2-7. Total Resource Cost Savings Summary

End Use Type	Research Category	Units	Quantity	Effective Useful Life	Ex Ante Gross Savings (kWh)	Ex Ante Gross Peak Demand Reduction (kW)	Verified Gross Savings (kWh)	Verified Gross Peak Demand Reduction (kW)
Appliance	Refrigerator	Each	412	12	125,322	NA	171,845	26
Appliance	Room AC	Each	43	12	47,113	NA	16,144	16
HVAC	Central AC	Each	40	18	28,399	NA	43,865	29
Lighting	LED Installations	Each	9,399	10	60,605	NA	394,661	38
Shell	Air Sealing	Home	216	15	262,760	NA	85,030	42
Shell	Sidewall Insulation	Square Feet	162,462	25	120,059	NA	40,057	17
Shell	Attic Insulation	Square Feet	237,525	25	67,457	NA	50,269	19

The Total Resource Cost (TRC) variable table only includes cost-effectiveness analysis inputs available at the time of finalizing this PY9 impact evaluation report. Additional required cost data (e.g., measure costs, program level incentive and non-incentive costs) are not included in this table and will be provided to evaluation at a later date. Further, detail in this table (e.g., EULs) other than final PY9 savings and program data are subject to change and are not final.

3. CBA PROGRAM

3.1 Program Description

Residential Retrofit: Single Family Retrofits, Chicago Bungalow Association (CBA)

- Provides energy efficiency upgrades to income qualified homeowners in the ComEd/Peoples Gas service territory
- The program measures include weatherization (e.g., air sealing, insulation), direct install aerators and lighting (e.g., low flow aerators, LEDs), and health and safety upgrades (e.g., carbon monoxide (CO) detectors, chimney liners, etc.)

3.2 CBA Program Savings

The program had 459 participants in PY9, distributed 8,601 measures, and completed 738 projects as shown in the following table and graph.

Table 3-1. PY9 Volumetric Findings Detail

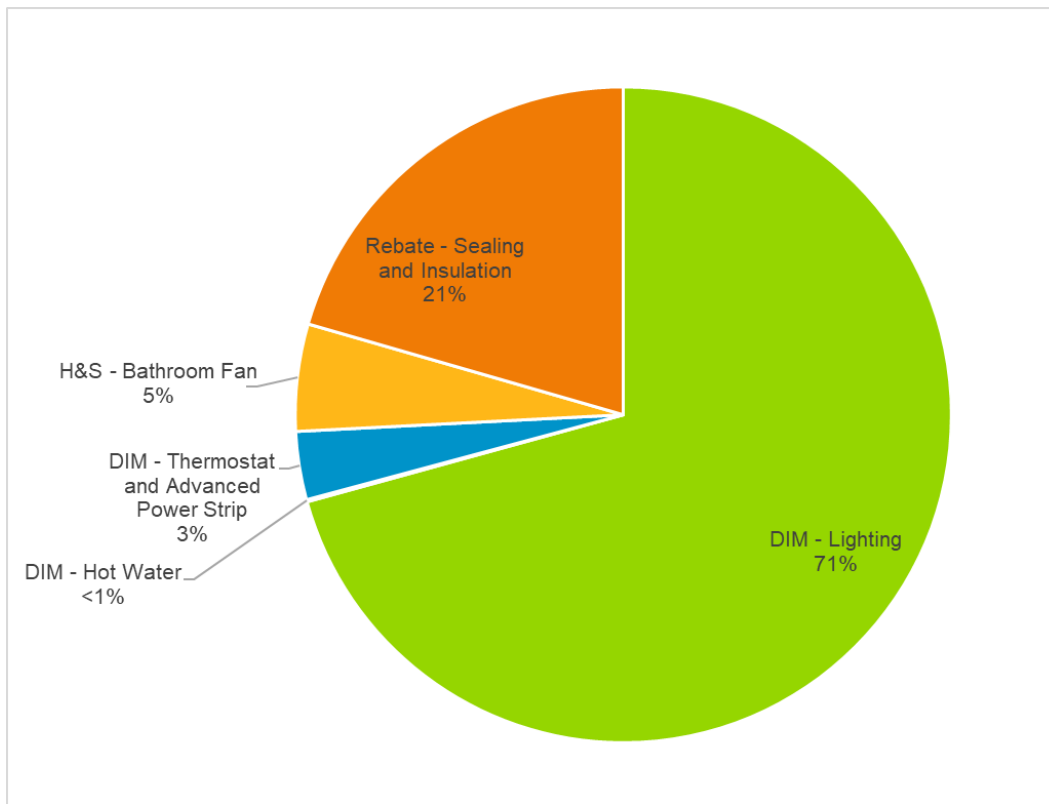
Participation	Pilot Program
Participants*	459
Unique Projects†	738
Total Measures	8,601
Number of Units/Project	11.7
LED Installation (Unit)	6,083
Aerator - Bathroom (Unit)	1
Showerhead (Unit)	2
DHW Pipe Insulation (Linear Feet)	6
Advanced Power Strip - Tier 1 (Unit)	65
Advanced Power Strip - Tier 2 (Unit)	106
Bathroom Fan (Unit)	454
Programmable Tstat - Gas Furnace (Unit)	45
Reprogramming Tstat - Gas Furnace (Unit)	73
Air Sealing (Project)	458
Attic Insulation (Project)	451
Crawl Space Insulation (Project)	83
Foundation Wall Insulation (Project)	55
Wall Insulation (Project)	719

* Participants are defined as unique customer names

† Unique projects are defined as unique project IDs

Source: ComEd tracking data and Navigant team analysis.

Figure 3-1. Distribution of Measures Installed by Type



DIM = Direct Install Measure
H&S = Health and Safety
Source: Evaluation Analysis

Table 2-2 summarizes the energy and demand savings the CBA Program achieved in PY9.

Table 3-2. PY9 Total Annual Incremental Savings

Savings Category	Energy Savings (kWh)	Demand Savings (kW)	Peak Demand Savings (kW)
Ex Ante Gross Savings	642,515	NA	320
Program Gross Realization Rate	96%	NA	41%
Verified Gross Savings	613,604	488	131
Program Net-to-Gross Ratio (NTGR)	1.00	1.00	1.00
Verified Net Savings	613,604	488	131

Source: ComEd tracking data and Navigant team analysis.

3.3 CBA Savings by Measure

The program includes 14 measures as shown in the following table. LED installations, air sealing, and wall insulation contribute the most savings and make up 39 percent, 22 percent, and 16 percent of overall verified program savings, respectively.

Table 3-3. PY9 Energy Savings by Measure

End Use Type	Research Category	Ex Ante Gross Savings (kWh)	Verified Gross Realization Rate	Verified Gross Savings (kWh)	NTGR *	Verified Net Savings (kWh)	Technical Measure Life	Persistence	Effective Useful Life (EUL)†
Lighting	LED Installation	237,377	100%	237,646	1.00	237,646	NA	NA	12
Hot Water	Aerator - Bathroom	16	99%	16	1.00	16	NA	NA	9
Hot Water	Showerhead	656	100%	656	1.00	656	NA	NA	10
Hot Water	DHW Pipe Insulation	136	100%	136	1.00	136	NA	NA	15
Electronics	Advanced Power Strip - Tier 1	6,695	100%	6,695	1.00	6,695	NA	NA	4
Electronics	Advanced Power Strip - Tier 2	22,260	100%	22,260	1.00	22,260	NA	NA	7
HVAC	Bathroom Fan	40,406	100%	40,215	1.00	40,215	NA	NA	19
HVAC	Programmable Tstat - Gas Furnace	2,565	100%	2,565	1.00	2,565	10	50%	5
HVAC	Reprogramming Tstat - Gas Furnace	4,161	100%	4,161	1.00	4,161	5	40%	2
Shell	Air Sealing	157,084	87%	136,491	1.00	136,491	NA	NA	15
Shell	Attic Insulation	68,964	79%	54,812	1.00	54,812	NA	NA	25
Shell	Crawl Space Insulation	2,410	97%	2,349	1.00	2,349	NA	NA	25
Shell	Foundation Wall Insulation	6,804	102%	6,920	1.00	6,920	NA	NA	25
Shell	Wall Insulation	92,981	106%	98,682	1.00	98,682	NA	NA	25
Total‡		642,515	96%	613,604	1.00	613,604			

* A deemed value. The TRM v6 deems NTG at 1.0 for Income Eligible programs.

† EUL is a combination of technical measure life and persistence.

‡ Values may not sum due to rounding.

Source: ComEd tracking data and Navigant team analysis.

Table 3-4. PY9 Demand Savings by Measure

End Use Type	Research Category	Ex Ante Gross Demand Reduction (kW)	Verified Gross Realization Rate	Verified Gross Demand Reduction (kW)	NTGR*	Verified Net Demand Reduction (kW)
Lighting	LED Installation	NA	NA	268	1.00	268
Hot Water	Aerator - Bathroom	NA	NA	1	1.00	1
Hot Water	Showerhead	NA	NA	2	1.00	2
Hot Water	DHW Pipe Insulation	NA	NA	0	1.00	0
Electronics	Advanced Power Strip - Tier 1	NA	NA	1	1.00	1
Electronics	Advanced Power Strip - Tier 2	NA	NA	5	1.00	5
HVAC	Bathroom Fan	NA	NA	5	1.00	5
HVAC	Programmable Tstat - Gas Furnace	NA	NA	NA	1.00	NA
HVAC	Reprogramming Tstat - Gas Furnace	NA	NA	NA	1.00	NA
Shell	Air Sealing	NA	NA	105	1.00	105
Shell	Attic Insulation	NA	NA	34	1.00	34
Shell	Crawl Space Insulation	NA	NA	1	1.00	1
Shell	Foundation Wall Insulation	NA	NA	4	1.00	4
Shell	Wall Insulation	NA	NA	63	1.00	63
Total‡		NA	NA	488	1.00	488

* A deemed value. The TRM v6 deems NTG at 1.0 for Income Eligible programs.

‡ Values may not sum due to rounding.

Source: ComEd tracking data and Navigant team analysis.

Table 3-5. PY9 Peak Demand Savings by Measure

End Use Type	Research Category	Ex Ante Gross Peak Demand Reduction (kW)	Verified Gross Realization Rate	Verified Gross Peak Demand Reduction (kW)	NTGR*	Verified Net Peak Demand Reduction (kW)
Lighting	LED Installation	25	100%	25	1.00	25
Hot Water	Aerator - Bathroom	0	100%	0	1.00	0
Hot Water	Showerhead	0	100%	0	1.00	0
Hot Water	DHW Pipe Insulation	0	100%	0	1.00	0
Electronics	Advanced Power Strip - Tier 1	1	101%	1	1.00	1
Electronics	Advanced Power Strip - Tier 2	4	100%	4	1.00	4
HVAC	Bathroom Fan	5	100%	5	1.00	5
HVAC	Programmable Tstat - Gas Furnace	0	NA	NA	1.00	NA
HVAC	Reprogramming Tstat - Gas Furnace	0	NA	NA	1.00	NA
Shell	Air Sealing	192	25%	49	1.00	49
Shell	Attic Insulation	39	41%	16	1.00	16
Shell	Crawl Space Insulation	1	57%	0	1.00	0
Shell	Foundation Wall Insulation	2	72%	2	1.00	2
Shell	Wall Insulation	52	56%	29	1.00	29
Total†		320	41%	131	1.00	131

* A deemed value. The TRM v6 deems NTG at 1.0 for Income Eligible programs.

† Values may not sum due to rounding.

Source: ComEd tracking data and Navigant team analysis.

3.4 CBA Impact Analysis Findings and Recommendations

3.4.1 Impact Parameter Estimates

The implementer provided program calculators and tracking data. Navigant relied on the following files for ex ante savings:

- Final PY9 tracking file: "SFIE_PY9_EOY_Evaluation_Data_Rev1_01112018.xlsx"
- Final PY9 Weatherization Calculator: "ComEd_FE_Wx_Measure_Builds_v1_PY9_2.9.2017.xlsx"
- Final PY9 Direct Install Measure Calculator: "PY9 DI Savings Values per TRM-9.21.16.xlsx"

Table 3-6 summarizes the parameters and references used in the verified gross and net savings calculations. Navigant calculated savings for each measure following algorithms defined by the Illinois TRM version 5.0.

Table 3-6. Verified Gross Savings Parameters

Research Category	Value	Deemed* or Evaluated?
Quantity (Units)	Varies	Evaluated
NTGR	1.00	Deemed
LED Installation (kWh/unit)	Varies	Deemed
Aerator – Bathroom (kWh/unit)	16.2	Deemed
Showerhead (kWh/unit)	328	Deemed
DHW Pipe Insulation (kWh/unit)	23	Deemed
Advanced Power Strip - Tier 1 (kWh/unit)	103	Deemed
Advanced Power Strip - Tier 2 (kWh/unit)	210	Deemed
Programmable Tstat - Gas Furnace (kWh/unit)	57	Deemed
Reprogramming Tstat - Gas Furnace (kWh/unit)	57	Deemed
Bathroom Fan (kWh/unit)	89	Deemed
Air Sealing (kWh/unit)	Varies	Deemed
Attic Insulation (kWh/unit)	Varies	Deemed
Crawl Space Insulation (kWh/unit)	Varies	Deemed
Foundation Wall Insulation (kWh/unit)	Varies	Deemed
Wall Insulation (kWh/unit)	Varies	Deemed

* State of Illinois Technical Reference Manual version 5.0 from <http://www.ilsag.info/technical-reference-manual.html>

3.4.2 Other Impact Findings and Recommendations

Verified Gross Impacts and Realization Rate

Finding 1. The PY9 CBA program achieved 613,604 kWh of verified gross energy savings, 488 kW of verified gross demand reduction, and 131 kW of verified gross peak demand reduction. The overall verified gross program realization rate for energy savings is 95 percent and the verified gross program realization rate for peak demand savings is 41 percent. Navigant calculated gross demand savings as required for PJM reporting, but the realization rate for gross demand savings is NA as the implementer did not track gross demand reduction.

Recommendation 1. Navigant recommends that the implementer track and report gross demand reduction to comply with PJM reporting.

Verified Net Impacts and NTGR

Finding 2. The evaluation used a deemed net-to-gross (NTG) value of 1.00³ for the CBA program in PY9 to calculate verified net savings of 613,604 kWh, verified net demand reduction of 488 kW and verified net peak demand reduction of 131 kW.

Impact Analysis

Finding 3. Navigant found variability in realization rates at the measure level. Recommendations 2-9 below are brief summaries; measure level and other impact analysis recommendation details are included in CBA Impact Analysis Detail

³ The TRM v6 deems NTG at 1.0 for Income Eligible programs.

Recommendation 2. Navigant recommends the implementers verify that the CF values for LED candelabra bulbs match the installation locations to prevent the use of interior CF values for bulbs installed in exterior locations.

Recommendation 3. Navigant recommends that quality control measures be put in place to ensure that savings for bathroom faucet aerators are properly entered into the tracking system from program calculators.

Recommendation 4. Navigant recommends the implementer use collected data about cooling system types to calculate cooling savings for air sealing measures. This recommendation addresses the biggest contributor to the lower peak demand realization rate.

Recommendation 5. Navigant recommends the implementer apply the TRM equation and calculate coincident peak demand savings for air sealing using $\Delta kWh_{cooling}$ instead of ΔkWh .

Recommendation 6. Navigant recommends the implementer use CF_{PJM} to calculate air sealing peak demand savings to support ComEd's PJM compliance requirements.

Recommendation 7. Navigant recommends that the implementer does not calculate insulation cooling savings for homes with window air conditioning or no air conditioning.

Recommendation 8. Navigant recommends the implementer use TRM-deemed values for the cooling adjustment factor to calculate insulation energy savings.

Recommendation 9. Navigant recommends the implementer use the TRM-deemed value for the conversion of therms to BTU to calculate insulation energy savings.

Program Participation

Finding 4. The program had 459 participants in PY9, distributed 8,601 measures, and completed 738 projects. All projects were completed at homes in Chicago.

3.5 CBA Impact Analysis Detail

3.5.1 LED Installation

LED Installations have a realization rate of 100 percent. Navigant observed that the implementer's calculator used the interior coincidence factor (CF), 0.121, while calculating verified peak demand savings for *exterior* LED candelabra bulbs instead of 0.273, the exterior CF.

Recommendation 2. Navigant recommends the implementers verify that the CF values for LED candelabra bulbs match the installation locations to prevent the use of interior CF values for bulbs installed in exterior locations.

3.5.2 Aerator – Bathroom

Bathroom aerators have a realization rate of 99 percent and represent less than one percent of overall program savings. The deemed per unit savings value for bathroom aerators is 16.2 kWh, which was correctly included in the program calculator. The tracking data listed 16.4 kWh as the savings for bathroom aerators indicating a possible error in transferring savings values from the program calculator to the tracking data.

Recommendation 3. Navigant recommends that quality control measures be put in place to ensure that savings for bathroom faucet aerators are properly entered into the tracking system from program calculators.

3.5.3 Air Sealing

Air sealing has a gross energy realization rate of 87 percent and a gross peak demand saving realization rate of 25 percent. The discrepancy in energy savings comes from the implementer inserting an additional parameter to the equation for cooling savings. The implementer included a 66% factor to adjust for the percentage of homes with central air conditioning based on IL TRM v5.0 footnote 253:

The weighted average value is based on assumption that 75% of homes installing BPM furnace blower motors have Central AC. 66% of IL housing units have CAC and 66% have gas furnaces.

The implementer recorded the cooling system type of the project's home in the field "Existing_Cooling_System_Type" as "None," "Central," or "Window." Navigant removed the adjustment factor and calculated cooling savings if the field Existing_Cooling_System_Type showed that the home had central air conditioning.

Recommendation 4. Navigant recommends the implementer use collected data about cooling system types to calculate cooling savings for air sealing measures.

There are two reasons for the discrepancy in peak demand savings realization rate. The TRM algorithm for air sealing coincident peak demand savings is:

$$\Delta kW = (\Delta kWh_{cooling} / FLH_{cooling}) * CF$$

The implementer used ΔkWh instead of $\Delta kWh_{cooling}$ to calculate ex ante coincident peak demand savings. Navigant used $\Delta kWh_{cooling}$ to calculate ex post coincident peak demand savings as indicated in the TRM.

Recommendation 5. Navigant recommends the implementer apply the TRM equation and calculate coincident peak demand savings for air sealing using $\Delta kWh_{cooling}$ instead of ΔkWh .

The second reason is that the implementer used CF_{SSP} in the calculation of coincident peak demand savings. Navigant used CF_{PJM} to calculate verified peak demand savings to support ComEd's PJM compliance requirements.

Recommendation 6. Navigant recommends the implementer use CF_{PJM} to calculate air sealing peak demand savings to support ComEd's PJM compliance requirements.

3.5.4 All Insulation (Attic, Crawl Space, Foundation Wall, and Wall)

Attic, crawl space, foundation wall, and wall insulation have gross energy realization rates of 79 percent, 97 percent, 102 percent, and 106 percent, respectively. Navigant found the following while calculating verified savings:

Energy savings are the sum of cooling savings and heating savings. Cooling savings are only calculated if the home has air conditioning. The implementer calculated cooling savings for all three types of cooling system type, "None," "Central," and "Window." Navigant only calculated cooling savings for homes with "Central" as the existing cooling system type.

Recommendation 7. Navigant recommends that the implementer does not calculate insulation cooling savings for homes with window air conditioning or no air conditioning.

Cooling energy savings is a function of the cooling savings adjustment factors, $ADJ_{WallAtticCool}$ for attic and wall insulation and $ADJ_{BasementCool}$ for crawl space and foundation wall insulation. The implementer used 1.00 for attic and wall insulation and 0.8 for crawl space and foundation wall insulation for the cooling

adjustment factor. Navigant used the TRM-deemed 0.8 cooling savings adjustment factor for all insulation measures, which affected savings for attic and wall insulation.

Recommendation 8. Navigant recommends the implementer use TRM-deemed values for cooling adjustment factor to calculate insulation energy savings.

Heating savings are dependent on the home’s heating system type, either electric heat or gas heat. Navigant observed that the implementer used 100,000 as the conversion of therms to BTU for homes with gas heat, The TRM algorithm for gas savings uses 100,067 Btu/therm.

Recommendation 9. Navigant recommends the implementer use TRM-deemed value for the conversion of therms to BTU to calculate insulation energy savings.

Similar to air sealing, the implementer used CF_{SSP} in the calculation of coincident peak demand savings. Navigant used CF_{PJM} to calculate verified peak demand savings to support ComEd’s PJM compliance requirements. See Recommendation 6.

3.6 CBA TRC Detail

Table 2-7 below shows the total resource cost savings summary for the CBA Program.

Table 3-7. Total Resource Cost Savings Summary

End Use Type	Research Category	Units	Quantity	Effective Useful Life	Ex Ante Gross Savings (kWh)	Ex Ante Gross Peak Demand Reduction (kW)	Verified Gross Savings (kWh)	Verified Gross Peak Demand Reduction (kW)
Lighting	LED Installations - Track and Recessed	Each	1,297	15	76,171	8	76,188	8
Lighting	LED Installations - All Other	Each	4,786	10	161,206	17	161,458	17
Hot Water	Aerator - Bathroom	Each	1	9	16	0	16	0
Hot Water	Showerhead	Each	2	10	656	0	656	0
Hot Water	DHW Pipe Insulation	Linear Feet	6	15	136	0	136	0
Electronics	Advanced Power Strip - Tier 1	Each	65	4	6,695	1	6,695	1
Electronics	Advanced Power Strip - Tier 2	Each	106	7	22,260	4	22,260	4
HVAC	Bathroom Fan	Each	454	19	40,406	5	40,215	5
HVAC	Programmable Tstat - Gas Furnace	Each	45	5	2,565	0	2,565	0
HVAC	Reprogramming Tstat - Gas Furnace	Each	73	2	4,161	0	4,161	0
Shell	Air Sealing	Homes	458	15	157,084	192	136,491	49
Shell	Attic Insulation	Square Feet	68,964	25	68,964	39	54,812	16
Shell	Crawl Space Insulation	Square Feet	2,410	25	2,410	1	2,349	0
Shell	Foundation Wall Insulation	Square Feet	6,804	25	6,804	2	6,920	2
Shell	Wall Insulation	Square Feet	92,981	25	92,981	52	98,682	29

The Total Resource Cost (TRC) variable table only includes cost-effectiveness analysis inputs available at the time of finalizing this PY9 impact evaluation report. Additional required cost data (e.g., measure costs, program level incentive and non-incentive costs) are not included in this table and will be provided to evaluation at a later date. Further, detail in this table (e.g., EULs) other than final PY9 savings and program data are subject to change and are not final.

4. MULTIFAMILY RETROFITS PROGRAM

4.1 Program Description

Residential Retrofit: Elevate Savers Multifamily Elevate Energy (Multifamily)

- Provides energy efficiency upgrades to multifamily buildings in the ComEd/Peoples Gas service territory
- The program measures include weatherization (e.g., air sealing, insulation), direct install aerators and lighting (e.g., low flow aerators, CFLs, LEDs), and health and safety upgrades (e.g., CO detectors, chimney liners, etc.)

4.2 Multifamily Program Savings

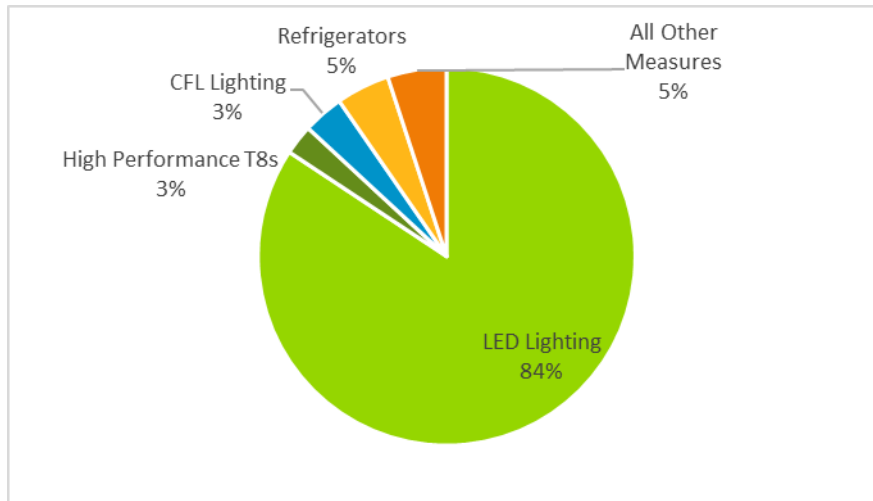
The PY9 participants and measures are shown in the following tables and graphs.

Table 4-1. PY9 Multifamily Volumetric Findings Detail

Participation	Direct Install	Rebate	Trade Ally	Total
Participants	76	67	54	128
Units / Projects†	1192	73	54	1299
Measure Types	5	7	5	14

Source: ComEd tracking data and Navigant team analysis.

Figure 4-1. PY9 Multifamily Number of Measures Installed by Type



Source: Evaluation Analysis

Table 2-2 summarizes the energy and demand savings the Multifamily program achieved in PY9.

Table 4-2. PY9 Multifamily Total Annual Incremental Savings

Savings Category	Energy Savings (kWh)	Demand Savings (kW)	Peak Demand Savings (kW)
Ex Ante Gross Savings	1,246,641	NR*	128
Program Gross Realization Rate	81%	NA†	125%
Verified Gross Savings	1,005,938	539	161
Program Net-to-Gross Ratio (NTGR)	1.00	1.00	1.00
Verified Net Savings	1,005,938	539	161

Source: ComEd tracking data and Navigant team analysis.

*NR = not reported

†NA = not applicable

4.3 Multifamily Program Savings by Measure

The program includes 14 measures as shown in the following table. LED Lighting and ENERGY STAR refrigerators contributed the most savings.

Table 4-3. Multifamily PY9 Energy Savings by Measure

End Use Type	Research Category	Ex Ante Gross Savings (kWh)	Verified Gross Realization Rate	Verified Gross Savings (kWh)	NTGR *	Verified Net Savings (kWh)	Technical Measure Life	Persistence	Effective Useful Life (EUL)†
Weatherization	Air Sealing	2,777	87%	2,405	1.00	2,405			15
Weatherization	Attic Insulation	4,955	690%	34,166	1.00	34,166			25
HVAC	Central Air Conditioner	13,019	40%	5,207	1.00	5,207			18
Lighting	CFL Lighting	9,282	100%	9,272	1.00	9,272			4
HVAC	Furnace	15,620	100%	15,620	1.00	15,620			20
Lighting	High Performance T8s	68,472	97%	66,107	1.00	66,107			15
Lighting	LED Exit Sign	47,561	98%	46,588	1.00	46,588			16
Lighting	LED Lighting	519,684	99%	516,545	1.00	516,545			10
Lighting	Occupancy Sensor	20,407	94%	19,104	1.00	19,104			8
HVAC	Package Terminal Heat Pump	293,076	27%	77,989	1.00	77,989			15
HVAC	Programmable Thermostat	29,780	18%	5,499	1.00	5,499	10	5	5
Appliances	Refrigerator	209,384	93%	194,625	1.00	194,625			12
Appliances	Room Air Conditioner	1,103	117%	1,293	1.00	1,293			12
Consumer Electronics	Smart Strip	11,522	100%	11,519	1.00	11,519			4
	Total	1,246,641	81%	1,005,938	1.00	1,005,938			

Source: ComEd tracking data and Navigant team analysis.

* A deemed value. The TRM v6 deems NTG at 1.0 for Income Eligible programs.

† EUL is a combination of technical measure life and persistence.

Table 4-4. Multifamily PY9 Demand Savings by Measure

End Use Type	Research Category	Ex Ante Gross Demand Reduction (MW)	Verified Gross Realization Rate	Verified Gross Demand Reduction (kW)	NTGR*	Verified Net Demand Reduction (MW)
Weatherization	Air Sealing	NR†	NA	5	1.00	5
Weatherization	Attic Insulation	NR	NA	34	1.00	34
HVAC	Central Air Conditioner	NR	NA	11	1.00	11
Lighting	CFL Lighting	NR	NA	12	1.00	12
HVAC	Furnace	NR	NA	9	1.00	9
Lighting	High Performance T8s	NR	NA	12	1.00	12
Lighting	LED Exit Sign	NR	NA	6	1.00	6
Lighting	LED Lighting	NR	NA	346	1.00	346
Lighting	Occupancy Sensor	NR	NA	14	1.00	14
HVAC	Package Terminal Heat Pump	NR	NA	51	1.00	51
HVAC	Programmable Thermostat	NR	NA	0	1.00	0
Appliances	Refrigerator	NR	NA	29	1.00	29
Appliances	Room Air Conditioner	NR	NA	6	1.00	6
Consumer Electronics	Smart Strip	NR	NA	3	1.00	3
	Total	NR	NA	539	1.00	539

Source: ComEd tracking data and Navigant team analysis.

* A deemed value. The TRM v6 deems NTG at 1.0 for Income Eligible programs.

† NR = not reported

Table 4-5. Multifamily PY9 Peak Demand Savings by Measure

End Use Type	Research Category	Ex Ante Gross Peak Demand Reduction (kW)	Verified Gross Realization Rate	Verified Gross Peak Demand Reduction (kW)	NTGR*	Verified Peak Net Demand Reduction (kW)
Weatherization	Air Sealing	0	NA	3	1.00	3
Weatherization	Attic Insulation	0	54065%	16	1.00	16
HVAC	Central Air Conditioner	13	39%	5	1.00	5
Lighting	CFL Lighting	1	111%	1	1.00	1
HVAC	Furnace	4	100%	4	1.00	4
Lighting	High Performance T8s	8	96%	8	1.00	8
Lighting	LED Exit Sign	6	97%	6	1.00	6
Lighting	LED Lighting	37	81%	29	1.00	29
Lighting	Occupancy Sensor	2	329%	8	1.00	8
HVAC	Package Terminal Heat Pump	21	218%	47	1.00	47
HVAC	Programmable Thermostat	0	NA	0	1.00	0
Appliances	Refrigerator	32	93%	29	1.00	29
Appliances	Room Air Conditioner	1	124%	2	1.00	2
Consumer Electronics	Smart Strip	2	101%	2	1.00	2
	Total	128	125%	161	1.00	161

Source: ComEd tracking data and Navigant team analysis.

* A deemed value. The TRM v6 deems NTG at 1.0 for Income Eligible programs.

4.4 Multifamily Retrofits Program Impact Analysis Findings and Recommendations

4.4.1 Impact Parameter Estimates

Navigant estimated verified unit savings for each program measure using impact algorithm sources found in the version 5 of the Illinois Technical Reference Manual.⁴ (TRM v5.0) Table 5-6 presents the key parameters and the references used in the verified gross and net savings calculations. Detailed breakdown of the measure quantities and per unit savings values are provided in section 4.5.

Table 4-6. Multifamily Verified Gross Savings Parameters

Gross Savings Input Parameters	Value	Deemed* or Evaluated?
Measure Quantities	Varies	Evaluated
Measure Type and Eligibility	Varies	Deemed
Savings Input Assumptions	Varies	Deemed
Gross Savings per Unit	Varies	Deemed
Verified Realization Rate on Ex Ante Gross Savings	Varies	Evaluated
NTGR†	Varies	Deemed

* State of Illinois Technical Reference Manual version 5.0 from <http://www.ilsag.info/technical-reference-manual.html>.

⁴ Illinois Statewide Technical Reference Manual for Energy Efficiency Version 5.0, available at: <http://www.ilsag.info/technical-reference-manual.html>

† Deemed values. The TRM v6 deems NTG at 1.0 for Income Eligible programs.

4.4.2 Other Impact Findings and Recommendations

Finding 1: For air sealing measures, information about the number of stories or the equipment age was not provided in the tracking data. Navigant requested this information, but the implementer was unable to provide additional detail. Therefore, Navigant was unable to isolate the specific source of error as we do not know what values were used in the ex ante calculations. Table 5-7 shows the variable inputs for a sample of two projects.

Table 4-7. Inputs for Air Sealing Measures

Variable	2615478	2573215
Delta_CFM	1080	880
N_Cool	34.79	38.9
CDD	831	842
DUA	0.75	0.75
nCool	14	14
LM	3.2	3.2
N_heat	23.9	23.9
HDD	5113	5113
nHeat	2.4	2.4

Recommendation 1: Compare the inputs to the calculators with Navigant’s values and determine if there is a difference in inputs or the equations.

Finding 2: For attic insulation measures, Navigant was unable to isolate the source of error in the ex ante calculations. Table 5-8 shows the variable inputs for a sample of three projects.

Table 4-8. Inputs for Attic Insulation Measures

Variable	1927714	2452166	103121
R_Old	15	5	15
R_New	54	54	49
CDD	831	831	842
nCool	14	14	14
HDD	5113	5113	5113
FLH Cooling	486.5	486.5	506

Recommendation 2: Review the table above and compare with the values used in the ex ante calculators. Determine if difference is in the assumed values for the variables or the algorithms.

Finding 3: For central air conditioning measures, values for Btu/h were not provided in the tracking data. Navigant requested additional data from ComEd, but this information was not collected from the customer. Therefore, Navigant assumed that Btu/h is 36,000 for all measures lines.

Recommendation 3: Collect the system capacity information from the customer or include a default capacity value in the tracking data.

Finding 4: CFLs had an energy savings realization rate of 100%. However, the tracking data provided the wattage of the efficient bulb, but not the lumens. Navigant requested specification sheets for these bulbs but did not receive any. Navigant made assumptions about the baseline wattage, but was not able to verify these values are correct.

Recommendation 4: Include the lumen value of the energy efficient bulbs or provide specification sheets to Navigant of all energy efficient bulbs installed.

Finding 5: For CFLs the peak demand savings realization rate was 111%. As the energy savings realization rate was 100%, Navigant believes that the source of error is the coincidence factor. The TRM states that for direct install measures the CF should be 7.4%. Navigant used this value in the verified calculations.

Recommendation 5: Review the coincidence factor used in the ex ante calculations and determine if the difference in calculated savings comes from using a different value or if the error is in in equation used.

Finding 6: For High Performance T8s, the specific measures that had realization rates not equal to 100% were CA 1L 4' HPT8/LWT8 L&B Retro, CA 2L 4' HPT8/LWT8 L&B Retro, and CA 2L 8' T12 Slimline/HO/VHO - 4L 4' HPT8 L, M or H BF. Neither the baseline nor efficient wattages were provided in the tracking data. Navigant requested specification sheets for all bulbs, but did not receive them. Table 5-9 shows the values Navigant used to calculate energy savings. These values are based from a document titled "PY9 DI TA Implementer Savings Calc" provided to Navigant for the Multifamily Common Area Pilot.

Table 4-9. Inputs for High Performance T8 Measures

Variable	CA 1L 4' HPT8/LWT8 L&B Retro	CA 2L 4' HPT8/LWT8 L&B Retro	CA 2L 8' T12 Slimline/HO/VHO - 4L 4' HPT8 L, M or H BF
Watts Base	41.5	77	171.95
Watts EE	23.49	46.2	90.09
WHFe	1.14	1.14	1.14
WHFd	1.32	1.32	1.32
CF	64%	64%	64%
HOU	6138	6138	6138
ISR	100%	100%	100%

Recommendation 6: Review the inputs provided in the table about and provide feedback as to the values used in the ex ante calculations. Additionally, if available, please provide Navigant with specification sheets so we can verify the WattsBase and WattsEE values.

Finding 7: For LED Exit Signs, 24/7 CA CHI LED Exit Sign Retrofit had a realization rate of 80% whereas LED Exit Sign Retrofit had a realization rate of 100%. Based on the tracking data, Navigant was unable to determine the difference in these two measures. Navigant used the deemed values in the TRM to calculate savings. Table 5-10 shows the variables that Navigant used in the verified calculations.

Table 4-10. Inputs for Exit Sign Measures

Variable	Value
Watts Base	23
Watts EE	23.00
WHFe	1.14
WHFd	1.32
CF	100%
HOU	8766
ISR	100%

Recommendation 7: Review the inputs above and provide feedback to Navigant as to the difference between the two measures and what values were used from the 24/7 CA CHI LED Exit Signs.

Finding 8: For LED Lighting measures, Navigant used the document titled “PY9 DI TA Implementer Savings Calc” and the TRM for the values of the variables to calculate energy savings. Table 5-11 shows the values Navigant used to calculate verified energy savings.

Table 4-11. Inputs for LED Lighting Measures

Measure	CF	Hours	ISR	Watts Base	Watts EE	WHFe	WhFd
Exterior Wall Pack/Fixture (<=175W MH) to LED	0%	4903	100%	156.25	55.4	1	1
Exterior Wall Pack/Fixture (176-250W MH) to LED	0%	4903	100%	284.1	122.5	1	1
Exterior Wall Pack/Fixture (>250W MH) to LED	0%	4903	100%	454.5	215	1	1
5W LED Candelabra (40W) - Interior - Incandescent to LED	12%	1190	97%	40	5	1.04	1.07
6W LED (12W) - CA - CFL to LED	64%	5950	96%	12	6	1.14	1.32
6W LED (40W) - Interior - Incandescent to LED	7%	759	97%	29	6	1.04	1.07
9W LED (14W) - CA- CFL to LED	64%	5950	96%	14	9	1.14	1.32
9W LED (40W) - Interior - Incandescent to LED	7%	759	97%	43	9	1.04	1.07
9W LED (60W) - Interior - Incandescent to LED	7%	759	97%	43	9	1.04	1.07
CA Exterior 15W LED Flood (100W-Incandes.)	0%	4903	100%	100	15	1	1
CA Exterior 9W LED (13W-CFL)	0%	4903	97%	13	9	1	1
CA Exterior 9W LED (60W-Incandes.)	0%	4903	97%	43	9	1	1
CA Interior 15W LED (100W-Incandes.)	64%	5950	98%	72	15	1.14	1.32
CA Interior 15W LED (23W-CFL)	64%	5950	98%	23	15	1.14	1.32
CA Interior 6W LED Globe (40/60W-Incandes.)	64%	5950	98%	50	6	1.14	1.32
CA Interior 9W LED (13W-CFL)	64%	5950	97%	13	9	1.14	1.32
CA Interior 9W LED (60W-Incandes.)	64%	5950	97%	43	9	1.14	1.32
Ext - DD Outdoor <=175W HID to LED	0%	4903	100%	156.25	55.4	1	1
Ext - DD Outdoor 176-250W HID to LED	0%	4903	100%	284.1	122.5	1	1
Ext - DD Outdoor 251-400W HID to LED	0%	4903	100%	454.5	215	1	1
IU Interior LED - 5W Candelabra (40W)	12%	1190	97%	40	5	1.04	1.07
IU Interior LED - 6W Globe (40/60W)	7%	759	97%	50	6	1.04	1.07
IU Interior LED - 8W Flood (65W)	9%	862	97%	65	8	1.04	1.07
IU Exterior LED - 6W (40W)	0%	4903	97%	29	6	1	1
IU Interior LED - 15W (100W)	7%	759	97%	72	15	1.04	1.07
IU Interior LED - 6W (40W)	7%	759	97%	29	6	1.04	1.07
IU Interior LED - 9W (60W)	7%	759	97%	43	9	1.04	1.07

Recommendation 9: Review the inputs in the table above and advise Navigant if these assumptions match the ex ante calculations. Additionally, if available, please provide Navigant with specification sheets for the energy efficient bulbs installed. In future years, please provide Navigant with the values used in the calculations with the tracking data.

Finding 10: For occupancy sensor controls, Navigant found that the implementer is using the incorrect algorithms to calculate savings. Navigant believes the implementer used the algorithms for lighting measures and not those deemed in section 4.5.10 of the TRM (v5.0).

Recommendation 10: Update the equations used to calculate savings for the occupancy sensor controls so they match those defined in the TRM (v5.0).

Finding 11: For package terminal heat pumps (PTHP), insufficient information was provided in the tracking data for Navigant to accurately verify the savings. Information about the kBtu/hrcool and kBtu/hrheat, EER_{ee} or SEER_{ee}, and COP_{ee} was not provided and is required to calculate savings using the TRM algorithms. Navigant requested this information, but the implementer was

unable to provide any additional detail. Table 5-12 shows the assumed inputs Navigant used in the verified calculations.

Table 4-12. Inputs Used for PTHP Calculations

Variable	Value
kBtu/hr Cool	24
EERee	10.2684
EFLHcool	767
kBtu/hr heat	24
COPee	2.89971
COP Exist	2.6
EFLHheat	1685
EERExist	8.1

Recommendation 11: Review the inputs in the table above. If different values were used, please provide Navigant with justification as to why those values were used. Additionally, the capacity and energy efficiency of equipment should be collected in future years.

Finding 12: For programmable thermostats, Navigant found that project ID 103147 had a realization rate of 14% whereas all other projects had realization rates between 307 to 309%. For all projects, Navigant used the values in the TRM for “unknown” building type. Table 5-13 shows the values used in the verified calculations.

Table 4-13. Inputs Used for Programmable Thermostat Calculations

Variable	Value
% ElecHeat	13%
Elec Heating Consumption	15678
Heating Reduction	6%
HF	65%
% Fossil Heat	87%
Gas Heating Consumption	1005
Fe	3%

Recommendation 12: ComEd should review the inputs provided above and provide Navigant with the values used in the implementers calculations if different from above. Additionally, ComEd should review project ID 103147 to determine why the ex ante savings are so high.

Finding 13: For ENERGY STAR Refrigerators, the tracking data was missing information about the refrigerator type. For these measures, Navigant assumed that the refrigerators were “Refrigerator-Freezer—partial automatic defrost.” Navigant also assumed that these measures were early replacement measures.

Recommendation 13: Please provide additional information to Navigant regarding the type of refrigerator that was installed. Moving forward, this information should be collected and provided to Navigant at the same time as the tracking data.

Finding 14: For room air conditioner measures, information was not included about the size or type of air conditioner. Navigant assumed a size of 8,500 Btu/hr and the product was without reverse cycle and did not have louvered sides.

Recommendation 14: Provide Navigant with a specification sheet for the room air conditioners used so that Navigant can verify the size and product type.

4.5 Multifamily Impact Analysis Detail

Navigant downloaded the final tracking data and measure workbook for the Multifamily PY9 impact evaluation from the ComEd Evaluation Share file site. We relied on the following documents to verify the per-unit savings for each program measure:

- Final PY9 tracking database file: “MFIE_PY9_EOY_Data_Rev3_02122018.xlsx”
- Measure workbook of default savings: “PY9 DI TA Implementer Savings Calc.xlsx”
- Illinois Technical Reference Manual (TRM v5.0) for deemed input parameters

The following sections show the quantity of units delivered, and ex ante and verified savings per unit.

4.5.1 Air Sealing

Air sealing had an overall realization rate of 87% for energy savings and contributed to <1% of the overall energy savings. Table 7-1 shows the per unit savings of each measure.

Table 4-14. Air Sealing Measures Impact Detail

Measure Name	Unit Basis	Quantity Installed	Ex Ante Gross Savings (kWh)	Verified Gross kWh Realization Rate	Verified Gross Savings (kWh)
Air Sealing - No Testing	Projects	36	Varies	0.98	Varies
Attic Insulation and Air Sealing*	Projects	1	483	35%	167

*For this measure, the total reported energy savings was 965 kWh. As the measure name was for both attic insulation and air sealing, Navigant divided 965 by 2 and applied that value to both air sealing and attic insulation

4.5.2 Attic Insulation

Attic Insulation measures had an overall realization rate of 690% and contributed to 3% of the overall savings. Table 7-2 shows the per unit savings of each measure.

Table 4-15. Attic Insulation Measures Impact Detail

Measure Name	Unit Basis	Quantity Installed	Ex Ante Gross Savings (kWh)	Verified Gross kWh Realization Rate	Verified Gross Savings (kWh)
Attic Insulation - Savings	Projects	2	Varies	7.93	Varies
Attic Insulation and Air Sealing*	Projects	1	483	43%	209

*For this measure, the total reported energy savings was 965 kWh. As the measure name was for both attic insulation and air sealing, Navigant divided 965 by 2 and applied that value to both air sealing and attic insulation

4.5.3 Central Air Conditioner

Central Air Conditioner measures had an overall realization rate of 72% and contributed to 1% of the overall savings. Table 7-3 shows the per unit savings of each measure.

Table 4-16. Central Air Conditioner Measures Impact Detail

Measure Name	Unit Basis	Quantity Installed	Ex Ante Gross Savings (kWh)	Verified Gross kWh Realization Rate	Verified Gross Savings (kWh)
14.5 SEER Air Conditioner PG/ComEd	Each	8	343	39%	134
Central Air Condition SEER 14.5 Central w/prog tstat	Each	11	342	41%	139

4.5.4 CFL Lighting

CFL Lighting measures had an overall realization rate of 100% and contributed to 1% of the overall savings. Table 7-4 shows the per unit savings of each measure.

Table 4-17. CFL Lighting Measures Impact Detail

Measure Name	Unit Basis	Quantity Installed	Ex Ante Gross Savings (kWh)	Verified Gross kWh Realization Rate	Verified Gross Savings (kWh)
IU Interior CFL - 13W (60W)	Fixture	344	24	100%	24
IU Interior CFL - 18W (75W)	Fixture	29	28	100%	28
IU Interior CFL - 23W (100W)	Fixture	3	39	100%	39
IU Interior CFL - 9W (40W)	Fixture	6	16	100%	16

4.5.5 High Efficiency Furnace

Furnace measures had an overall realization rate of 100% and contributed to 2% of the overall savings. Table 7-5 shows the per unit savings of each measure.

Table 4-18. Furnace Measures Impact Detail

Measure Name	Unit Basis	Quantity Installed	Ex Ante Gross Savings (kWh)	Verified Gross kWh Realization Rate	Verified Gross Savings (kWh)
Furnace > 95% AFUE – In Unit	Each	11	710	100%	710

4.5.6 High Performance T8s

High Performance T8 measures had an overall realization rate of 97% and contributed to 7% of the overall savings. Table 7-6 shows the per unit savings of each measure.

Table 4-19. High Performance T8 Measures Impact Detail

Measure Name	Unit Basis	Quantity Installed	Ex Ante Gross Savings (kWh)	Verified Gross kWh Realization Rate	Verified Gross Savings (kWh)
CA 1L 4' HPT8/LWT8 L&B Retro	Fixture	32	163	77%	126
CA 2L 4' HPT8/LWT8 L&B Retro	Fixture	19	280	77%	216
CA 2L 8' T12 Slimline/HO/VHO - 4L 4' HPT8 L, M or H BF	Fixture	3	559	103%	573
Int- 24/7 1L 4ft HPT8/LWT8 L&B Retro	Fixture	9	180	100%	180
Int- CA 1L 4ft HPT8/LWT8 L&B Retro	Fixture	13	126	100%	126
Int- CA 1L 8ft T12 Slim/HO/VHO - 2L 4ft HPT8	Fixture	4	386	56%	216
Int- CA 2L 4ft HPT8/LWT8 L&B Retro	Fixture	138	216	143%	308
Int- CA 2L 8ft T12 Slim/HO/VHO - 4L 4ft HPT8	Fixture	7	573	71%	405
Int- CA Delamp w/Ref 2L Utube T12 to 2L 2ft T8	Fixture	19	230	168%	386
Int- CA 4L 4ft HPT8/LWT8 L&B Retro	Fixture	17	405	141%	573
Int- 24/7 2L 4ft HPT8/LWT8 L&B Retro	Fixture	21	308	75%	230

4.5.7 LED Exit Signs

LED Exit Sign measures had an overall realization rate of 98% and contributed to 5% of the overall savings. Table 7-7 shows the per unit savings of each measure.

Table 4-20. LED Exit Sign Measures Impact Detail

Measure Name	Unit Basis	Quantity Installed	Ex Ante Gross Savings (kWh)	Verified Gross kWh Realization Rate	Verified Gross Savings (kWh)
LED Exit Sign Retrofit	Each	19	210	100%	210
24/7 CA CHI LED Exit Sign Retrofit (per face)	Each	203	263	80%	210

4.5.8 LED Lighting

LED Lighting measures had an overall realization rate of 99% and contributed to 53% of the overall savings. Table 7-8 shows the per unit savings of each measure.

Table 4-21. LED Lighting Measures Impact Detail

Measure Name	Unit Basis	Quantity Installed	Ex Ante Gross Savings (kWh)	Verified Gross kWh Realization Rate	Verified Gross Savings (kWh)
Exterior Wall Pack/Fixture (<=175W MH) to LED	Fixture	97	662	75%	494
Exterior Wall Pack/Fixture (176-250W MH) to LED	Fixture	308	1265	63%	792
Exterior Wall Pack/Fixture (>250W MH) to LED	Fixture	1	1897	62%	1174
5W LED Candelabra (40W) - Interior - Incandescent to LED	Fixture	341	28	152%	42
6W LED (12W) - CA - CFL to LED	Fixture	204	36	109%	39
6W LED (40W) - Interior - Incandescent to LED	Fixture	1177	27	66%	18
9W LED (14W) - CA- CFL to LED	Fixture	20	30	109%	33
9W LED (40W) - Interior - Incandescent to LED	Fixture	187	24	106%	26
9W LED (60W) - Interior - Incandescent to LED	Fixture	17	40	65%	26
CA Exterior 15W LED Flood (100W-Incandes.)	Fixture	4	404	103%	417
CA Exterior 9W LED (13W-CFL)	Fixture	3	19	100%	19
CA Exterior 9W LED (60W-Incandes.)	Fixture	3	162	100%	162
CA Interior 15W LED (100W-Incandes.)	Fixture	536	375	101%	379
CA Interior 15W LED (23W-CFL)	Fixture	117	53	101%	53
CA Interior 6W LED Globe (40/60W-Incandes.)	Fixture	97	289	101%	292
CA Interior 9W LED (13W-CFL)	Fixture	34	26	100%	26
CA Interior 9W LED (60W-Incandes.)	Fixture	102	223	100%	223
Ext - DD Outdoor <=175W HID to LED	Fixture	15	494	100%	494
Ext - DD Outdoor 176-250W HID to LED	Fixture	4	792	100%	792
Ext - DD Outdoor 251-400W HID to LED	Fixture	4	1174	100%	1174
IU Exterior LED - 6W (40W)	Fixture	66	55	76%	42
IU Interior LED - 15W (100W)	Fixture	1	44	77%	34
IU Interior LED - 5W Candelabra (40W)	Fixture	386	42	117%	50
IU Interior LED - 6W (40W)	Fixture	102	18	621%	109
IU Interior LED - 6W Globe (40/60W)	Fixture	2518	28	154%	44
IU Interior LED - 8W Flood (65W)	Fixture	39	49	36%	18
IU Interior LED - 9W (60W)	Fixture	2849	26	100%	26

4.5.9 Occupancy Sensors

Occupancy Sensor measures had an overall realization rate of 94% and contributed to 2% of the overall savings. Table 7-9 shows the per unit savings of each measure.

Table 4-22. Occupancy Sensor Measures Impact Detail

Measure Name	Unit Basis	Quantity Installed	Ex Ante Gross Savings (kWh)	Verified Gross kWh Realization Rate	Verified Gross Savings (kWh)
CA Occ Sensor (per sensor 100-256W)	Each	5	512	57%	293
Int - 24/7 Occupancy Sensor (>=100W)	Each	11	427	101%	431
Int - CA Occupancy Sensor (>=100W)	Each	44	299	98%	293

4.5.10 PTHP

PTHP measures had an overall realization rate of 27% and contributed to 8% of the overall savings. Table 7-10 shows the per unit savings of each measure.

Table 4-23. PTHP Measures Impact Detail

Measure Name	Unit Basis	Quantity Installed	Ex Ante Gross Savings (kWh)	Verified Gross kWh Realization Rate	Verified Gross Savings (kWh)
PTHP (replace PTAC >7<15MBH)	Each	82	3574	27%	951

4.5.11 Programmable Thermostats

Programmable Thermostat measures had an overall realization rate of 18% and contributed to 1% of the overall savings. Table 7-11 shows the per unit savings of each measure.

Table 4-24. Programmable Thermostat Measures Impact Detail

Measure Name	Unit Basis	Quantity Installed	Ex Ante Gross Savings (kWh)	Verified Gross kWh Realization Rate	Verified Gross Savings (kWh)
In-Unit Multi-Family Programmable Thermostat	Each	1	37	307%	115
In-Unit Multi-Family Programmable Thermostat - Line-Voltage	Each	35	837	14%	115
IU Gas Tstat - Furnace - Program	Each	12	37	309%	115

4.5.12 ENERGY STAR Refrigerators

ENERGY STAR Refrigerator measures had an overall realization rate of 80% and contributed to 17% of the overall savings. Table 7-12 shows the per unit savings of each measure.

Table 4-25. ENERGY STAR Refrigerator Measures Impact Detail

Measure Name	Unit Basis	Quantity Installed	Ex Ante Gross Savings (kWh)	Verified Gross kWh Realization Rate	Verified Gross Savings (kWh)
Energy Star rated refrigerator	Each	209	417	93%	388
Energy Star Refrigerator	Each	293	417	93%	388

4.5.13 Room Air Conditioner

Room Air Conditioner measures had an overall realization rate of 117% and contributed to <1% of the overall savings. Table 7-13 shows the per unit savings of each measure.

Table 4-26. Room Air Conditioner Measures Impact Detail

Measure Name	Unit Basis	Quantity Installed	Ex Ante Gross Savings (kWh)	Verified Gross kWh Realization Rate	Verified Gross Savings (kWh)
Energy Star Room Air Conditioner	Each	11	50	117%	59

4.5.14 Smart Strips

Smart Strip measures had an overall realization rate of 100% and contributed to 1% of the overall savings. Table 7-14 shows the per unit savings of each measure.

Table 4-27. Smart Strip Measures Impact Detail

Measure Name	Unit Basis	Quantity Installed	Ex Ante Gross Savings (kWh)	Verified Gross kWh Realization Rate	Verified Gross Savings (kWh)
IU Smart Strip - Embertec	Each	48	210	100%	210
IU Smart Strip - Tricklestar	Each	14	103	100%	103

4.6 Multifamily TRC Detail

Table 8-1 below shows the total resource cost savings summary for the Multifamily Program.

Table 4-28. Total Resource Cost Savings Summary

End Use Type	Research Category	Units	Quantity	Effective Useful Life (EUL)*	Ex Ante Gross Savings (kWh)	Ex Ante Gross Peak Demand Reduction (kW)	Verified Gross Savings (kWh)	Verified Peak Net Demand Reduction (kW)
Weatherization	Air Sealing	Projects	37	15	2,777	0	2,405	3
Weatherization	Attic Insulation	Projects	3	25	4,955	0	34,166	16
HVAC	Central Air Conditioner	Each	18	18	13,019	13	5,207	5
Lighting	CFL Lighting	Fixture	382	4	9,282	1	9,272	1
HVAC	Furnace	Each	11	20	15,620	4	15,620	4
Lighting	High Performance T8s	Fixture	282	15	68,472	8	66,107	8
Lighting	LED Exit Sign	Each	222	16	47,561	6	46,588	6
Lighting	LED Lighting	Fixture	9,232	10	519,684	37	516,545	29
Lighting	Occupancy Sensor	Each	60	8	20,407	2	19,104	8
HVAC	Package Terminal Heat Pump	Each	82	15	293,076	21	77,989	47
HVAC	Programmable Thermostat	Each	48	5	29,780	0	5,499	0
Appliances	Refrigerator	Each	502	12	209,384	32	194,625	29
Appliances	Room Air Conditioner	Each	11	12	1,103	1	1,293	2
Consumer Electronics	Smart Strip	Each	62	4	11,522	2	11,519	2

The Total Resource Cost (TRC) variable table only includes cost-effectiveness analysis inputs available at the time of finalizing this PY9 impact evaluation report. Additional required cost data (e.g., measure costs, program level incentive and non-incentive costs) are not included in this table and will be provided to evaluation at a later date. Further, detail in this table (e.g., EULs) other than final PY9 savings and program data are subject to change and are not final.

* Average estimate based on LED lamp life in hours divided by operating hours per year.

5. AFFORDABLE HOUSING NEW CONSTRUCTION PROGRAM

5.1 Program Description

Affordable Housing New Construction (AHNC)

- Provides grants to affordable housing developers to incorporate energy efficient building practices
- The program provides building guidelines which include requirements for energy efficient air sealing, HVAC, lighting, appliances, and insulation

5.2 AHNC Program Savings

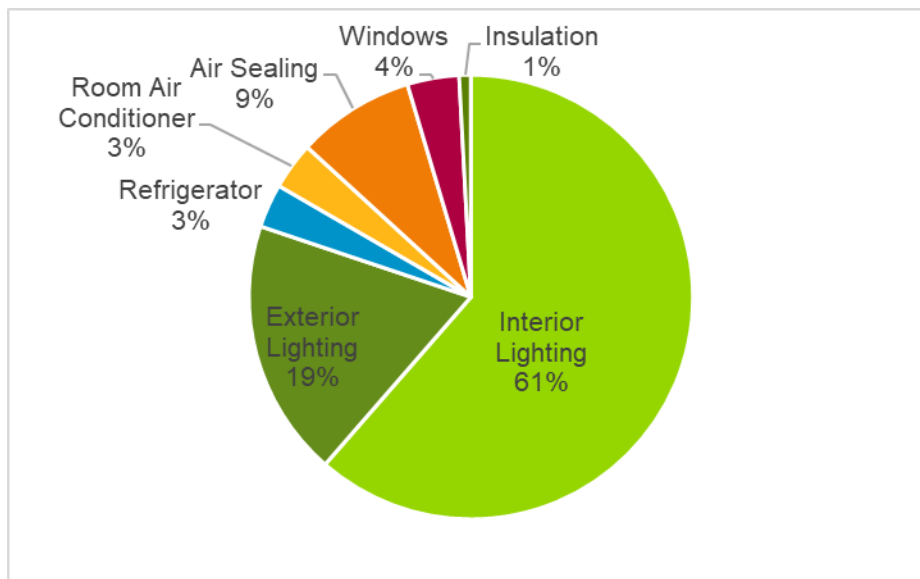
The PY9 participants and measures are shown in the following tables and graphs. The AHNC program completed one project in PY9.

Table 5-1. PY9 AHNC Volumetric Findings Detail

Participation	Quantity
Participants	1
Unique Projects	1
Housing Units	33
Interior Lighting (Fixtures)	632
Exterior Lighting (Fixtures)	24
Refrigerator (Units)	33
Room Air Conditioner (Units)	33
Air Sealing (Project)	1
Windows (Sq. Ft.)	5,167
Insulation (Sq. Ft.)	22,698

Source: ComEd tracking data and Navigant team analysis.

Figure 5-1. AHNC Distribution of Measures Installed by Verified Savings



Source: Evaluation Analysis

Table 2-2 summarizes the incremental energy and demand savings the AHNC program achieved in PY9.

Table 5-2. PY9 AHNC Total Annual Incremental Savings

Savings Category	Energy Savings (kWh)	Demand Savings (kW)	Peak Demand Savings (kW)
Ex Ante Gross Savings	60,740	NA	19
Program Gross Realization Rate	66%	NA	57%
Verified Gross Savings	39,790	26	10
Program Net-to-Gross Ratio (NTGR)	1.00	1.00	1.00
Verified Net Savings	39,790	26	10

Source: ComEd tracking data and Navigant team analysis.

5.3 AHNC Program Savings by Measure

The program includes seven measures as shown in the following table. The interior lighting and exterior lighting measures contributed the most savings at 61 and 19 percent of overall savings, respectively.

Table 5-3. AHNC PY9 Energy Savings by Measure

End Use Type	Research Category	Ex Ante Gross Savings (kWh)	Verified Gross Realization Rate	Verified Gross Savings (kWh)	NTGR *	Verified Net Savings (kWh)	Technical Measure Life	Persistence	Effective Useful Life (EUL)†
Lighting	Interior Lighting	45,899	53%	24,437	1.00	24,437	NA	NA	15
Lighting	Exterior Lighting	6,434	116%	7,457	1.00	7,457	NA	NA	10
Appliance	Refrigerator	1,040	122%	1,270	1.00	1,270	NA	NA	12
HVAC	Room Air Conditioner	1,369	100%	1,369	1.00	1,369	NA	NA	9
Shell	Air Sealing	3,987	86%	3,417	1.00	3,417	NA	NA	15
Shell	Windows	1,639	91%	1,500	1.00	1,500	NA	NA	25
Shell	Insulation	372	91%	340	1.00	340	NA	NA	25
Total		60,740	66%	39,790	1.00	39,790			

* A deemed value. The TRM v6 deems NTG at 1.0 for Income Eligible programs.

† EUL is a combination of technical measure life and persistence.

Table 5-4. AHNC PY9 Demand Savings by Measure

End Use Type	Research Category	Ex Ante Gross Demand Reduction (kW)	Verified Gross Realization Rate	Verified Gross Demand Reduction (kW)	NTGR*	Verified Net Demand Reduction (kW)
Lighting	Interior Lighting	NA	NA	9	1.00	9
Lighting	Exterior Lighting	NA	NA	2	1.00	2
Appliance	Refrigerator	NA	NA	0	1.00	0
HVAC	Room Air Conditioner	NA	NA	5	1.00	5
Shell	Air Sealing	NA	NA	7	1.00	7
Shell	Windows	NA	NA	3	1.00	3
Shell	Insulation	NA	NA	1	1.00	1
Total		NA	NA	26	1.00	26

* A deemed value. The TRM v6 deems NTG at 1.0 for Income Eligible programs.

Table 5-5. AHNC PY9 Peak Demand Savings by Measure

End Use Type	Research Category	Ex Ante Gross Peak Demand Reduction (kW)	Verified Gross Realization Rate	Verified Gross Peak Demand Reduction (kW)	NTGR*	Verified Net Peak Demand Reduction (kW)
Lighting	Interior Lighting	5	53%	3	1.00	3
Lighting	Exterior Lighting	0	100%	0	1.00	0
Appliance	Refrigerator	0	122%	0	1.00	0
HVAC	Room Air Conditioner	5	52%	3	1.00	3
Shell	Air Sealing	5	59%	3	1.00	3
Shell	Windows	2	63%	1	1.00	1
Shell	Insulation	0	63%	0	1.00	0
Total		19	57%	10	1.00	10

* A deemed value. The TRM v6 deems NTG at 1.0 for Income Eligible programs.

5.4 AHNC Program Impact Analysis Findings and Recommendations

5.4.1 Impact Parameter Estimates

The implementer provided project savings calculators and documentation for Navigant’s review. Project documentation included program forms and applications; architectural, landscape, mechanical, and plumbing drawings; and appliance, lighting, HVAC, and window specifications. The implementer also provided photos and reports from site visits and testing results. The evaluation team analyzed all documentation and verified that savings and measure counts reported in the project calculators were consistent with the provided project documentation and program tracking data. Navigant relied on the following files for ex ante savings:

- Final PY9 program tracking data file: “AH-NC PY9 Completed Projects_Data from Access Database_for ComEd and Navigant 020718.xlsx”
- Final PY9 project savings calculator: “Energy Savings Estimation Calculator_AH0002_rev1 020718.xlsx”
- Project documentation: “Documentation for evaluation for AH0002_020818.zip”

Navigant used algorithms outlined in the Illinois Technical Reference Manual, version 5.0 to calculate verified gross savings for the AHNC program. The evaluation team verified that these algorithms and appropriate deemed input parameters were correctly applied and validated any custom parameters that were used. Navigant calculated verified net savings by multiplying the verified gross savings by a deemed net-to-gross ratio (NTGR). The NTGR for the AHNC program was approved through a consensus process managed through the Illinois Stakeholder Advisory Group (IL SAG).

Table 5-6. AHNC Verified Gross Savings Parameters

Gross Savings Input Parameters	Value	Deemed* or Evaluated?
Measure Quantities	Varies	Evaluated
Savings Input Assumptions	Varies	Deemed
Gross Savings per Unit	Varies	Deemed
Verified Realization Rate on Ex Ante Gross Savings	Varies	Deemed
NTGR	1.00	Deemed

* State of Illinois Technical Reference Manual version 5.0 from <http://www.ilsag.info/technical-reference-manual.html>.

5.4.2 Impact Findings and Recommendations

Verified Gross Impacts and Realization Rate

Finding 1. The PY9 AHNC program achieved 39,790 kWh of verified gross energy savings, 26 kW of verified gross demand reduction, and 10 kW of verified gross peak demand reduction. The overall verified gross program realization rate was 66 percent for energy savings and 57 percent for peak demand savings. Navigant did not calculate a realization rate for gross demand savings because ComEd did not track gross demand reduction.

Recommendation 1. Navigant recommends that ComEd track gross demand reduction.

Finding 2. Navigant found variability in realization rates at the measure level. Recommendations 2-7 summarize the recommendations at the measure level and Section 5.5 includes impact analysis details by measure

Recommendation 2. Navigant recommends using CF_{PJM} instead of CF_{SSP} to calculate coincident peak demand savings for all applicable measures.

Recommendation 3. Navigant recommends using the building permit date to determine the baseline building energy code for baseline specifications.

Recommendation 4. In future program years, Navigant recommends calculating savings for common spaces using the lighting power density method, and for housing units on a lamp or fixture basis.

Recommendation 5. Navigant recommends the implementer carefully review product documentation, specification sheets, and the TRM to determine baseline and efficient product specifications.

Recommendation 6. Navigant recommends using equipment efficiency metrics specific to equipment types to calculate savings for air sealing, windows, and insulation. For example, use EER instead of SEER for room air conditioners.

Recommendation 7. Navigant recommends using a standard conversion formula to convert infiltration at 75 pascals to infiltration at 50 pascals.

Verified Net Impacts and NTGR

Finding 3. The evaluation used a deemed NTGR of 1.00 for the AHNC program to calculate verified net savings of 39,790 kWh, verified net demand reduction of 26 kW, and verified net peak demand reduction of 10 kW.

Program Participation

Finding 4. The program had one program participant in PY9 and completed one project with 33 income eligible housing units.

5.5 AHNC Impact Analysis Detail

5.5.1 Coincidence Factor

The overall verified gross program realization rate is 57 percent for peak demand savings. The primary reason for the discrepancy in peak demand savings is due to the coincidence factor applied to windows, air sealing, insulation, and room air conditioner savings algorithms. The implementer used the system peak coincidence factor, CF_{SSP} , but Navigant used CF_{PJM} to support ComEd's PJM compliance requirements.

Recommendation 2. Navigant recommends the implementer use CF_{PJM} instead of CF_{SSP} to calculate coincident peak demand savings for all applicable measures.

5.5.2 Interior Lighting

The realization rate for interior lighting is 53 percent, and the main reason for the discrepancy between ex ante and verified savings is due to the baseline building energy code. The implementer used IECC 2012 as the baseline code, but the building was permitted and built under IECC 2015 code. Navigant used IECC 2015, which decreased the baseline lighting power density from 0.70 to 0.51 watts per square foot.

Furthermore, in reviewing specifications for individual lighting fixtures, Navigant found that the 7-watt LEDs installed in kitchens were in fact 17 watts and the fixtures installed in bathrooms had two lamps per fixture instead of one lamp per fixture. Navigant also calculated a slightly different area of the common space. The total floor area of the building was found to be 35,289 square feet from building design documentation instead of 35,239 square feet, which resulted in 13,839 square feet as the area of the common space instead of 13,789 square feet.

Recommendation 3. Navigant recommends using the building permit date to determine the baseline building energy code for baseline specifications.

Recommendation 4. In future program years, Navigant recommends calculating savings for common spaces using the lighting power density method, and for housing units on a lamp or fixture basis.

Recommendation 5. Navigant recommends carefully reviewing product documentation, specification sheets, and the TRM to determine baseline and efficient product specifications.

5.5.3 Exterior Lighting

Navigant found a slight difference between ex ante and verified savings for exterior lighting. In reviewing specifications for individual lighting fixtures and baseline wattages, Navigant determined that the baseline wattage for the Type A fixture should be 72 W, which was twice the reported baseline of 37.2 W.

Recommendation 5. Navigant recommends carefully reviewing product documentation, specification sheets, and the TRM to determine baseline and efficient product specifications.

5.5.4 Refrigerators

Refrigerators have a realization rate of 122 percent. The difference between reported and verified savings is due to the size of the freezer capacity and product category used to calculate baseline and efficient case energy use. The implementer used 3.2 cubic feet as the freezer volume to calculate an adjusted volume of 17.8 cubic feet, but the product specification shows that the installed freezer volume was 3.7 cubic feet, resulting in an adjusted volume of 18.6 cubic feet. The implementer also used product category 1, refrigerators with manual defrost, to calculate baseline and efficient case energy savings

despite the project documentation and specification sheet showing installed refrigerators in product category 3, refrigerator – automatic defrost with top-mounted freezer without through-the-door ice service. Navigant used product category 3 to calculate verified energy savings.

Recommendation 5. Navigant recommends carefully reviewing product documentation, specification sheets, and the TRM to determine baseline and efficient product specifications.

5.5.5 Air Sealing, Windows, and Insulation

Air sealing, windows, and insulation have realization rates of 86, 91, and 91 percent, respectively. These realization rates are primarily due to the value of the cooling system efficiency. The implementer used the SEER value to calculate savings, but given that each housing unit has a commercial grade room air conditioner, the EER value of the room air conditioner units should be used as the value for the cooling system efficiency.

Additionally, for air sealing, Navigant used a different conversion factor to convert infiltration at 75 pascals to infiltration at 50 pascals. The implementer used results from a specific field study to calculate the conversion whereas Navigant used a standard conversion formula:

$$CFM50 = CFM75 * \frac{50 CFM^{0.65}}{75 CFM} = CFM75 * 0.768$$

Recommendation 6. Navigant recommends using equipment efficiency metrics specific to equipment types to calculate savings for air sealing, windows, and insulation. For example, use EER instead of SEER for room air conditioners.

Recommendation 7. Navigant recommends using a standard conversion formula to convert infiltration at 75 pascals to infiltration at 50 pascals.

5.6 AHNC TRC Detail

Table 2-7 shows the total resource cost savings summary for the AHNC Program.

Table 5-7. Total Resource Cost Savings Summary

End Use Type	Research Category	Units	Quantity	Effective Useful Life	Ex Ante Gross Savings (kWh)	Ex Ante Gross Peak Demand Reduction (kW)	Verified Gross Savings (kWh)	Verified Gross Peak Demand Reduction (kW)
Lighting	Interior Lighting	Each	632	15	45,899	5	24,437	3
Lighting	Exterior Lighting	Each	24	10	6,434	-	7,457	-
Appliance	Refrigerator	Each	33	12	1,040	0	1,270	0
HVAC	Room Air Conditioner	Each	33	9	1,369	5	1,369	3
Shell	Air Sealing	Project	1	15	3,987	5	3,417	3
Shell	Windows	Sq. Ft.	5,167	25	1,639	2	1,500	1
Shell	Insulation	Sq. Ft.	22,698	25	372	0	340	0

The Total Resource Cost (TRC) variable table only includes cost-effectiveness analysis inputs available at the time of finalizing this PY9 impact evaluation report. Additional required cost data (e.g., measure costs, program level incentive and non-incentive costs) are not included in this table and will be provided to evaluation at a later date. Further, detail in this table (e.g., EULs) other than final PY9 savings and program data are subject to change and are not final.