



ComEd AirCare Plus Program Impact Evaluation Report

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

Presented to
ComEd

FINAL

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Prepared by:

Chelsea Lamar
Navigant Consulting, Inc.

Rick Berry
Navigant Consulting, Inc.

Jennifer Ma
Navigant Consulting, Inc.

www.navigant.com

Submitted to:

ComEd
Three Lincoln Centre
Oakbrook Terrace, IL 60181

Submitted by:

Navigant Consulting, Inc.
150 N. Riverside, Suite 2100
Chicago, IL 60606

Contact:

Randy Gunn, Managing Director
312.583.5714
Randy.Gunn@Navigant.com

Jeff Erickson, Director
608.497.2322
Jeff.Erickson@Navigant.com

Patricia Plympton, Associate Director
202.253.9356
Patricia.Plympton@Navigant.com

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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 customers¹ 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 participants² 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

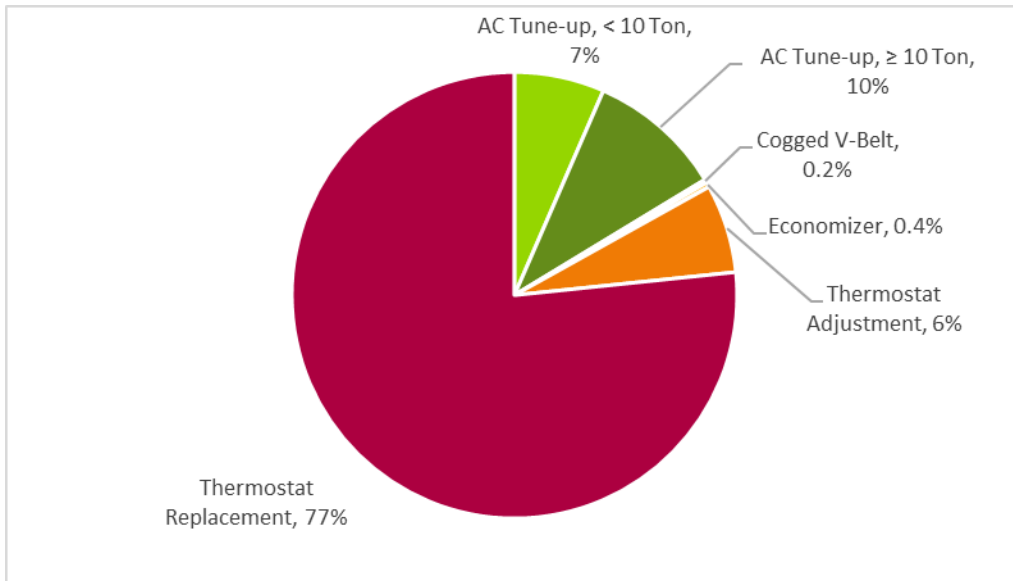
Source: ComEd tracking data and Navigant team analysis.

¹ Customers with a peak demand less than or equal to 100 kW.

² 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.

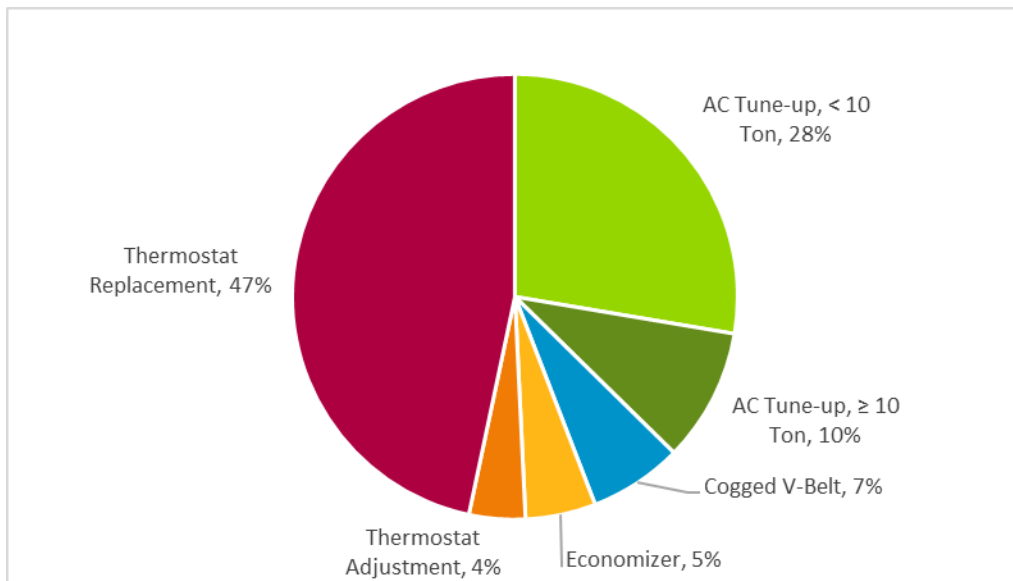
Figure 2-1. PY9 AirCare Plus Program Savings by Measure



Source: Evaluation Analysis

Figure 2-2 shows that thermostat replacements and air conditioner tune-ups were the most commonly implemented measures.

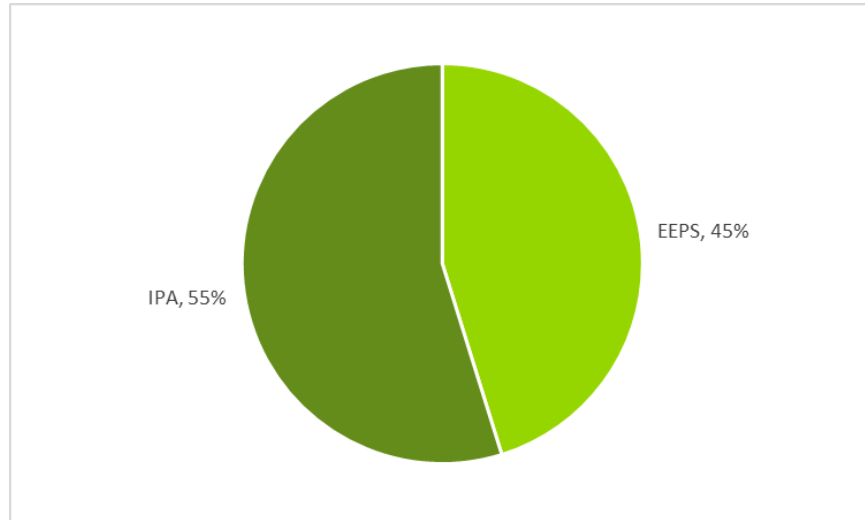
Figure 2-2. PY9 AirCare Plus Program Installations by Measure



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	99%	NA	NA
Verified Gross Savings	25,854,939	20,018	4,009
Program Net-to-Gross Ratio (NTGR)	0.90	0.90	0.90
Verified Net Savings	23,269,445	18,016	3,608

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	100%	NA	NA
Verified Gross Savings	14,149,164	9,048	1,896
Program Net-to-Gross Ratio (NTGR)	0.90	0.90	0.90
Verified Net Savings	12,734,248	8,143	1,706

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	99%	NA	NA
Verified Gross Savings	11,705,775	10,970	2,113
Program Net-to-Gross Ratio (NTGR)	0.90	0.90	0.90
Verified Net Savings	10,535,198	9,873	1,902

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%	1,691,822	0.90	1,522,640	NA	NA	3.0
HVAC	AC Tune-up >= 10 Ton (unit size)	2,523,815	100%	2,531,914	0.90	2,278,723	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	100%	1,660,394	0.90	1,494,355	8.0	25%	2.0
HVAC	Thermostat Replacement	19,950,721	99%	19,818,550	0.90	17,836,695	8.0	50%	4.0
	Totals§	25,985,070	99%	25,854,939	0.90	23,269,445	NA	NA	3.7

* 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	7,770	0.90	6,993
HVAC	AC Tune-up >= 10 Ton (unit size)	NR	NA	12,237	0.90	11,013
HVAC	Cogged V-Belt	NR	NA	10	0.90	9
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
	Total	NR	NA	20,018	0.90	18,016

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	1,596	0.90	1,436
HVAC	AC Tune-up >= 10 Ton (unit size)	NR	NA	2,403	0.90	2,163
HVAC	Cogged V-Belt	NR	NA	10	0.90	9
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
	Total†	NR	NA	4,009	0.90	3,608

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-three 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 seven 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. After communicating with the implementation team, we determined that the cause was due to a manual calculation process for these projects. The evaluation of these 18 projects found the ex ante savings to be accurate, given the additional explanation.

Recommendation 1. Navigant recommends avoiding the use of manual calculations since they provide additional opportunities for errors.

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 percent 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 two measures, the tracking data showed no improvement in efficiency, yet 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 percent 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.

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

One hundred percent of the thermostat adjustment measures and nearly 100 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. In one measure, the ex ante savings was calculated based on an “as left” heating setback of 15°F, instead of the tracking data value of 14°F.

Recommendation 5. Navigant recommends using the setback values found in the tracking data, in accordance with the IL TRM v5.0, to generate savings.

Finding 6. In five 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.

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-Up³

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

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

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
- EFLH* = Equivalent full load hours for cooling
- CF_{PJM}* = PJM summer peak coincidence factor

³ IL TRM v5.0, 4.4.1 Air Conditioner Tune-Up

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

7. APPENDIX 2. IMPACT ANALYSIS DETAIL

Table 7-1 provides the equipment number for all instances where a finding is applicable to an air conditioner tune-up measure.

Table 7-1. Air Conditioner Tune-Up Installations with Findings

Equipment Number	Measure Name	Realization Rate	Finding 1	Finding 2	Finding 3	Finding 4
101-440	AC Tune-up < 10 Ton (unit size)	100%			X	
101-448	AC Tune-up >= 10 Ton (unit size)	100%			X	
101-933	AC Tune-up < 10 Ton (unit size)	100%	X			
103-215	AC Tune-up < 10 Ton (unit size)	34%		X		
103-220	AC Tune-up < 10 Ton (unit size)	94%		X		
104-218	AC Tune-up >= 10 Ton (unit size)	100%			X	
104-639	AC Tune-up < 10 Ton (unit size)	11%		X		
104-722	AC Tune-up < 10 Ton (unit size)	100%			X	
104-724	AC Tune-up < 10 Ton (unit size)	100%			X	
104-739	AC Tune-up < 10 Ton (unit size)	11%		X		
104-751	AC Tune-up < 10 Ton (unit size)	9%		X		
104-777	AC Tune-up < 10 Ton (unit size)	8%		X		
105-102	AC Tune-up < 10 Ton (unit size)	100%	X	X		
105-123	AC Tune-up < 10 Ton (unit size)	100%	X	X		
105-124	AC Tune-up < 10 Ton (unit size)	100%	X	X		
105-187	AC Tune-up < 10 Ton (unit size)	100%	X	X		
105-191	AC Tune-up < 10 Ton (unit size)	100%	X	X		
105-206	AC Tune-up < 10 Ton (unit size)	100%	X	X		
105-813	AC Tune-up >= 10 Ton (unit size)	112%			X	
105-965	AC Tune-up < 10 Ton (unit size)	0%				X
106-051	AC Tune-up < 10 Ton (unit size)	0%				X
107-750	AC Tune-up < 10 Ton (unit size)	100%	X	X		
108-304	AC Tune-up >= 10 Ton (unit size)	105%		X		
108-618	AC Tune-up < 10 Ton (unit size)	11%		X		
108-619	AC Tune-up < 10 Ton (unit size)	11%		X		

Equipment Number	Measure Name	Realization Rate	Finding 1	Finding 2	Finding 3	Finding 4
109-266	AC Tune-up >= 10 Ton (unit size)	100%	X	X		
109-269	AC Tune-up >= 10 Ton (unit size)	100%	X	X		
109-271	AC Tune-up >= 10 Ton (unit size)	100%	X	X		
109-318	AC Tune-up >= 10 Ton (unit size)	100%	X	X		
109-359	AC Tune-up < 10 Ton (unit size)	100%	X	X		
109-395	AC Tune-up < 10 Ton (unit size)	100%			X	
109-398	AC Tune-up < 10 Ton (unit size)	100%	X	X		
109-439	AC Tune-up >= 10 Ton (unit size)	121%		X		
109-447	AC Tune-up < 10 Ton (unit size)	10%		X		
109-469	AC Tune-up < 10 Ton (unit size)	100%	X	X		
109-470	AC Tune-up < 10 Ton (unit size)	100%	X	X		
109-713	AC Tune-up < 10 Ton (unit size)	100%	X	X		
109-731	AC Tune-up < 10 Ton (unit size)	100%	X	X		
109-918	AC Tune-up < 10 Ton (unit size)	5%		X		
Total			18	29	7	2

Table 7-2 provides the equipment number for all instances where a finding is applicable to a thermostat measure.

Table 7-2. Thermostat Installations with Findings

Equipment Number	Measure Name	Realization Rate	Finding 5	Finding 6
104-523	Thermostat Replacement	43%		X
104-606	Thermostat Replacement	16%		X
104-607	Thermostat Replacement	14%		X
104-608	Thermostat Replacement	14%		X
104-609	Thermostat Replacement	14%		X
109-885	Thermostat Replacement	99%	X	
Total			1	5

8. APPENDIX 3. TOTAL RESOURCE COST DETAIL

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. EULs are subject to change and are not final.

Table 8-1. 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)
HVAC	AC Tune-up < 10 Ton (unit size)	Tune-up	1,002	3.0	1,697,883	NR	1,691,822	1,596
HVAC	AC Tune-up >= 10 Ton (unit size)	Tune-up	351	3.0	2,523,815	NR	2,531,914	2,403
HVAC	Cogged V-Belt	Belt	246	4.0	61,246	NR	61,246	10
HVAC	Economizer	Economizer	185	5.0	91,011	NR	91,013	0
HVAC	Thermostat Adjustment	Thermostat	148	2.0	1,660,394	NR	1,660,394	0
HVAC	Thermostat Replacement	Thermostat	1,691	4.0	19,950,721	NR	19,818,550	0