



# ComEd AirCare Plus Program Impact Evaluation Report

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

Presented to  
ComEd

**DRAFT**

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## 1. INTRODUCTION

This report presents the results of the impact evaluation of ComEd's PY9 AirCare Plus (ACP) Program. It presents a summary of the energy and demand impacts for the total program and for relevant measure and program structure details. Section 6 (Appendix 1) presents the impact analysis methodology. PY9 covers June 1, 2016 through December 31, 2017.

## 2. PROGRAM DESCRIPTION

The ACP Program focused on optimizing the energy performance of HVAC packaged rooftop units and split systems, including mechanical adjustments (tune-ups) and hardware retrofits. The ACP Program was implemented by CLEAResult and included an Illinois Power Agency (IPA) element for small business customers<sup>1</sup> and an Energy Efficiency Portfolio Standard (EEPS) element for larger customers. The measures available through the PY9 ACP Program were air conditioner tune-up, thermostat replacement and adjustment, economizer repair and optimization, and clogged v-belt installation.

The program had 780 participants<sup>2</sup> in PY9 and distributed 3,623 measures as shown in the following table and graph.

**Table 2-1. PY9 Volumetric Findings Detail by Program Element**

Participation	EEPS	IPA	Total
Participants	645	135	780
Total Measures	2,313	1,310	3,623
Number of Measures/Participant	3.6	9.7	4.6
AC Tune-up < 10 Ton (unit size)	773	229	1,002
AC Tune-up >= 10 Ton (unit size)	134	217	351
Cogged V-Belt	92	154	246
Economizer	50	135	185
Thermostat Adjustment	64	84	148
Thermostat Replacement	1,200	491	1,691

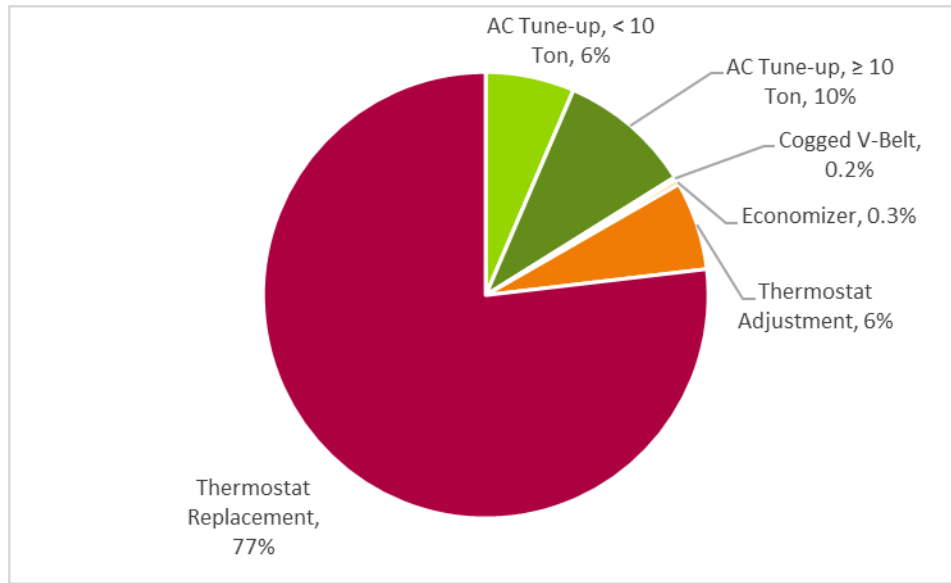
*Source: ComEd tracking data and Navigant team analysis.*

<sup>1</sup> Customers with a peak demand less than or equal to 100 kW.

<sup>2</sup> Participants are defined as unique business names in the program tracking data.

Figure 2-1 illustrates that thermostat replacements account for most (77 percent) of the program savings.

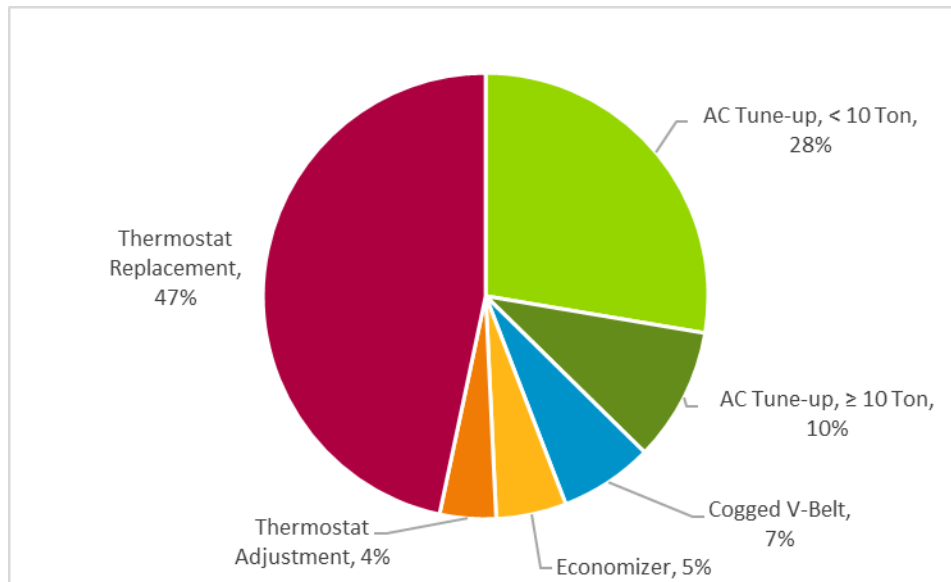
**Figure 2-1. PY9 AirCare Plus Program Savings by Measure**



Source: Evaluation Analysis

Figure 2-2 shows that thermostat replacements and air conditioner tune-ups were the most commonly implemented measures. While economizer and cogged v-belts accounted for 12 percent of the program installations, they produced less than one percent of the program savings.

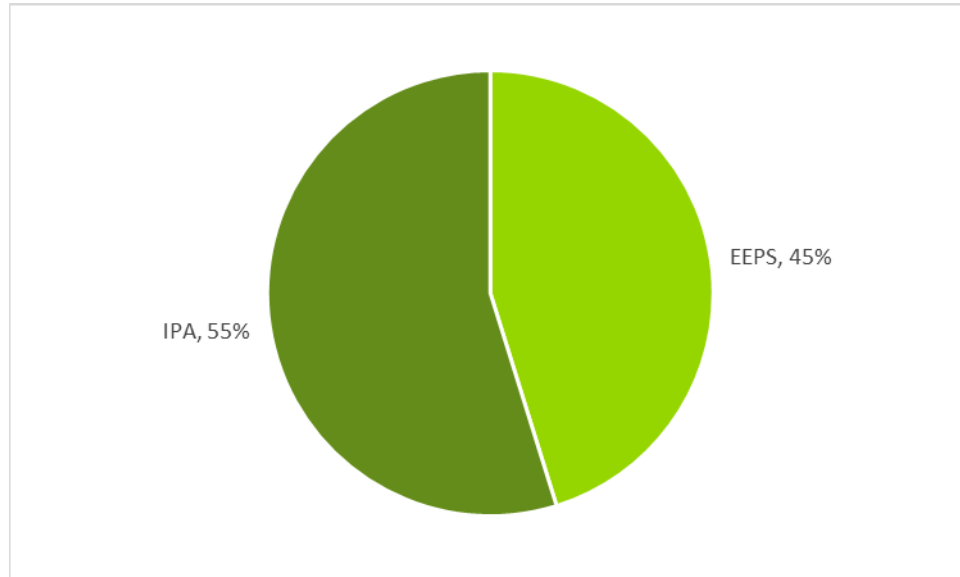
**Figure 2-2. PY9 AirCare Plus Program Installations by Measure**



Source: Evaluation Analysis

Figure 2-3 indicates that the IPA element of the AirCare Plus program produced slightly more savings than the EEPS element in PY9.

**Figure 2-3. PY9 AirCare Plus Program Savings by Element**



Source: Evaluation Analysis

### 3. PROGRAM SAVINGS

Table 3-1 through Table 3-3 summarize the incremental energy and demand savings the AirCare Plus Program achieved in PY9.

**Table 3-1. PY9 Total Annual Incremental Savings**

Savings Category	Energy Savings (kWh)	Demand Savings (kW)	Peak Demand Savings (kW)
Ex Ante Gross Savings	25,985,070	NR	NR
Program Gross Realization Rate	100%	NA	NA
Verified Gross Savings	26,065,238	19,852	3,991
Program Net-to-Gross Ratio (NTGR)	0.90	0.90	0.90
Verified Net Savings	23,458,714	17,867	3,592

NR = not reported

Source: ComEd tracking data and Navigant team analysis.

**Table 3-2. PY9 Total Annual Incremental EEPS Savings**

Savings Category	Energy Savings (kWh)	Demand Savings (kW)	Peak Demand Savings (kW)
Ex Ante Gross Savings	14,172,212	NR	NR
Program Gross Realization Rate	101%	NA	NA
Verified Gross Savings	14,283,484	8,965	1,887
Program Net-to-Gross Ratio (NTGR)	0.90	0.90	0.90
Verified Net Savings	12,855,136	8,068	1,698

NR = not reported

Source: ComEd tracking data and Navigant team analysis.

**Table 3-3. PY9 Total Annual Incremental IPA Savings**

Savings Category	Energy Savings (kWh)	Demand Savings (kW)	Peak Demand Savings (kW)
Ex Ante Gross Savings	11,812,859	NR	NR
Program Gross Realization Rate	100%	NA	NA
Verified Gross Savings	11,781,754	10,887	2,103
Program Net-to-Gross Ratio (NTGR)	0.90	0.90	0.90
Verified Net Savings	10,603,579	9,798	1,893

NR = not reported

Source: ComEd tracking data and Navigant team analysis.

## 4. PROGRAM SAVINGS BY MEASURE

The program includes six measures as shown in the following table. The thermostat replacement measure contributed the majority of the savings.

**Table 4-1. 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)‡
HVAC	AC Tune-up < 10 Ton (unit size)	1,697,883	99%	1,681,519	0.90	1,513,367	NA	NA	3.0
HVAC	AC Tune-up >= 10 Ton (unit size)	2,523,815	100%	2,522,597	0.90	2,270,337	NA	NA	3.0
HVAC	Cogged V-Belt	61,246	100%	61,246	0.90	55,121	NA	NA	4.0
HVAC	Economizer	91,011	100%	91,013	0.90	81,912	NA	NA	5.0
HVAC	Thermostat Adjustment	1,660,394	101%	1,672,337	0.90	1,505,103	NA	25%	2.0
HVAC	Thermostat Replacement	19,950,721	100%	20,036,527	0.90	18,032,874	NA	50%	4.0
<b>Total§</b>		<b>25,985,070</b>	<b>100%</b>	<b>26,065,238</b>	<b>0.90</b>	<b>23,458,714</b>	<b>NA</b>	<b>NA</b>	<b>3.7</b>

\* A deemed value. Source: ComEd\_NTG\_History\_and\_PY9\_Recommendations\_2016-02-26\_Final.xlsx, which is to be found on the IL SAG web site here: <http://ilsag.info/net-to-gross-framework.html>.

† "The expected measure life of a programmable thermostat is assumed to be 8 years based upon equipment life only. For the purposes of claiming savings" for thermostat replacement and adjustments, persistence factors are provided. State of Illinois Technical Reference Manual, version 5.0

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

§ Numbers do not sum exactly due to rounding.

Source: ComEd tracking data and Navigant team analysis.

**Table 4-2. 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)
HVAC	AC Tune-up < 10 Ton (unit size)	NR	NA	8	0.90	7
HVAC	AC Tune-up >= 10 Ton (unit size)	NR	NA	12	0.90	11
HVAC	Cogged V-Belt	NR	NA	0	0.90	0
HVAC	Economizer	NR	NA	0	0.90	0
HVAC	Thermostat Adjustment	NR	NA	0	0.90	0
HVAC	Thermostat Replacement	NR	NA	0	0.90	0
	<b>Total</b>	NR	NA	20	0.90	18

NR = not reported

\* A deemed value. Source: ComEd\_NTG\_History\_and\_PY9\_Recommendations\_2016-02-26\_Final.xlsx, which is to be found on the IL SAG web site here: <http://ilsag.info/net-to-gross-framework.html>.

Source: ComEd tracking data and Navigant team analysis.

**Table 4-3. 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)
HVAC	AC Tune-up < 10 Ton (unit size)	NR	NA	2	0.90	1
HVAC	AC Tune-up >= 10 Ton (unit size)	NR	NA	2	0.90	2
HVAC	Cogged V-Belt	NR	NA	0	0.90	0
HVAC	Economizer	NR	NA	0	0.90	0
HVAC	Thermostat Adjustment	NR	NA	0	0.90	0
HVAC	Thermostat Replacement	NR	NA	0	0.90	0
	<b>Total†</b>	NR	NA	4	0.90	4

NR = not reported

\* A deemed value. Source: ComEd\_NTG\_History\_and\_PY9\_Recommendations\_2016-02-26\_Final.xlsx, which is to be found on the IL SAG web site here: <http://ilsag.info/net-to-gross-framework.html>.

† Numbers do not sum exactly due to rounding.

Source: ComEd tracking data and Navigant team analysis.

## 5. IMPACT ANALYSIS FINDINGS AND RECOMMENDATIONS

Navigant found several differences between ex ante and ex post savings estimates. These are described by measure below.

### 5.1 Air Conditioner Tune-Up

Navigant used the measure inputs deemed by the IL TRM v5.0 to calculate energy and demand savings. The realization rates for units less than 10 tons is 99 percent and the realization rate for units greater than or equal to 10 tons is 100 percent. The TRM uses the following equation to calculate energy savings for this measure.

For units with cooling capacities less than 65 kBtu/hr (5.42 tons):



$$\Delta kWh = \frac{kBtu}{hr} * \left( \frac{1}{SEER_{before}} - \frac{1}{SEER_{after}} \right) * EFLH$$

For units with cooling capacities equal to or greater than 65 kBtu/hr (5.42 tons):

$$\Delta kWh = \frac{kBtu}{hr} * \left( \frac{1}{EER_{before}} - \frac{1}{EER_{after}} \right) * EFLH$$

Ninety-two percent of the air conditioner tune-up measures have a realization rate of 100 percent. Explanations for the change in realization rates of the remaining eight percent are provided below.

**Finding 1.** In 18 tune-ups, the ex ante savings were calculated using the “Cooling\_Capacity\_Tons” field instead of the “Cooling\_Cap\_kBTUh” field.

**Recommendation 1.** Navigant recommends correcting the algorithm used to calculate savings for these measures.

**Finding 2.** In 29 measures, the “Cooling\_Capacity\_Tons” values do not correctly convert to “Cooling\_Cap\_kBTUh” values.

**Recommendation 2.** Navigant recommends correcting these values in the tracking data.

**Finding 3.** In seven projects, the equivalent full load hours (EFLH) in the tracking data did not match the corresponding EFLH for the building type and climate zone listed in the tracking data. Only one of these projects had a non-100% realization rate.

**Recommendation 3.** While most of these instances did not affect the verified savings, Navigant recommends that the EFLH values reflect the combination of building type and climate zone in the tracking data per the TRM.

**Finding 4.** In three measures, the tracking data showed no improvement in efficiency. Two of those measures, claimed energy savings.

**Recommendation 4.** Evaluation recommends that energy savings not be claimed for projects resulting in no efficiency improvement.

For the remainder of the non-100% realization rate projects, the exact cause of the ex ante savings not matching the IL TRM-based verified savings could not be determined.

## 5.2 Thermostat Adjustment and Replacement

Navigant used the measure level inputs deemed by the IL TRM v5.0 to calculate energy savings for thermostat adjustment and replacement. The realization rates for adjustment and replacement are 101 percent and 100 percent, respectively. The TRM uses the following algorithm to calculate savings for this measure.

$$\Delta kWh = (Baseline\ Energy\ Use - Proposed\ Energy\ Use) * Cooling\ Capacity$$

Eighty five percent of the thermostat adjustment measures and 78 percent of the thermostat replacement measures have a realization rate of 100 percent. Explanations for the change in realization rates of the remaining of the projects are provided below.

**Finding 5.** Most of the discrepancies involved the “as left” cooling and heating setback fields. In 64 measures, the ex ante savings were calculated based on an “as left” cooling setback of 15°F, instead of the tracking data value. A similar discrepancy occurred with the “as left” heating setback values in 320 measures.

**Recommendation 5.** Navigant recommends using the setback values found in the tracking data to generate savings.

**Finding 6.** In seven measures, the ex ante savings were calculated using a building type different from the tracking data building type.

**Recommendation 6.** Navigant recommends that the algorithm input values such as building type and EFLH reflect the values used to calculate the ex ante savings.

For the remainder of the non-100% realization rate projects, the evaluation team could not determine the exact cause of the ex ante savings not matching the IL TRM-based verified savings.

### 5.3 Cogged V-Belt

Navigant used the measure level inputs deemed by the IL TRM v5.0 to calculate energy savings. The realization rate for this measure is 100 percent. The TRM uses the following algorithm to calculate energy savings for this measure:

$$\Delta kWh = kW_{connected} * Hours * ESF$$

All cogged v-belt measures have a realization rate of 100 percent.

### 5.4 Economizer Repair and Optimization

Navigant used the measure level inputs deemed by the IL TRM v5.0 to calculate energy savings. The realization rate for this measure is 100 percent. The TRM uses the following algorithm to calculate energy savings for this measure:

$$\Delta kWh = (Baseline Energy Use - Proposed Energy Use) * Cooling Capacity$$

Ninety-five percent of the economizer repair and optimization measures have a realization rate of 100 percent. The remaining five percent had realization rates of 99 or 101 percent, which were due to differences in rounding.

## 6. APPENDIX 1. IMPACT ANALYSIS METHODOLOGY

### 6.1 Air Conditioner Tune-Up<sup>3</sup>

$$\Delta kWh = \frac{kBtu}{hr} * \left( \frac{1}{EER_{before}} - \frac{1}{EER_{after}} \right) * EFLH$$

$$\Delta kW = \frac{kBtu}{hr} * \left( \frac{1}{EER_{before}} - \frac{1}{EER_{after}} \right) * CF$$

Where:

- $kBtu/hr$  = Capacity of cooling equipment
- $EER_{before}$  = Energy efficiency ratio of equipment prior to tune-up
- $EER_{after}$  = Energy efficiency ratio of equipment after tune-up

<sup>3</sup> IL TRM v5.0, 4.4.1 Air Conditioner Tune-Up

*EFLH* = Equivalent full load hours for cooling  
*CF* = Summer peak coincidence factor

**Table 6-1. Air Conditioner Tune-up Custom and Deemed Values Comparison**

Value	Variable	Source	Deemed/Custom
Actual	kBtu/hr	<i>Program Tracking Data</i>	Custom
Actual	$EER_{before}$	<i>Program Tracking Data</i>	Custom
Actual	$EER_{after}$	<i>IL TRM v5.0, 4.4.1</i>	Custom
Varies by Climate Zone	EFLH	<i>IL TRM v5.0, 4.4.1</i>	Deemed
47.8%	CF	<i>IL TRM v5.0, 4.4.1</i>	Deemed

## 6.2 Thermostat Adjustment and Replacement<sup>4</sup>

$$\Delta kWh = [Baseline Usage - Proposed Usage] * Capacity$$

$$\Delta kW = 0$$

Where:

*Baseline Usage* = Per-ton baseline energy usage, kWh/ton<sup>5</sup>  
*Proposed Usage* = Per-ton proposed energy usage, kWh/ton<sup>5</sup>  
*Capacity* = Cooling system capacity, tons  
*CZ* = Climate zone coefficient  
*Fu* = Fan mode during unoccupied period  
*Fo* = Fan mode during occupied period  
*Th* = Degrees of heating setback, °F  
*Tc* = Degrees of cooling setback, °F  
*Ws* = Weekly hours thermostat is in occupied mode

**Table 6-2. Programmable Thermostat Adjustment Custom and Deemed Values**

Value	Variable	Source	Deemed/ Custom
Actual	Capacity	<i>Program Tracking Data</i>	Custom
Varies	CZ	<i>IL TRM v5.0, 4.4.25</i>	Deemed
Actual	Fu	<i>Program Tracking Data</i>	Custom
Actual	Fo	<i>Program Tracking Data</i>	Custom
Actual	Th	<i>Program Tracking Data</i>	Custom
Actual	Tc	<i>Program Tracking Data</i>	Custom
Actual	Ws	<i>Program Tracking Data</i>	Custom

## 6.3 Cogged V-Belts<sup>6</sup>

$$\Delta kWh = kW_{connected} * Hours * ESF$$

$$\Delta kW = kW_{connected} * ESF$$

<sup>4</sup> IL TRM v5.0, 4.4.18 Small Commercial Programmable Thermostats

<sup>5</sup> The baseline and proposed usage algorithms are listed in the IL TRM v5.0.

<sup>6</sup> IL TRM v5.0, 4.4.30 Notched V Belts for HVAC System

$$kW_{connected} = HP * 0.746 * \frac{LF}{Motor\ Efficiency}$$

Where:

- $kW_{connected}$  = Electrical demand of HVAC equipment
- Hours = Annual hours of operation
- ESF = Energy savings factor
- HP = Nominal horsepower
- 0.746 = kWh/Btu conversion factor
- LF = Load factor
- Motor Efficiency = Motor efficiency

**Table 6-3. Cogged V-Belts Custom and Deemed Values Comparison**

Value	Variable	Source	Deemed/ Custom
Actual	$kW_{connected}$	Calculated	Custom
Actual or Deemed (Varies by Building Type)	Hours	Program Tracking Data or IL TRM v5.0, 4.4.30	Custom or Deemed
2%	ESF	IL TRM v5.0, 4.4.30	Deemed
Actual	HP	Program Tracking Data	Custom
80%	LF	IL TRM v5.0, 4.4.30	Custom or Deemed
Varies by Motor Size	Motor Efficiency	IL TRM v5.0, 4.4.30	Custom or Deemed

## 6.4 Economizer Repair and Optimization<sup>7</sup>

$$\Delta kWh = [Baseline\ Usage - Proposed\ Usage] * Capacity$$

$$\Delta kW = 0$$

Where:

- Baseline Usage = Per-ton baseline energy usage, kWh/ton<sup>8</sup>
- Proposed Usage = Per-ton proposed energy usage, kWh/ton<sup>5</sup>
- Capacity = Cooling system capacity, tons
- CZ = Climate zone coefficient
- Fu = Fan mode during unoccupied period
- Fo = Fan mode during occupied period
- Th = Degrees of heating setback, °F
- Tc = Degrees of cooling setback, °F
- Ws = Weekly hours thermostat is in occupied mode

<sup>7</sup> IL TRM v5.0, 4.4.35 Economizer Repair and Optimization

<sup>8</sup> The baseline and proposed usage algorithms are listed in the IL TRM v5.0.

**Table 6-4. Programmable Thermostat Adjustment Custom and Deemed Values**

Value	Variable	Source	Deemed/ Custom
Actual	Capacity	<i>Program Tracking Data</i>	Custom
Varies	CZ	<i>IL TRM v5.0, 4.4.25</i>	Deemed
Actual	Fu	<i>Program Tracking Data</i>	Custom
Actual	Fo	<i>Program Tracking Data</i>	Custom
Actual	Th	<i>Program Tracking Data</i>	Custom
Actual	Tc	<i>Program Tracking Data</i>	Custom
Actual	Ws	<i>Program Tracking Data</i>	Custom

## 7. APPENDIX 2. TRC DETAIL

[We will include this section in the second draft.]