



ComEd

CLEAResult Schools Direct Install Program Evaluation Report

FINAL

**Energy Efficiency / Demand Response Plan:
Plan Year 8 (PY8)
(6/1/2015-5/31/2016)**

**Presented to
Commonwealth Edison Company**

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E. EXECUTIVE SUMMARY

This report presents a summary of the findings and results from the impact and limited process evaluation of the PY8¹ IPA CLEAResult Schools Direct Install (CLEAResult-Schools) program. The PY8 CLEAResult-Schools program focused on assisting private educational facility customers implement both low-cost/no-cost and operational savings measures. This program was designed for private educational facility customers with demands less than 100 kW. All targeted customers taking delivery service from ComEd were eligible for the program regardless of their choice of supplier. CLEAResult-Schools was implemented by CLEAResult. CLEAResult used various marketing and outreach channels such as using a customer list from ComEd for mailings, follow-up calls, website referrals, face-to-face visits, and scheduled meetings with decision makers to recruit facility managers and school administrators.

Eligible measures included LED exit signs, CFL lamps, occupancy sensors, controls for vending machines and refrigerated coolers, and operational savings. The PY8 net savings target was 4,097 MWh with an anticipated participation of 163 schools.²

E.1. Program Savings

The table below summarizes the electricity savings from the PY8 CLEAResult-Schools program.

Table E-1. PY8 Total Program Electric Savings

Savings Category	Energy Savings (MWh)	Demand Savings (MW)	Peak Demand Savings (MW)
Ex Ante Gross Savings	778	(Not Tracked)	0.0538
Verified Gross Savings	813	0.7740	0.1984
Verified Net Savings	773	0.7353	0.1885

Source: ComEd tracking data and Navigant analysis.

E.2. Program Savings by Educational Facility Type

The following table below summarizes the electricity savings from the CLEAResult-Schools program by type of educational facility.

¹ The PY8 program year began June 1, 2015 and ended May 31, 2016.

² <https://www.illinois.gov/sites/ipa/Documents/ComEd-Appendices-C-2-to-C-5.pdf> Accessed: November 4, 2016

Table E-2. PY8 Program Results by Educational Facility Type

Category	Ex Ante Gross Energy Savings (MWh)	Ex Ante Gross Peak Demand Savings (MW)	Verified Gross Energy Savings (MWh)	Verified Gross Peak Demand Savings (MW)	Verified Gross Energy Realization Rate (%)	NTGR†	Verified Net Energy Savings (MWh)	Verified Net Peak Demand Savings (MW)
Elementary School	301	0.0163	301	0.0283	100	0.95	286	0.0269
College	54	0.0041	76	0.0220	141	0.95	72	0.0209
Childcare/Pre-School	183	0.0098	190	0.0818	104	0.95	180	0.0777
High School	30	0.0035	32	0.0036	106	0.95	30	0.0034
Office-Low Rise	36	0.0035	48	0.0093	135	0.95	46	0.0088
Religious Building	175	0.0166	167	0.0535	95	0.95	158	0.0508
Total‡	778	0.0538	813	0.1984	105	0.95	773	0.1885

Source: ComEd tracking data and Navigant analysis.

† A deemed value. Source: "ComEd_NTG_History_and_PY8_Recommendations.xls", found on the IL SAG web site: <http://ilsag.info/net-to-gross-framework.html>.

‡Numbers do not sum exactly due to rounding.

E.3. Program Volumetric Detail

The program had 85 participants in PY8 and installed 2,821 measures as shown in the following table.

Table E-3. PY8 Volumetric Findings by Measure

Measure	Quantity
CFL Lamp (15W or Less)	1,098
Occupancy Sensor (Wall Mounted)	938
LED Exit Sign (Incandescent Base)	540
CFL Lamp (16-20W)	3
CFL Lamp (21W or Greater)	80
Vending Machine Controls (Non-Refrigerated Snack Machine)	5
Vending Machine Controls (Refrigerated Beverage Machine)	8
Pre-rinse Spray Valve	2
Smart Strips - 7 plug	37
Low flow aerator – bath	74
Low flow aerator – kitchen	14
Low Flow Showerhead	7
Vending Machine Controls (Glass Front Refrigerated Coolers)	1
13W LED A-lamp	14
Total	2,821

Source: ComEd tracking data and Navigant analysis.

E.4. Results Summary

The following table summarizes the key metrics from PY8.

Table E-4. PY8 Results Summary

Participation	Units	PY8
Verified Net Savings	MWh	773
Verified Net Peak Demand Reduction	MW	0.1885
Verified Gross Savings	MWh	813
Verified Gross Peak Demand Reduction	MW	0.1984
Program Energy Realization Rate	%	105
Program NTG Ratio	#	0.95
Total Measures Installed	#	2,821
Customers Touched	#	85

Source: ComEd tracking data and Navigant analysis.

E.5. Findings and Recommendations

The following provides insight into key program findings and recommendations.³

Program Volumetric Findings.

Finding 1. Eighty-five educational facilities participated in the program. The PY8 target number of participating educational facilities was 163—the program met 52 percent of its participation target. According to the program manager, the implementation took longer than and the program got a “slow start” in PY8. Also in January 2016, the implementation contractor shifted focus away from operational savings measures and focused exclusively on direct install measures due to lack of interest in the operational savings measures. In addition, in the spring, the implementer discovered that some of the occupancy sensors had malfunctioned, so they ceased installations. These circumstances contributed to the lower than anticipated participation for the program as well as lower than anticipated savings per educational facility.

Verified Net Impacts

Finding 2. The PY8 CLEAResult-Schools program net savings target was 4,097 net MWh. The PY8 net verified energy savings were estimated to be 773 MWh—the program met 19 percent of the net energy savings target. [See Finding 1.]

Verified Gross Impacts and Realization Rate

Finding 3. The tracking system did not include demand reduction savings.

Recommendation 1. Include ex ante demand reduction savings calculations in the tracking system.

Finding 4. The program energy realization rate is 105 percent due to adjustments made for hours of facility operation by category, waste heat factors for energy and demand and coincidence factors by facility category. In addition, the program demand realization rate is 369 percent due to adjustments made for hours of facility operation by category, waste heat factors for energy and demand and coincidence factors by facility category.

Recommendation 2. Use these adjustments to better reflect TRM values within facility categories.

Tracking System Findings

Finding 5. The tracking system consisted of hard coded values of net energy and demand savings for different measures. The calculations and algorithms for deemed savings for various measures were provided in a separate lookup file⁴.

Recommendation 3. Navigant recommends including all the information (i.e., the parameter assumptions and algorithms) in the tracking file.

Finding 6. The implementer did not collect the building type information and assumed all the participant facilities as Elementary Schools.

Recommendation 4. Navigant recommends that the implementer collect building type information and use parameter assumptions from the TRM based on different building types to estimate savings.

³ Numbering on the findings and recommendations in this section are the same as the more complete list found in the Findings and Recommendations section of the evaluation report for ease of reference between each section.

⁴ ComEd TPEP School DI - PY8 measures and savings 10142015.xlsx

1. INTRODUCTION

1.1 Program Description

The PY8⁵ CLEAResult Schools Direct Install (CLEAResult-Schools) program focused on assisting private educational facility customers implement both low-cost/no-cost and operational savings measures. This program was designed for private educational facility customers with demand less than 100 kW. All targeted customers taking delivery service from ComEd were eligible for the program regardless of their choice of supplier. CLEAResult-Schools was implemented by CLEAResult. CLEAResult used various marketing and outreach channels such as using the customer list from ComEd for mailings, follow-up calls, website referrals, face-to-face visits, and scheduled meetings with decision makers to recruit facility managers and school administrators.

Eligible measures included LED exit signs, CFL lamps, occupancy sensors, controls for vending machines and refrigerated coolers, and operational savings. The PY8 net savings target was 4,097 MWh with an anticipated participation of 163 schools.⁶

1.2 Evaluation Objectives

The evaluation team identified the following key researchable questions for PY8.

1.2.1 Impact Questions

1. What are the program's verified gross savings?
2. What are the program's verified net savings?
3. What updates are recommended for the Illinois Technical Reference Manual (TRM)?

1.2.2 Process Questions

1. What caused the program's low participation in PY8?
2. What are the changes for PY9?

⁵ The PY8 program year began June 1, 2015 and ended May 31, 2016.

⁶ <https://www.illinois.gov/sites/ipa/Documents/ComEd-Appendices-C-2-to-C-5.pdf> Accessed: November 4, 2016

2. EVALUATION APPROACH

We prepared a two-year evaluation plan to identify tasks by year on a preliminary basis (Table 2-1). Final activities will be determined annually to reflect current program conditions.

Table 2-1. Evaluation Plan Summary

Activity	PY8	PY9
Gross Impact Approach	Tracking Data Review	Tracking Data Review
Verified Net Impact Approach	Deemed Value	Deemed Value
Program Manager and Implementer Interviews/ Review Materials	Yes	Yes

2.1 Overview of Data Collection Activities

The core data collection activities included reviewing the tracking database, and in- depth interviews with the program manager and implementer staff. The full set of data collection activities is shown in the following tables.

Table 2-2. Primary Data Collection Activities

What	Who	Target Completes	Completes Achieved	When
Program Tracking Database Review	Participants	Program Participation	85	August 2016 – November 2016
In Depth Interviews	Program Manager/Implementer Staff	2	2	October 2016

Table 2-3. Additional Resources

Reference Source	Application
Illinois Technical Reference Manual v4.0	College, Elementary and High Schools, Office-Low Rise, Religious Building
Illinois Technical Reference Manual v5.0	Childcare/Pre-School†

†IL TRM v5.0 was used for these schools because this category of schools was not included in v4.0 of the TRM.

2.2 Verified Savings Parameters

Verified gross and net energy savings and demand savings resulting from the PY8 CLEAResult-Schools program were calculated using the deemed values as defined by the Illinois TRM version 4.0⁷ and TRM version 5.0. TRM version 4.0 does not define a building type for Childcare/Pre-Schools. TRM version 5.0 includes assumptions for Childcare/Pre-Schools. Since the Technical Advisory Committee (TAC) approved using assumptions in the TRM v5.0 for Childcare/Pre-Schools, Navigant used the parameter values in TRM v5.0 to estimate savings for Childcare/Pre-Schools. For other building types, Navigant used the parameter values from TRM v4.0.

The implementer did not categorize the 85 participating facilities in different categories and assumed the building type as Elementary Schools for all the facilities. Navigant categorized the facilities in six categories to obtain reasonable estimates of hours of use (HOU) and waste heat factors for energy

⁷ Source: <http://www.ilsag.info/technical-reference-manual.html>

(WHFe) and demand (WHFd) and coincidence factors. Navigant performed online research to categorize the schools in six different categories as shown below.

1. Elementary School
2. College
3. Childcare/Pre-School
4. High School
5. Office-Low Rise
6. Religious Building

Verified gross and net savings (energy and coincident peak demand) resulting from the PY8 program were calculated using the deemed values and following algorithms as defined in the Section 4.5 of IL TRM v4.0:

CFLs

$$\Delta kWh = ((WattsBase - WattsEE) / 1000) * ISR * Hours * WHFe$$

$$\Delta kW = ((WattsBase - WattsEE) / 1000) * ISR * WHFd * CF$$

Where:

WattsBase = Actual (if retrofit measure) or based on lumens of CFL bulb and program year installed

WattsEE = Actual wattage of CFL purchased or installed

ISR = 100%, In Service Rate or the percentage of units rebated that get installed.

Hours = Average hours of use per year are provided in Reference Table in Section 4.5, Screw based bulb annual operating hours, for each building type. If unknown use the Miscellaneous value.

WHFe = Waste heat factor for energy to account for cooling energy savings from efficient lighting are provided below for each building type in Reference Table in Section 4.5. If unknown, use the Miscellaneous value.

WHFd = Waste heat factor for demand to account for cooling savings from efficient lighting in cooled buildings is provided in the Reference Table in Section 4.5. If unknown, use the Miscellaneous value.

CF = Summer Peak Coincidence Factor for measure is provided in the Reference Table in Section 4.5. If unknown, use the Miscellaneous value.

LED Exit Signs

$$\Delta kWh = ((WattsBase - WattsEE) / 1000) * Hours * WHFe$$

$$\Delta kW = ((WattsBase - WattsEE) / 1000) * WHFd * CF$$

Where:

WattsBase = Actual wattage

WattsEE = Actual wattage, if unknown assume the following:

Baseline Types	WattsBase
Incandescent	35W
Fluorescent	11W
Unknown (e.g. time of sale)	23W

HOURS = Annual operating hours, 8766

WHFe = Waste heat factor for energy to account for cooling energy savings from efficient lighting are provided below for each building type in Reference Table in Section 4.5. If unknown, use the Miscellaneous value.

WHFd = Waste heat factor for demand to account for cooling savings from efficient lighting in cooled buildings is provided in the Reference Table in Section 4.5. If unknown, use the Miscellaneous value.

CF = Summer Peak Coincidence Factor for measure is provided in the Reference Table in Section 4.5. If unknown, use the Miscellaneous value.

LED fixtures

$\Delta kWh = ((WattsBase - WattsEE)/1000) * Hours * WHFe * ISR$

$\Delta kW = ((WattsBase - WattsEE)/1000) * ISR * WHFd * CF$

Where:

WattsBase = Input wattage of the existing system. Reference the “LED New and Baseline Assumptions” table for default values in the TRM.

WattsEE = Actual wattage of LED purchased / installed. For ENERGY STAR rated lamps lumen equivalence values should be used.

Omnidirectional Lamps - ENERGY STAR Minimum Luminous Efficacy = 50Lm/W for <10W lamps and 55Lm/W for >=10W lamps.

ISR = 100%, In Service Rate or the percentage of units rebated that get installed.

Hours = Average hours of use per year are provided in Reference Table in Section 4.5, Screw based bulb annual operating hours, for each building type. If unknown use the Miscellaneous value.

WHFe = Waste heat factor for energy to account for cooling energy savings from efficient lighting are provided below for each building type in Reference Table in Section 4.5. If unknown, use the Miscellaneous value.

WHFd = Waste heat factor for demand to account for cooling savings from efficient lighting in cooled buildings is provided in the Reference Table in Section 4.5. If unknown, use the Miscellaneous value.

CF = Summer Peak Coincidence Factor for measure is provided in the Reference Table in Section 4.5. If unknown, use the Miscellaneous value.

Occupancy Sensors

$$\Delta kWh = KW_{Controlled} * Hours * ESF * WHF_e$$

$$\Delta kW = KW_{controlled} * WHF_d * (CF_{baseline} - CF_{os})$$

Where:

$KW_{Controlled}$ = Total lighting load connected to the control in kilowatts. Savings is per control. The total connected load per control should be collected from the customer or the default values presented below used;

LIGHTING CONTROL TYPE	DEFAULT KW CONTROLLED
Wall mounted occupancy sensor	0.350
Remote mounted occupancy sensor	0.587
Fixture mounted sensor	0.073

Hours = total operating hours of the controlled lighting circuit before the lighting controls are installed. This number should be collected from the customer. Average hours of use per year are provided in the Reference Table in Section 4.5, Fixture annual operating hours, for each building type if customer specific information is not collected. If unknown building type, use the Miscellaneous value.

ESF = Energy Savings factor (represents the percentage reduction to the operating Hours from the non-controlled baseline lighting system).

Lighting Control Type	Energy Savings Factor
Wall or Ceiling-Mounted Occupancy Sensors	41% or custom
Fixture Mounted Occupancy Sensors	30% or custom
Wall-Mounted Occupancy Sensors Configured as "Vacancy Sensors"	53% or custom

WHF_e = Waste heat factor for energy to account for cooling energy savings from efficient lighting is provided in the Reference Table in Section 4.5 for each building type. If building is un-cooled, the value is 1.0.

WHF_d = Waste Heat Factor for Demand to account for cooling savings from efficient lighting in cooled buildings is provided in the Reference Table in Section 4.5. If the building is un-cooled, the WHF_d is 1.

CF_{baseline} = Baseline Summer Peak Coincidence Factor for the lighting system without Occupancy Sensors installed is selected from the Reference Table in Section 4.5 for each building type. If the building type is unknown, use the Miscellaneous value of 0.66

CF_{os} = Retrofit Summer Peak Coincidence Factor for the lighting system with Occupancy Sensors installed is 0.15 regardless of building type.

Low Flow Faucet Aerators

$$\Delta kWh = \%Electric\ DHW * ((GPM_base - GPM_low)/GPM_base) * Usage * EPG_electric * ISR$$

$$\Delta kW = (\Delta kWh / Hours) * CF$$

Where:

%ElectricDHW = proportion of water heating supplied by electric resistance heating

DHW fuel	%Electric_DHW
Electric	100%
Fossil Fuel	0%

GPM_base = Average flow rate, in gallons per minute, of the baseline faucet “as- used”
= 1.39 or custom based on metering studies.⁸ Or if measured during DI

GPM_low = Average flow rate, in gallons per minute, of the low-flow faucet aerator “as-used”

Usage = 0.94 or custom based on metering studies, or if measured during DI:

Usage = Estimated usage of mixed water (mixture of hot water from water heater line and cold water line) per faucet (gallons per year)

EPG_electric = Energy per gallon of mixed water used by faucet (electric water heater)
= $(8.33 * 1.0 * (WaterTemp - SupplyTemp)) / (RE_electric * 3412)$
= $(8.33 * 1.0 * (90 - 54.1)) / (0.98 * 3412)$
= 0.0894 kWh/gal

8.33 = Specific weight of water (lbs/gallon)

1.0 = Heat Capacity of water (Btu/lb-°F)

WaterTemp = Assumed temperature of mixed water
= 86F for Bath, 93F for Kitchen, 91F for Unknown

SupplyTemp = Assumed temperature of water entering building
= 54.1°F

RE_electric = Recovery efficiency of electric water heater
= 98%

3412 = Converts Btu to kWh (Btu/kWh)

ISR = 0.95, Direct Install – Deemed

Hours = Annual electric DHW recovery hours for faucet use

CF = Coincidence Factor for electric load reduction

Low Flow Showerheads

$$\Delta kWh = \%Electric\ DHW * ((GPM_base * L_base - GPM_low * L_low) * NSPD * 365.25) * EPG_electric * ISR$$

⁸ Measurement should be based on actual average flow consumed over a period of time rather than a onetime spot measurement for maximum flow. Studies have shown maximum flow rates do not correspond well to average flow rate due to occupant behavior which does not always use maximum flow.

$$\Delta kW = \Delta kWh / \text{Hours} * CF$$

Where:

- %Electric DHW = proportion of water heating supplied by electric resistance heating
= 1 if electric DHW, 0 if fuel DHW, if unknown assume 16%
- GPM_base = Flow rate of the baseline showerhead
= 2.67 for Direct-install programs
- GPM_low = As-used flow rate of the low-flow showerhead, which may, as a result of measurements of program evaluations deviate from rated flows, see table below:

Rated Flow
2.0 GPM
1.75 GPM
1.5 GPM
Custom or Actual

- L_base = Shower length in minutes with baseline showerhead
= 8.20 min
- L_low = Shower length in minutes with low-flow showerhead
= 8.20 min
- 365.25 = Days per year, on average.
- NSPD = Estimated number of showers taken per day for one showerhead
- EPG_electric = Energy per gallon of hot water supplied by electric
= $(8.33 * 1.0 * (\text{Shower Temp} - \text{Supply Temp})) / (\text{RE_electric} * 3412)$
= $(8.33 * 1.0 * (105 - 54.1)) / (0.98 * 3412)$
= 0.127 kWh/gal
- 8.33 = Specific weight of water (lbs/gallon)
- 1.0 = Heat Capacity of water (btu/lb-°F)
- ShowerTemp = Assumed temperature of water
= 105°F
- SupplyTemp = Assumed temperature of water entering house
= 54.1°F
- RE_electric = Recovery efficiency of electric water heater
= 98%
- 3412 = Converts Btu to kWh (btu/kWh)
- ISR = 0.95, Direct Install – Deemed
- Hours = Annual electric DHW recovery hours for showerhead use
- CF = Coincidence Factor for electric load reduction
= 0.0278

Smart Strips

- ΔkWh_{5-Plug} = 56.5 kWh
- ΔkWh_{7-Plug} = 103 kWh
- ΔkW = $\Delta kWh / \text{Hours} * CF$

Where:

- Hours = Annual number of hours during which the controlled standby loads are turned off by the Smart Strip.
= 7,129
- CF = 0.8, Summer Peak Coincidence Factor for measure

Beverage and Snack Machine Controls

ΔkWh = WATTS base / 1000 * HOURS * ESF
 ΔkW = 0

Where:
 WATTS base = connected W of the controlled equipment; see table below for default values by connected equipment type:

EQUIPMENT TYPE	WATTS BASE
Refrigerated Beverage Vending Machines	400
Non-Refrigerated Snack Vending Machines	85
Glass Front Refrigerated Coolers	460

1000 = conversion factor (W/kW)
 HOURS = operating hours of the connected equipment; assumed that the equipment operates 24 hours per day, 365.25 days per year = 8766
 ESF = Energy Savings Factor; represents the percent reduction in annual kWh consumption of the equipment controlled; see table below for default values:

EQUIPMENT TYPE	ENERGY SAVINGS FACTOR (ESF)
Refrigerated Beverage Vending Machines	46%
Non-Refrigerated Snack Vending Machines	46%
Glass Front Refrigerated Coolers	30%

High Efficiency Pre-Rinse Spray Valve

ΔkWh = $\Delta Gallons \times 8.33 \times 1 \times (T_{out} - T_{in}) \times (1/EFF \text{ electric}) / 3,413 \times FLAG$
 kW = 0

Where:
 $\Delta Gallons$ = amount of water saved as calculated below
 8.33 lbm/gal = specific mass in pounds of one gallon of water
 1 Btu/lbm°F = Specific heat of water: 1 Btu/lbm/°F
 T_{out} = Water Heater Outlet Water Temperature
 T_{in} = custom, otherwise assume $T_{in} + 70^\circ F$ temperature rise from T_{in}
 T_{in} = Inlet Water Temperature
 T_{in} = custom, otherwise assume 54.1 °F
 EFF = Efficiency of electric water heater supplying hot water to pre-rinse spray valve
 = custom, otherwise assume 97%
 Flag = 1 if electric or 0 if gas

The table below gives a list of deemed and evaluated parameters used for ex-post analysis.

Table 2-4. Verified Savings Parameter Data Sources

Gross Savings Input Parameter	Deemed or Evaluated	Data Source
Waste Heat Factors for Energy & Demand (WHF _e & WHF _d)	Deemed	IL TRM
Hours of Use (HOU) [by measure type and school type]	Deemed	IL TRM
Coincidence Factors	Deemed	IL TRM
Realization Rate	Evaluated	Navigant Analysis
NTGR	Deemed	IL SAG

2.2.1 Verified Gross Program Savings Analysis Approach

The program key gross impact evaluation activities for PY8 were based on (1) reviewing the tracking system to determine whether all fields were appropriately populated, (2) reviewing measure algorithms and savings values in the tracking system to ensure that the TRM v4.0 and TRM v5.0 were appropriately applied based on the building type, and (3) cross-checking measure totals and savings recorded in the tracking database.

TRM v4.0 does not define a building type for childcare/preschools. TRM v5.0 includes assumptions for childcare/preschools. Since the Technical Advisory Committee (TAC) approved using assumptions in the TRM v5.0 for childcare/preschools, Navigant used the parameter values in TRM v5.0 to estimate savings for childcare/preschools. For other building types, Navigant used the parameter values from TRM v4.0.

2.2.2 Verified Net Program Savings Analysis Approach

Verified net energy and demand (coincident peak and overall) savings were calculated by multiplying the verified gross savings estimates by a net-to-gross ratio (NTGR). In PY8, the NTGR estimates used to calculate the net verified savings were defined by SAG.⁹

2.3 Process Evaluation

Navigant conducted a limited process evaluation for this program to try to determine the cause of the low participation in PY8, as well as the changes for PY9, via a telephone interview with the implementation contractor’s program manager and WECC staff.¹⁰

⁹ A deemed value. Source: “ComEd_NTG_History_and_PY8_Recommendations.xls”, found on the IL SAG web site: <http://ilsag.info/net-to-gross-framework.html>.

¹⁰ Telephone interview with CLEAR Result program manager and WECC staff, November 1, 2016.

3. GROSS IMPACT EVALUATION

Overall, the tracking system adequately captured the information needed for successful implementation and evaluation of the program. There are two suggested modifications to enhance the tracking system. The ex-ante gross calculations used generalized assumptions for the hours of use and waste heat factors for energy in the calculations for energy savings according to the TRM. For the verified gross savings, in order to determine appropriate hours of use and waste heat factors for energy, Navigant categorized the 85 participating educational facilities into six facility categories as mentioned in Section 2.2. Also, the tracking system included hard-coded values of net energy and demand savings for different measures. The calculations and algorithms for deemed savings for various measures were provided in a separate lookup file¹¹. Navigant recommends including all the information (i.e., the parameter assumptions and algorithms) in the tracking file.

3.1 Program Volumetric Findings

For the CLEAResult-Schools program, there were 85 schools with 2,821 installed measures reported in the PY8 tracking system. As shown in Figure 3-1, installations in Elementary Schools represented approximately 37 percent of the savings.

Table 3-1. PY8 School Types

School Type	Count
Elementary School	31
College	4
Childcare/Pre-School	25
High School	4
Office-Low Rise	3
Religious Building	18
Total	85

Source: Navigant analysis.

Table 3-2. PY8 Volumetric Findings Detail

Participation	
Participants	85
Installed Measures	2,821
Average Measures / Project	33

Source: ComEd tracking data and Navigant analysis.

As shown in the following table, the majority of savings come from lighting fixtures (94 percent) followed by food service equipment measures, refrigeration, hot water and consumer electronic measures. Lighting measures also account for 98 percent of peak demand savings. Refrigeration measures do not yield any peak demand savings. As shown in Figure 3-2, more than 50 percent of savings are realized

¹¹ ComEd TPEP School DI - PY8 measures and savings 10142015.xlsx

due to installation of occupancy sensors. The non-lighting measures account for six percent of energy and two percent of peak demand savings.

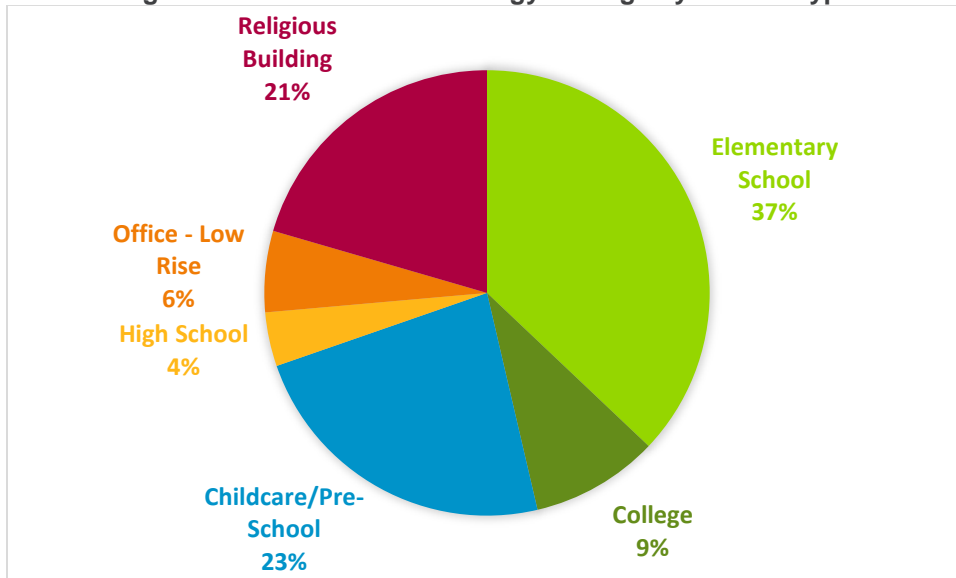
Table 3-3. PY8 Verified Volumetric Findings Detail by Measure Type

Participation	Measure Category	Number of Units Installed	% of Total Units Installed†	% of Total Energy Savings	% of Total Peak Demand Savings†
CFL Lamp (15W or Less)	Lighting	1,098	38.9%	10.7%	8.5%
Occupancy Sensor (Wall Mounted)	Lighting	938	33.3%	56.0%	75.1%
LED Exit Sign (Incandescent Base)	Lighting	540	19.1%	26.0%	12.8%
CFL Lamp (16-20W)	Lighting	3	0.1%	<0.1%	0.1%
CFL Lamp (21W or Greater)	Lighting	80	2.8%	1.2%	1.8%
13W LED A-lamp	Lighting	14	0.50%	0.2%	0.3%
Vending Machine Controls (Non-Refrigerated Snack Machine)	Refrigeration	5	0.2%	0.2%	0.00%
Vending Machine Controls (Refrigerated Beverage Machine)	Refrigeration	8	0.3%	1.6%	0.00%
Pre-rinse Spray Valve	Food Service Equipment	2	0.1%	2.0%	0.00%
Smart Strips - 7 plug	Consumer Electronics	37	1.3%	0.5%	0.2%
Low flow aerator - bath	Hot Water	74	2.6%	0.8%	1.0%
Low flow aerator - kitchen	Hot Water	14	0.5%	0.2%	0.2%
Low Flow Showerhead	Hot Water	7	0.3%	0.4%	0.2%
Vending Machine Controls (Glass Front Refrigerated Coolers)	Refrigeration	1	<0.1%	0.2%	0.00%

Source: ComEd tracking data and Navigant analysis.

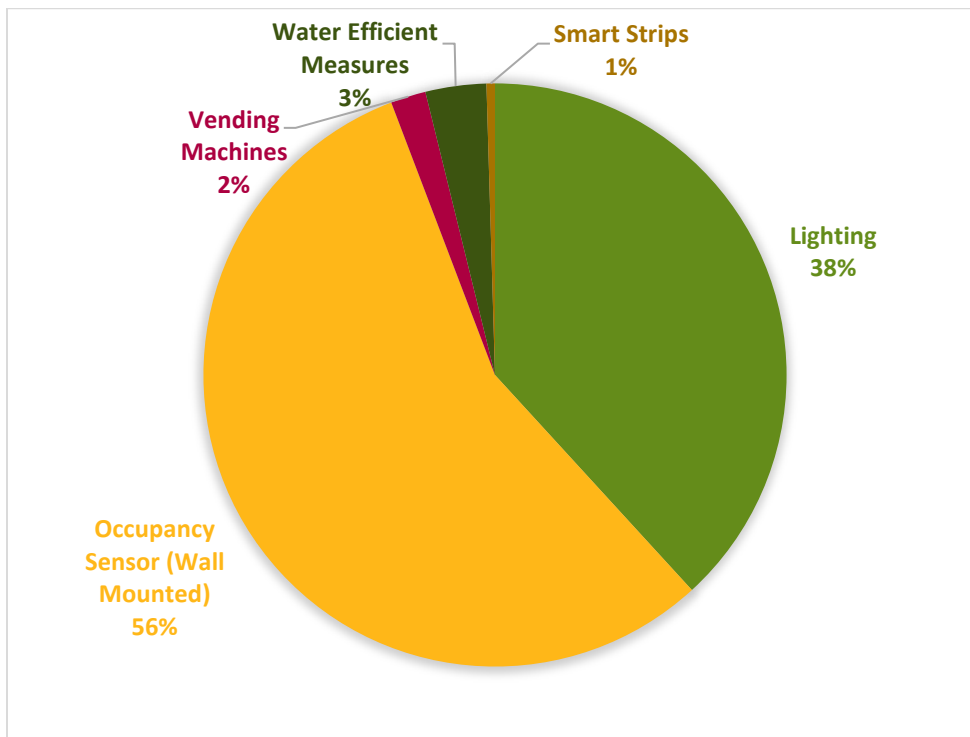
†Numbers do not sum exactly to 100 percent due to rounding.

Figure 3-1. Verified Gross Energy Savings by School Type



Source: Navigant analysis

Figure 3-2. Verified Gross Energy Savings by Measure Type



Source: Navigant analysis

3.2 Tracking System Review

The tracking data indicates total ex ante gross energy and peak demand savings of 778 MWh and 0.0538 MW respectively. Using the deemed NTG value of 0.95, the ex-ante net energy and peak demand savings are 739 MWh and 0.0511 MW respectively. The impact analysis of the tracking data yielded verified total gross energy and peak demand savings of 813 MWh and 0.1984 MW respectively, and verified net energy and peak demand savings of 773 MWh and 0.1885 MW. The realization rates resulting from the impact analysis were 105 percent for energy savings and 369 percent for peak demand savings.

The implementer did not categorize the 85 participating facilities in different categories and assumed the building type as Elementary Schools for all the facilities. Navigant categorized the facilities in six categories (as mentioned in Section 2.2) to obtain reasonable estimates of hours of use (HOU) and waste heat factors for energy (WHFe) and demand (WHFd) and coincidence factors. The coincidence factors and WHFd for other building types are more than that of Elementary Schools which resulted in higher peak demand realization rates.

Since Childcare/Pre-Schools building type is not mentioned in TRM v4.0, Navigant used the parameter assumptions from the Section 4.5 of TRM v5.0 per TAC’s approval to calculate the ex-post savings.

3.3 Gross Program Impact Parameter Estimates

Navigant used deemed savings from IL TRM v4.0 and TRM v5.0 based on building types to estimate the energy and demand savings. Per TAC’s approval, we used the assumptions in TRM v5.0 to estimate savings for Childcare/Pre-Schools since parameter assumptions for Childcare/Pre-Schools are not available in TRM v4.0. For other building types, Navigant used the parameter values from TRM v4.0. Navigant verified gross energy and coincident peak demand resulting from the program using the deemed values and algorithms mentioned in Section 2.2 as defined by the Illinois TRM versions 4.0 and 5.0¹².

3.3.1 Input Parameter Type

Table 3-4. Verified Gross Savings Parameters

Gross Savings Input Parameters	Value	Deemed † or Evaluated?
Quantity	Unit	Evaluated
Measure Type and Eligibility	Unit	Evaluated
Gross Savings per Unit, Deemed Measures	kWh	Deemed
Gross Demand Reduction per Unit, Deemed Measures	kW	Deemed
Verified Realization Rate on Ex-Ante Gross Savings (Lighting)	Percent	Evaluated

[†]State of Illinois Technical Reference Manual version 4.0 from <http://www.ilsag.info/technical-reference-manual.html>.

3.3.2 Deemed Values by School Type

The following table summarizes parameter values by school type.

¹² Source: <http://www.ilsag.info/technical-reference-manual.html>

Table 3-5. Verified Gross Savings Algorithm Input Parameters

School/Measure Type	Fixture HOU	Screw-based Bulb HOU	WHF _e	WHF _d	CF
Elementary School [†]	2,422	2,118	1.31	1.40	0.22
College [‡]	3,540	2,588	1.32	1.46	0.56
Childcare / Pre-School [†]	2,860	2,860	1.17	1.29	0.72
High School [†]	4,311	2,327	1.25	1.44	0.22
Office-Low Rise [†]	4,439	3,088	1.46	1.59	0.66
Religious Building [†]	1,664	1,664	1.48	1.44	0.66

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

[‡] State of Illinois Technical Reference Manual version 4.0 from <http://www.ilsag.info/technical-reference-manual.html>.

[§]Dependent on School type.

Hours of use (HOU): The implementer used parameter values of Elementary Schools for all the participant facilities to estimate deemed energy and demand savings. Navigant categorized the building types in six different categories as mentioned in Section 2.2. TRM v5.0 provides assumptions for Childcare/Pre-Schools. Since the Technical Advisory Committee (TAC) approved using assumptions in the TRM v5.0 for Childcare/Pre-Schools, Navigant used the parameter values in TRM v5.0 to estimate savings for Childcare/Pre-Schools. For other building types, Navigant used the parameter values from TRM v4.0 to verify deemed energy and demand savings.

Waste Heat Factors for Energy and Demand (WHF_e and WHF_d): For Childcare/Pre-Schools, TRM v5.0 was used to estimate energy and demand savings as approved by TAC for PY8. The WHF_e and WHF_d values from TRM v4.0 were used to estimate savings for other building types.

3.4 Verified Gross Program Impact Results

The resulting total program verified gross savings is 813 MWh and 0.1984 peak MW as shown in the following table by school type.

Table 3-6. PY8 Gross Impact Savings Estimates by School Category

	Gross Energy Savings (MWh)	Gross Peak Demand Savings (MW)
Elementary Schools		
Ex-Ante Gross Savings	301	0.0163
Verified Gross Savings	301	0.0283
Verified Gross Realization Rate	100%	173%
College		
Ex-Ante Gross Savings	54	0.0041
Verified Gross Savings	76	0.0220
Verified Gross Realization Rate	141%	534%
Childcare/Pre-Schools		
Ex-Ante Gross Savings	183	0.0098
Verified Gross Savings	190	0.0818
Verified Gross Realization Rate	104%	834%
High School		
Ex-Ante Gross Savings	30	0.0035
Verified Gross Savings	32	0.0036
Verified Gross Realization Rate	106%	103%
Office-Low Rise		
Ex-Ante Gross Savings	36	0.0035
Verified Gross Savings	48	0.0093
Verified Gross Realization Rate	135%	267%
Religious Building		
Ex-Ante Gross Savings	175	0.0166
Verified Gross Savings	167	0.0535
Verified Gross Realization Rate	95%	323%
Total		
Ex-Ante Gross Savings	778	0.0538
Verified Gross Savings	813	0.1984
Verified Gross Realization Rate	105%	369%

Source: Navigant analysis.

3.5 Program Savings by Measure

Table 3-7. PY8 Program Results by Measure

Measure	Ex Ante Gross Savings (kWh)	Ex Ante Gross Peak Demand Savings (kW)	Verified Gross Savings (kWh)	Verified Gross Peak Demand Savings (kW)	Verified Gross Energy RR (%)	Verified Net Savings (kWh)	Verified Net Demand Savings (kW)
CFL Lamp (15W or Less)	87,716	3.9694	87,241	16.7652	99%	82,879	15.9269
Occupancy Sensor (Wall Mounted)	427,071	22.7752	455,503	148.9163	107%	432,728	141.4705
LED Exit Sign (Incandescent Base)	204,633	24.5784	211,772	25.3982	103%	201,183	24.1283
CFL Lamp (16-20W)	283	0.0315	283	0.0315	100%	269	0.0299
CFL Lamp (21W or Greater)	10,876	1.1023	10,033	3.5628	92%	9,531	3.3847
Vending Machine Controls (Non-Refrigerated Snack Machine)	1,714	0.0000	1,714	0.0000	100%	1,628	0.0000
Vending Machine Controls (Refrigerated Beverage Machine)	12,903	0.0000	12,904	0.0000	100%	12,258	0.0000
Pre-rinse Spray Valve	16,618	0.0000	16,618	0.0000	100%	15,787	0.0000
Smart Strips - 7 plug	3,811	0.1965	3,811	0.4292	100%	3,620	0.4077
Low flow aerator - bath	5,426	0.8010	6,355	1.9430	117%	6,037	1.8459
Low flow aerator - kitchen	1,252	0.1776	1,431	0.4424	114%	1,359	0.4203
Low Flow Showerhead	3,048	0.0000	3,048	0.3771	100%	2,896	0.3583
Vending Machine Controls (Glass Front Refrigerated Coolers)	1,210	0.0000	1,210	0.0000	100%	1,149	0.0000
13W LED A-lamp	1,554	0.1722	1,379	0.5320	89%	1,310	0.5054
Total	778,114	53.8041	813,300	198.3977	105%	772,635	188.4779

Source: ComEd tracking data and Navigant analysis.

4. NET IMPACT EVALUATION

SAG determined¹³ that the NTG value for this program, 0.95, should be deemed prospectively and used to calculate verified net savings. The table below shows the PY8 verified net savings.

Table 4-1. PY8 Net Impact Savings Estimates by School Category

	Net Energy Savings (MWh)	Net Peak Demand Savings (MW)
Elementary Schools		
Ex-Ante Net Savings	286	0.0155
Verified Net Savings	286	0.0269
College		
Ex-Ante Net Savings	51	0.0039
Verified Net Savings	72	0.0209
Childcare/Pre-Schools		
Ex-Ante Net Savings	174	0.0093
Verified Net Savings	180	0.0777
High School		
Ex-Ante Net Savings	29	0.0033
Verified Net Savings	30	0.0034
Office-Low Rise		
Ex-Ante Net Savings	34	0.0033
Verified Net Savings	46	0.0088
Religious Building		
Ex-Ante Net Savings	166	0.0158
Verified Net Savings	158	0.0508
Total		
Ex-Ante Net Savings	739	0.0511
Verified Net Savings	773	0.1885

Source: Navigant analysis.

¹³ A deemed value. Source: "ComEd_NTG_History_and_PY8_Recommendations.xls", found on the IL SAG web site: <http://ilsag.info/net-to-gross-framework.html>.

5. PROCESS EVALUATION

Navigant conducted a limited process evaluation for this program. Through a telephone interview with the implementation contractor's program manager and WECC staff¹⁴, Navigant learned that the program took "a few months to get up and running and get [the] outreach associates in the field [which resulted in] a late start in the second half of PY8." The current program manager assumed the role in December 2015 and determined that the operational savings measures were not receiving a lot of interest from the educational facilities. Therefore, in January 2016, the program manager decided to focus exclusively on direct install measures. In addition, in the spring of 2016, some occupancy sensors malfunctioned. CLEAResult ceased performing installations and hired an electrical contractor to perform QC on the occupancy sensors that had been installed in PY8, which represented a large portion of the program's potential savings. This combination of circumstances affected both the participation levels and the amount of savings per educational facility.

For PY9, CLEAResult made adjustments to the measure mix to increase savings potential and revised the marketing materials.

¹⁴ Telephone interview with CLEAResult program manager and WECC staff, November 1, 2016.

6. FINDINGS AND RECOMMENDATIONS

This section summarizes the key impact and process findings and recommendations.

Program Volumetric Findings.

Finding 1. Eighty-five educational facilities participated in the program. The PY8 target number of participating educational facilities was 163—the program met 52 percent of its participation target. According to the program manager, the implementation took longer than and the program got a “slow start” in PY8. Also in January 2016, the implementation contractor shifted focus away from operational savings measures and focused exclusively on direct install measures due to lack of interest in the operational savings measures. In addition, in the spring, the implementer discovered that some of the occupancy sensors had malfunctioned, so they ceased installation for that measure. These circumstances contributed to the lower than anticipated participation for the program as well as lower than anticipated savings per educational facility.

Verified Net Impacts

Finding 2. The PY8 CLEAResult-Schools program net savings target was 4,097 net MWh. The PY8 net verified energy savings were estimated to be 773 MWh—the program met 19 percent of the net energy savings target. [See Finding 1.]

Verified Gross Impacts and Realization Rate

Finding 3. The tracking system did not include demand reduction savings.

Recommendation 1. Include ex ante demand reduction savings calculations in the tracking system.

Finding 4. The program energy realization rate is 105 percent due to adjustments made for hours of facility operation by category, waste heat factors for energy and demand and coincidence factors by facility category. In addition, the program demand realization rate is 369 percent due to adjustments made for hours of facility operation by category, waste heat factors for energy and demand and coincidence factors by facility category.

Recommendation 2. Use these adjustments to better reflect TRM values within facility categories.

Tracking System Findings

Finding 5. The tracking system consisted of hard coded values of net energy and demand savings for different measures. The calculations and algorithms for deemed savings for various measures were provided in a separate lookup file¹⁵.

Recommendation 3. Navigant recommends including all the information (i.e., the parameter assumptions and algorithms) be included in the tracking file.

Finding 6. The implementer did not collect the building type information and assumed all the participant facilities were Elementary Schools.

Recommendation 4. Navigant recommends that the implementer collect building type information and use parameter assumptions from TRM based on different building types to estimate savings.

Finding 7. Navigant found several records in the tracking system where an educational facility appeared to have had installations in two different months. In some cases these facilities had the same address while in other cases, the addresses were different.

¹⁵ ComEd TPEP School DI - PY8 measures and savings 10142015.xlsx

Recommendation 5. Navigant recommends assigning project IDs to different educational facilities to accurately track the number of participants.

7. APPENDIX

7.1 Evaluation Research Impact Findings

Table 7-1. Savings and Realization Rates by School

School Number	School Type	Ex Ante Gross Energy Savings (kWh)	Verified Gross Energy Savings (kWh)	Energy Realization Rate	Verified Gross Peak Demand Savings (kW)
1	Childcare/Pre-School	9,332	9,659	103%	4.7610
2	Childcare/Pre-School	7,511	7,738	103%	3.7314
3	Religious Building	14,027	14,237	102%	3.7575
4	Elementary School	991	991	100%	0.0775
5	Religious Building	4,517	3,971	88%	2.3995
6	Elementary School	241	241	100%	0.0267
7	Elementary School	6,374	6,374	100%	0.4802
8	Elementary School	4,425	4,425	100%	0.4916
9	Elementary School	5,155	5,155	100%	0.5649
10	High School	6,824	8,206	120%	0.7465
11	Religious Building	9,651	10,675	111%	1.0251
12	Childcare/Pre-School	5,763	5,589	97%	1.8852
13	Office - Low Rise	3,680	3,876	105%	0.3971
14	Religious Building	6,041	5,333	88%	2.4297
15	Elementary School	455	455	100%	0.0343
16	Elementary School	6,374	6,374	100%	0.4802
17	Elementary School	36,706	37,190	101%	4.1532
18	Elementary School	32,010	32,010	100%	2.5449
19	Elementary School	29,677	29,823	100%	2.7784
20	Elementary School	19,038	19,038	100%	2.0478
21	Childcare/Pre-School	4,261	4,725	111%	2.0555
22	Childcare/Pre-School	4,926	4,400	89%	0.5538
23	Elementary School	3,187	3,187	100%	0.2401
24	Elementary School	1,821	1,821	100%	0.1372
25	Childcare/Pre-School	1,611	1,687	105%	0.6650
26	Elementary School	1,669	1,669	100%	0.1610
27	Elementary School	16,517	16,516	100%	1.6063
28	Religious Building	22,264	19,602	88%	9.0193
29	Elementary School	1,895	1,895	100%	0.2310
30	Religious Building	29,197	24,242	83%	13.3402
31	Religious Building	7,579	8,563	113%	0.9500
32	Religious Building	10,299	9,142	89%	3.5328
33	Elementary School	19,578	19,578	100%	1.4749
34	Religious Building	758	856	113%	0.0950
35	Childcare/Pre-School	22,323	23,086	103%	6.8807
36	Childcare/Pre-School	11,838	12,485	105%	6.6924
37	Childcare/Pre-School	14,570	15,366	105%	8.2368
38	Childcare/Pre-School	14,570	15,366	105%	8.2368
39	Childcare/Pre-School	16,009	16,578	104%	8.1924
40	Religious Building	3,182	3,283	103%	0.6791
41	Elementary School	10,158	10,158	100%	1.1536

School Number	School Type	Ex Ante Gross Energy Savings (kWh)	Verified Gross Energy Savings (kWh)	Energy Realization Rate	Verified Gross Peak Demand Savings (kW)
42	Elementary School	14,876	14,876	100%	1.6170
43	High School	4,038	5,239	130%	0.4155
44	Childcare/Pre-School	4,239	4,600	109%	1.8559
45	Childcare/Pre-School	3,982	4,742	119%	1.6242
46	Childcare/Pre-School	1,592	1,496	94%	0.3852
47	Religious Building	14,235	15,506	109%	1.9390
48	Elementary School	13,882	13,882	100%	1.2047
49	Elementary School	10,690	10,690	100%	1.1760
50	Elementary School	5,531	5,531	100%	0.5083
51	Elementary School	2,732	2,732	100%	0.2058
52	Religious Building	3,023	2,542	84%	1.3146
53	College	16,462	22,305	135%	6.1867
54	College	11,685	16,857	144%	5.1244
55	College	24,265	34,813	143%	10.2655
56	Elementary School	4,098	4,098	100%	0.3087
57	Religious Building	3,490	2,977	85%	1.6370
58	Childcare/Pre-School	16,990	16,940	100%	6.8592
59	Religious Building	9,474	10,703	113%	1.1875
60	Religious Building	18,552	16,661	90%	5.2825
61	Elementary School	17,274	17,274	100%	1.6409
62	Childcare/Pre-School	1,232	1,349	109%	0.6224
63	Childcare/Pre-School	1,821	1,921	105%	1.0296
64	Childcare/Pre-School	11,324	11,269	100%	4.2493
65	College	1,117	1,547	139%	0.4422
66	Elementary School	6,830	6,830	100%	0.5145
67	Childcare/Pre-School	2,426	2,314	95%	0.6852
68	Religious Building	5,090	5,068	100%	1.2510
69	Religious Building	7,579	8,563	113%	0.9500
70	Childcare/Pre-School	6,374	6,723	105%	3.6036
71	Childcare/Pre-School	911	960	105%	0.5148
72	Childcare/Pre-School	8,504	9,004	106%	3.9582
73	Elementary School	3,913	3,913	100%	0.4467
74	Elementary School	5,008	5,008	100%	0.3773
75	Elementary School	7,285	7,285	100%	0.5488
76	Elementary School	4,713	4,713	100%	0.4094
77	High School	7,958	7,594	95%	0.9975
78	Elementary School	7,746	7,745	100%	0.6362
79	Office - Low Rise	29,111	38,361	132%	7.1232
80	Childcare/Pre-School	515	515	100%	0.0580
81	Childcare/Pre-School	3,101	3,225	104%	1.3798
82	Childcare/Pre-School	7,573	7,988	105%	3.0440
83	Religious Building	5,690	4,818	85%	2.7125
84	High School	11,369	10,848	95%	1.4250
85	Office - Low Rise	2,812	5,711	203%	1.7332
Totals		778,114	813,300	105%	198.3977

Source: Navigant analysis of tracking data