



# ComEd HVAC SAVE Pilot Impact Evaluation Report

**Energy Efficiency / Demand Response Plan:  
Program Year 2018 (CY2018)  
(1/1/2018-12/31/2018)**

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## 1. INTRODUCTION

This report presents the results of the impact evaluation of ComEd's CY2018 HVAC SAVE Pilot. It presents a summary of the energy and demand impacts. The appendix presents the impact analysis methodology. CY2018 covers the period from January 1, 2018 to December 31, 2018.

## 2. PILOT DESCRIPTION

The HVAC SAVE Pilot provided incentives for quality installations of replacement residential central air conditioning (CAC) systems. The program achieved energy savings associated with specially-trained Energy Efficiency Service Providers (EESPs) installing qualified CAC units in ComEd customers' homes. ComEd provided training (via the Midwest Energy Efficiency Alliance (MEEA) and CLEAResult) to Energy Efficiency Service Providers (EESPs) in CY2018 via this HVAC SAVE Pilot and CLEAResult served as the implementation contractor (IC) and provided the quality assurance and quality control support for the program.

Navigant's evaluated savings related to the quality installation (QI) process associated with the HVAC SAVE Pilot.

In CY2018, the Pilot incentivized 126 quality installs of replacement CAC systems as shown in the following table.

**Table 2-1. CY2018 Volumetric Findings Detail**

Participation	
Total CAC systems installed via QI	126

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

## 3. PILOT SAVINGS DETAIL

Table 3-1 summarizes the incremental energy and demand savings the HVAC SAVE Pilot achieved in CY2018. The IC did not report demand savings, but they reported summer peak demand savings.

**Table 3-1. CY2018 Total Annual Incremental Electric Savings**

Savings Category	Energy Savings (kWh)	Demand Savings (kW)	Summer Peak Demand Savings (kW)
<b>Electricity</b>			
Ex Ante Gross Savings	19,575	NA	43
Program Gross Realization Rate	0.93	NA	0.44
Verified Gross Savings	18,234	NA	19
Program Net-to-Gross Ratio (NTG)	0.80	NA	0.80
Verified Net Savings	14,587	NA	15
<b>Converted from Gas*</b>			
Ex Ante Gross Savings	NA	NA	NA
Program Gross Realization Rate	NA	NA	NA
Verified Gross Savings	NA	NA	NA
Program Net-to-Gross Ratio (NTG)	NA	NA	NA
Verified Net Savings	NA	NA	NA
<b>Total Electric Plus Gas</b>			
Ex Ante Gross Savings	19,575	NA	43
Program Gross Realization Rate	0.93	NA	0.44
Verified Gross Savings	18,234	NA	19
Program Net-to-Gross Ratio (NTG)	0.80	NA	0.80
Verified Net Savings	14,587	NA	15

NA = Not available

Note: The coincident Summer Peak period is defined as 1:00-5:00 P.M. Central Prevailing Time on non-holiday weekdays, June through August.

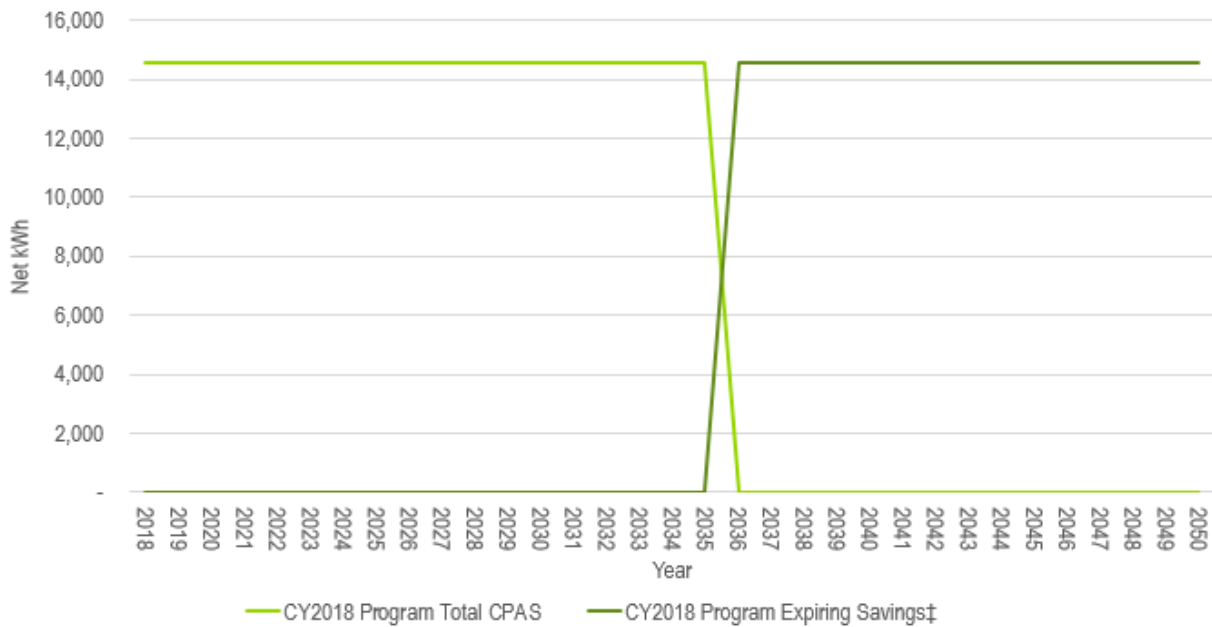
Source: ComEd tracking data and Navigant team analysis.

#### 4. CUMULATIVE PERSISTING ANNUAL SAVINGS

The total ex ante gross savings for the HVAC SAVE Pilot and the cumulative persisting annual savings (CPAS) are shown in the following table and figure. The total CPAS is 14,587 kWh. There were no calculated gas savings.



**Figure 4-1. Cumulative Persisting Annual Savings**



‡ Expiring savings are equal to CPAS Yn-1 - CPAS Yn + Expiring Savings Yn-1.  
 Source: Navigant analysis

## 5. PILOT SAVINGS BY MEASURE

The evaluation analyzed savings for the HVAC SAVE Pilot for the CAC QI measure as shown in following tables. There were no calculated gas savings.

**Table 5-1. CY2018 Energy Savings – Electric**

End Use Type	Research Category	Ex Ante Gross Savings (kWh)	Verified Gross Realization Rate	Verified Gross Savings (kWh)	NTG*	Verified Net Savings (kWh)	Effective Useful Life
HVAC	CAC- Quality Install	19,575	0.93	18,234	0.80	14,587	18
<b>Total</b>		<b>19,575</b>	<b>0.93</b>	<b>18,234</b>	<b>0.80</b>	<b>14,587</b>	<b>18</b>

\* A deemed value. Source: ComEd\_CY2018\_Pilot\_Programs\_NTG\_Memo\_Final\_2019-04-11.pdf, which is to be found on the IL SAG web site here: [http://ilsagfiles.org/SAG\\_files/NTG/2018\\_NTG\\_Meetings/ComEd\\_CY2018\\_Pilot\\_Programs\\_NTG\\_Memo\\_Final\\_2019-04-11.pdf](http://ilsagfiles.org/SAG_files/NTG/2018_NTG_Meetings/ComEd_CY2018_Pilot_Programs_NTG_Memo_Final_2019-04-11.pdf)  
 Source: ComEd tracking data and Navigant team analysis

**Table 5-2. CY2018 Summer Peak Demand Savings**

End Use Type	Research Category	Ex Ante Gross Peak Demand Reduction (kW)	Verified Gross Realization Rate	Verified Gross Peak Demand Reduction (kW)	NTG*	Verified Net Peak Demand Reduction (kW)
HVAC	CAC- Quality Install	43	0.44	19	0.80	15
<b>Total</b>		<b>43</b>	<b>0.44</b>	<b>19</b>	<b>0.80</b>	<b>15</b>

\* A deemed value. Source: ComEd\_CY2018\_Pilot\_Programs\_NTG\_Memo\_Final\_2019-04-11.pdf, which is to be found on the IL SAG web site here: [http://ilsagfiles.org/SAG\\_files/NTG/2018\\_NTG\\_Meetings/ComEd\\_CY2018\\_Pilot\\_Programs\\_NTG\\_Memo\\_Final\\_2019-04-11.pdf](http://ilsagfiles.org/SAG_files/NTG/2018_NTG_Meetings/ComEd_CY2018_Pilot_Programs_NTG_Memo_Final_2019-04-11.pdf)  
 Source: ComEd tracking data and Navigant team analysis.

## 6. IMPACT ANALYSIS FINDINGS AND RECOMMENDATIONS

### 6.1 Impact Parameter Estimates

As stated in the IC's savings calculator<sup>1</sup>, the IC calculated the gross and summer peak demand savings for the CAC QI measure using the algorithms in the Iowa Technical Reference Manual v. 2<sup>2</sup> with the exception of omitting the coincidence factor for the summer peak demand savings as follows:

#### Equation 1 Iowa TRM v2 Central Air Conditioning Electric Energy Savings: Time of Sale

$$\Delta kWh_{quality\ install} = (EFLH_{cool} * Capacity_{coolee} * \frac{(\frac{1}{(SEER_{base} * (1 - Derating\ Cool_{base}))} - \frac{1}{(SEER_{ee})})}{1000} - (EFLH_{cool} * Capacity_{coolee} * \frac{(\frac{1}{(SEER_{base} * (1 - Derating\ Cool_{base}))} - \frac{1}{(SEER_{ee} * (1 - Derating\ Cool_{ee}))})}{1000}))$$

Where,

$EFLH_{cool}$  = Equivalent Full Load Hours of Cooling

$Capacity_{coolee}$  = Cooling capacity of new equipment in  $\frac{Btu}{h}$

$SEER_{base}$  = Seasonal Energy Efficiency Ratio (SEER) of baseline unit  $(\frac{kBtu}{kWh})$

$SEER_{ee}$  = Seasonal Energy Efficiency Ratio (SEER) of efficient unit  $(\frac{kBtu}{kWh})$

$Derating\ Cool_{base}$  = Baseline Central Air Conditioner Cooling derating  
= 10.5%

$Derating\ Cool_{ee}$  = Efficient Central Air Conditioner Cooling derating  
= 0% if Quality Installation is performed and 10.5% if Quality Installation is not performed

#### Equation 2 Iowa TRM v2 Central Air Conditioning Summer Peak Demand Savings: Time of Sale

$$\Delta kW_{quality\ install} = (Capacity_{coolee} * \frac{(\frac{1}{(EER_{base} * (1 - Derating\ Cool_{base}))} - \frac{1}{(EER_{ee})})}{1000} * CF - (Capacity_{cooling} * \frac{(\frac{1}{(EER_{base} * (1 - Derating\ Cool_{base}))} - \frac{1}{(EER_{ee} * (1 - Derating\ Cool_{eff}))})}{1000} * CF)$$

Where,

$CFE$  = Summer system peak Coincidence Factor for cooling,  
= 68% for non - QI and 80% for QI or right sized unit

$EER_{ee}$  = EER Efficiency of ENERGY STAR unit

$EER_{base}$  = EER Efficiency of baseline unit

<sup>1</sup> ComEd HVAC SAVE Savings Estimates 02122018.xlsx

<sup>2</sup>Iowa Energy Efficiency Statewide Technical Reference Manual – Volume 2: Residential Measures (effective 01-01-2018) <https://efs.iowa.gov/cs/groups/external/documents/docket/mdax/njq1/~edisp/1645801.pdf>



Navigant calculated verified gross and summer peak demand savings for the CAC QI measure using the algorithms in the Illinois Technical Reference Manual (TRM) v7 as follows:

**Equation 3 IL TRM V7 Central Air Conditioning Electric Energy Savings: Time of Sale**

$$\Delta kWh_{quality\ install} = (FLH_{cooling} * Capacity_{cooling} * \frac{1}{(SEER_{base} * (1 - Derating\ Cool_{base})) - (SEER_{ee} * SEER_{adj})} - (FLH_{cooling} * Capacity_{cooling} * \frac{1}{(SEER_{base} * (1 - Derating\ Cool_{base})) - (SEER_{ee} * SEER_{adj} * (1 - Derating\ Cool_{ee}))})$$

Where,

$FLH_{cooling}$  = Full Load Cooling Hours

$Capacity_{cooling}$  = Size of new equipment in  $\frac{Btu}{hr}$

$SEER_{base}$  = Seasonal Energy Efficiency Ratio (SEER) of baseline unit  $(\frac{kBtu}{kWh})$

$SEER_{ee}$  = Seasonal Energy Efficiency Ratio (SEER) of efficient unit  $(\frac{kBtu}{kWh})$

$SEER_{adj}$  = Adjustment percentage to account for in – situ performance of the unit  
 $= 0.805 * (\frac{EER_{ee}}{SEER_{ee}}) + 0.367$

$EER_{ee}$  = EER Efficiency of ENERGY STAR unit

$Derating\ Cool_{base}$  = Baseline Central Air Conditioner Cooling derating  
 = 10%

$Derating\ Cool_{ee}$  = Efficient Central Air Conditioner Cooling derating  
 = 0% if Quality Installation is performed and 10% if Quality Installation is not performed or unknown

**Equation 4 IL TRM V7 Central Air Conditioning Summer Peak Demand Savings: Time of Sale**

$$\Delta kW_{quality\ install} = (Capacity_{cooling} * \frac{1}{(EER_{base} * (1 - Derating\ Cool_{base})) - (EER_{ee})} * CF - (Capacity_{cooling} * \frac{1}{(EER_{base} * (1 - Derating\ Cool_{base})) - (EER_{ee} * (1 - Derating\ Cool_{eff}))} * CF$$

Where,

$CF$  = PJM Summer Peak Coincidence Factor for CAC  
 = 46.6%

$EER_{ee}$  = EER Efficiency of ENERGY STAR unit

$EER_{base}$  = EER Efficiency of baseline unit

For the energy savings calculations, the IC used an algorithm from the IA TRM and inputs from both the IA TRM and the IL TRM; Navigant used the algorithm and inputs from the IL TRM v.2 as shown in Table 6-1.

- For the summer peak demand savings calculations, the IC used an algorithm as well as inputs from the IA TRM but omitted the Coincidence Factor; Navigant used an algorithm and inputs from the IL TRM v. 2 as shown in Table 6-2.

The following tables presents the specific input parameter sources that the IC and Navigant used to calculate the energy and summer peak demand savings.

**Table 6-1. IC's and Navigant's Algorithm Inputs for the Central Air Conditioning Energy Savings Calculations.**

Variable	Value Utilized by IC *	Value Utilized by Navigant †
Dwelling_Type	Single-Family Home	Single-Family Home
FLH_cooling_ Zone 1	512†	512
FLH_cooling_ Zone 2	570†	570
Derating Cool base	10.5%	10.0%
Derating Cool ee	0% if Quality Installation is performed and 10.5% if Quality Installation is not performed	0% if Quality Installation is performed and 10% if Quality Installation is not performed

\*Source: IC worksheet: HVAC SAVE\_Review Analysis\_032119.xlsx

† Source: IL TRM v.7

**Table 6-2 IC's and Navigant's Algorithm Inputs for the Central Air Conditioning Summer Peak Demand Savings Calculations.**

Variable	Value Utilized by IC *	Value Utilized by Navigant †
Dwelling_Type	Single-Family Home	Single-Family Home
Derating Cool base	10.5%	10.0%
Derating Cool ee	0% if Quality Installation is performed and 10.5% if Quality Installation is not performed	0% if Quality Installation is performed and 10% if Quality Installation is not performed
CF	omitted	PJM Summer Peak Coincidence Factor = 46.6%

\*Source: IC worksheet: HVAC SAVE\_Review Analysis\_032119.xlsx

† Source: IL TRM v.7

## 6.2 Other Impact Findings and Recommendations

Navigant developed the following findings and recommendations:

**Finding 1.** The IC used energy saving and summer peak demand savings algorithms for the CAC QI measure from the Iowa TRM instead of the Illinois TRM.

**Recommendation 1.** Navigant recommends using energy saving and summer peak demand savings algorithms from the Illinois TRM v.7.

**Finding 2.** Navigant determined that the main source of the discrepancy between ex-ante and verified summer peak demand savings was due to the IC omitting the PJM Summer Peak Coincidence Factor (CF) term when calculating the summer peak demand savings. This

omission led to a significant reduction in the realization rate for the summer peak demand savings.

**Recommendation 2.** Navigant recommends including the CF “term” in the calculation for the summer peak demand savings. The value CF is “0.466”. The IC has informed the evaluation team that they will be using the CF term for summer peak demand savings.

**Finding 3.** Navigant found that the main source of the discrepancy between the ex ante and verified energy savings was due to the incorrect value of derating factors used by IC. The savings for a quality installation are achieved through derating factors and there is a difference of 0.5% between the IA TRM and the IL TRM.

**Recommendation 3.** Navigant recommends using the IL TRM v.7 for all the algorithm inputs for both the energy saving and summer peak demand savings algorithms for the CAC QI measure. The IC has informed the evaluation team that they will be using the derating factor from the IL TRM v7 for summer peak demand savings.

**Finding 4.** Navigant also found that the IC inconsistently used the value of parameter “Deratingcooleff” (per the IC provided worksheet “HVAC SAVE\_Review Analysis\_032119.xlsx”). For job number 243394, the IC did not apply 0% and instead applied 10.5%.

**Recommendation 4.** Navigant recommends using the Deratingcooleff value of “0” for all cases when Quality install is performed in accordance with the Illinois TRM v.7. The IC has informed the evaluation team that they will be using a Deratingcooleff of 0% for all cases.

## 7. APPENDIX 1. IMPACT ANALYSIS METHODOLOGY

This section discusses the impact analysis methodology Navigant used for the HVAC SAVE Pilot. Navigant determined verified gross savings for the CAC QI measure by:

1. Reviewing the savings algorithm equation and inputs in the measure workbook for agreement with the IL TRM v.7.
2. Reviewing the savings algorithm calculation in the Savings Calculator provided by the implementer.
3. Determining if the savings algorithm was applied correctly.
4. Cross-checking gross-ex ante energy and peak demand saving values with the verified energy and peak demand saving values.

## 8. APPENDIX 2. IMPACT ANALYSIS DETAIL

Navigant used the following documents provided by the IC and the IL TRM v7 to verify the per-unit savings:

- Measure Workbook: “HVAC SAVE\_Review Analysis\_032119.xlsx”
- Savings Calculator: “ComEd HVAC SAVE Savings Estimates 02122018.xlsx”
- Illinois Technical Reference Manual (IL TRM v7.0) for deemed input parameters or secondary evaluation research to verify any custom inputs used in the ex ante calculations.

The following section provides an outline of the differences between the ex ante and verified savings associated with the HVAC SAVE QI measure as part of the HVAC SAVE Pilot.

### 8.1 Central Air Conditioning

Quality installed CACs had an electric energy realization rate of 93% and peak demand energy savings realization rate of 44%. Verified savings have been calculated for 126 CAC installations in the HVAC SAVE Pilot.

**Table 8-1. Quality Installed Replacement Central Air Conditioning Measure Impact Detail**

Measure	Project Type	Quantity	Ex ante Gross Savings (kWh)	Ex ante Gross Peak Demand Savings (kW)	Verified Gross Savings (kWh)	Verified Gross kWh Realization Rate	Verified Gross Peak Demand Savings (kW)	Verified Gross kW Realization Rate
CAC	Time of Sale- New Construction, Quality Install	126	19,575	43	18,234	0.93	19	0.44

Source: ComEd tracking data and Navigant team analysis.

### 9. APPENDIX 3. TOTAL RESOURCE COST DETAIL

Table 9-1, below, shows the Total Resource Cost (TRC) table. It includes only the cost-effectiveness analysis inputs available at the time of finalizing this 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 later.

**Table 9-1. Total Resource Cost Savings Summary**

End Use Type	Research Category	Units	Quantity	Effective Useful Life	Verified Gross Savings (kWh)	Verified Gross Peak Demand Reduction (kW)	Verified Gross Savings Therms	Gross Heating Penalty (kWh)	Gross Heating Penalty (Therms)	NTG Ratio (kWh)	NTG Ratio (kW)	NTG Ratio (Therms)	Verified Net Savings (kWh)	Verified Net Peak Demand Reduction (kW)	Verified Net Savings Therms	Net Heating Penalty (kWh)	Net Heating Penalty (Therms)
HVAC	CAC- Quality Install	CAC	126	18.0	18,234	19	NA	NA	NA	0.80	0.80	NA	14,587	15	NA	NA	NA

Source: ComEd tracking data and Navigant team analysis.