NAVIGANT

ComEd Heating and Cooling (HVAC) Rebates Impact Evaluation Report

Energy Efficiency / Demand Response Plan:
Program Year 2018 (CY2018)
(01/01/2018-12/31/2018)

Presented to
ComEd

DRAFT

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ComEd Heating and Cooling (HVAC) Rebates Impact Evaluation Report

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1. INTRODUCTION

This report presents the results of the impact evaluation of ComEd's CY2018 Heating and Cooling (HVAC) Rebates Program. It presents a summary of the energy and demand impacts for the total program and broken out by relevant measure and program structure details. The appendix presents the impact analysis methodology. CY2018 covers January 1, 2018 through December 31, 2018.

2. PROGRAM DESCRIPTION

The HVAC Rebates Program offers incentives for the installation of qualifying high efficiency equipment including central air conditioning systems, air source heat pumps, ductless mini-split heat pumps, furnace blower motors (electronically commutated motors (ECMs)), heat pump water heaters, ground source heat pumps, and smart thermostats.

The program had 14,732 participants in CY2018 and distributed 24,327 measures as shown in the following table and graph.

Table 2-1. CY2018 Volumetric Findings Detail

Participation	HVAC Rebates Total
Participants*	14,732
Total Measures	24,327
Installed Projects†	15,529
Heat Pump Water Heater	8
Advanced Thermostat	4,601
Air Source Heat Pump	192
Central Air Conditioning	8,912
Ductless Heat Pump	351
ECM Furnace Motor - Factory Installed	10,156
ECM Furnace Motor - Retrofit	92
Ground Source Heat Pump	15

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

Figure 2-1. Distribution of Measures Installed by Type
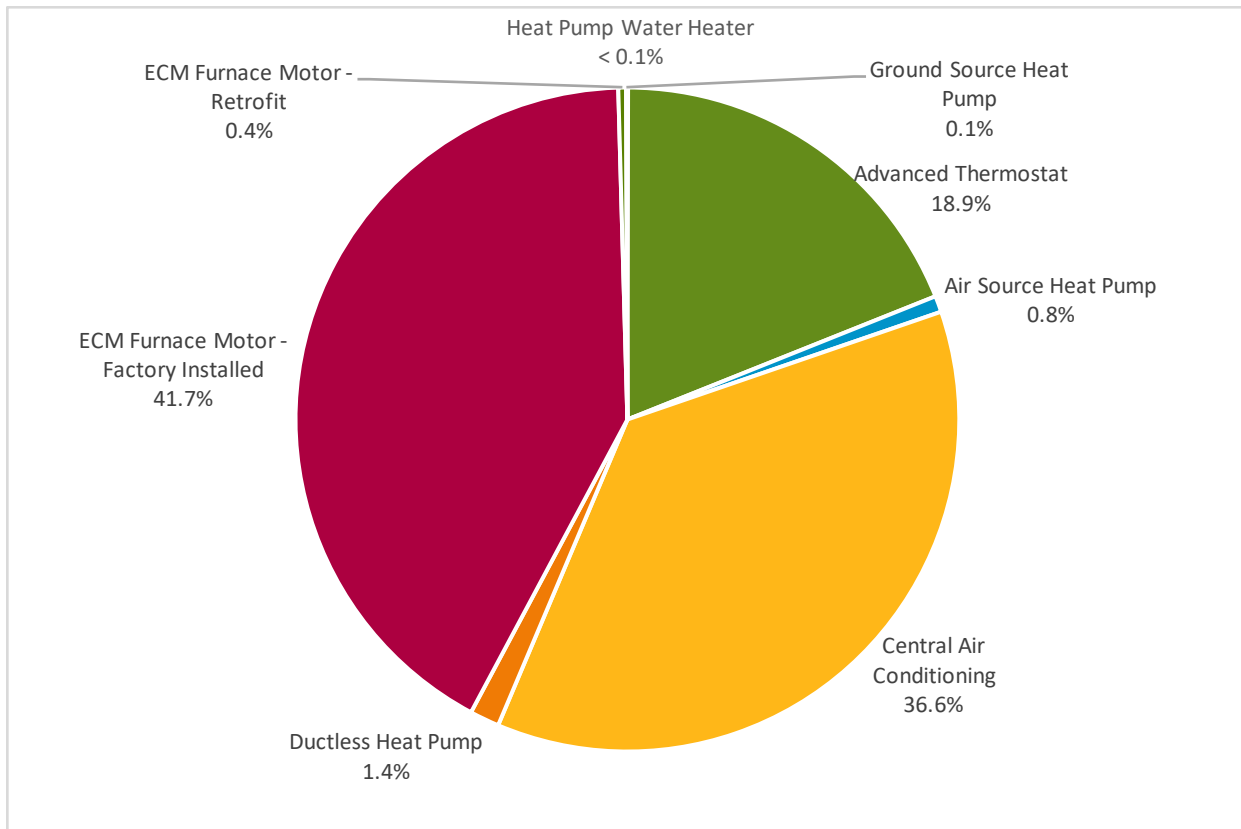
Source: ComEd tracking data and Navigant team analysis.

3. CUMULATIVE PERSISTING ANNUAL SAVINGS

The measure-specific and total verified gross savings for the HVAC Rebates Program and the cumulative persisting annual savings (CPAS) for the measures installed in CY2018 are shown in the following tables and figure. The electric CPAS across all measures is 9,250,021 kWh. The program achieved 8,956,632 kWh CPAS equivalent of gas savings converted to electricity that might be counted toward ComEd's goal[1] (the middle table in the following set of tables). Adding the savings converted from gas savings to the electric savings produces a total of 18,206,653 kWh of total CPAS.

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[1] The evaluation will determine which gas savings will be counted toward goal while producing the portfolio-wide Summary Report.

ComEd Heating and Cooling (HVAC) Rebates Impact Evaluation Report

Table 3-1. Cumulative Persisting Annual Savings (CPAS) – Electric

End Use Type	Research Category	EUL	CY2018 Verified Gross Savings	NTG*	Lifetime Net Savings†	Verified Net kWh Savings								
						2018	2019	2020	2021	2022	2023	2024	2025	2026
Hot Water	Heat Pump Water Heater	13.0	16,823	0.76	166,206	12,785	12,785	12,785	12,785	12,785	12,785	12,785	12,785	12,785
HVAC	Advanced Thermostat	10.0	1,122,272	NA§	11,222,725	1,122,272	1,122,272	1,122,272	1,122,272	1,122,272	1,122,272	1,122,272	1,122,272	1,122,272
HVAC	Air Source Heat Pump	18.0	396,130	0.57	1,775,718	225,794	225,794	225,794	225,794	225,794	225,794	35,079	35,079	35,079
HVAC	Central Air Conditioning	18.0	2,923,771	0.69	15,142,657	2,017,402	2,017,402	2,017,402	2,017,402	2,017,402	2,017,402	253,187	253,187	253,187
HVAC	Ductless Heat Pump	18.0	1,132,901	0.68	6,660,604	770,373	770,373	770,373	770,373	770,373	770,373	169,864	169,864	169,864
HVAC	ECM Furnace Motor - Factory Installed	20.0	7,349,294	0.68	99,950,398	4,997,520	4,997,520	4,997,520	4,997,520	4,997,520	4,997,520	4,997,520	4,997,520	4,997,520
HVAC	ECM Furnace Motor - Retrofit	20.0	66,442	0.80	1,063,072	53,154	53,154	53,154	53,154	53,154	53,154	53,154	53,154	53,154
HVAC	Ground Source Heat Pump	25.0	85,967	0.59	801,269	50,721	50,721	50,721	50,721	50,721	50,721	50,721	50,721	23,265
CY2018 Program Total Electric CPAS			**13,093,601**		**136,782,649**	**9,250,021**	9,250,021	9,250,021	9,250,021	9,250,021	9,250,021	6,694,582	6,694,582	6,667,126
CY2018 Program Expiring Electric Savings‡							0	0	0	0	0	2,555,439	2,555,439	2,582,895

End Use Type	Research Category	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038
Hot Water	Heat Pump Water Heater	12,785	12,785	12,785	12,785								
HVAC	Advanced Thermostat	1,122,272											
HVAC	Air Source Heat Pump	35,079	35,079	35,079	35,079	35,079	35,079	35,079	35,079	35,079			
HVAC	Central Air Conditioning	253,187	253,187	253,187	253,187	253,187	253,187	253,187	253,187	253,187			
HVAC	Ductless Heat Pump	169,864	169,864	169,864	169,864	169,864	169,864	169,864	169,864	169,864			
HVAC	ECM Furnace Motor - Factory Installed	4,997,520	4,997,520	4,997,520	4,997,520	4,997,520	4,997,520	4,997,520	4,997,520	4,997,520	4,997,520	4,997,520	
HVAC	ECM Furnace Motor - Retrofit	53,154	53,154	53,154	53,154	53,154	53,154	53,154	53,154	53,154	53,154	53,154	
HVAC	Ground Source Heat Pump	23,265	23,265	23,265	23,265	23,265	23,265	23,265	23,265	23,265	23,265	23,265	23,265
CY2018 Program Total Electric CPAS		6,667,126	5,544,854	5,544,854	5,544,854	5,532,069	5,532,069	5,532,069	5,532,069	5,532,069	5,073,938	5,073,938	23,265
CY2018 Program Expiring Electric Savings‡		2,582,895	3,705,167	3,705,167	3,705,167	3,717,952	3,717,952	3,717,952	3,717,952	3,717,952	4,176,083	4,176,083	9,226,756

End Use Type	Research Category	2039	2040	2041	2042	2043	2044	2045	2046	2047	2048	2049	2050
Hot Water	Heat Pump Water Heater												
HVAC	Advanced Thermostat												
HVAC	Air Source Heat Pump												
HVAC	Central Air Conditioning												
HVAC	Ductless Heat Pump												
HVAC	ECM Furnace Motor - Factory Installed												
HVAC	ECM Furnace Motor - Retrofit												
HVAC	Ground Source Heat Pump	23,265	23,265	23,265	23,265								
CY2018 Program Total Electric CPAS		23,265	23,265	23,265	23,265	0	0	0	0	0	0	0	0
CY2018 Program Expiring Electric Savings‡		9,226,756	9,226,756	9,226,756	9,226,756	9,250,021	9,250,021	9,250,021	9,250,021	9,250,021	9,250,021	9,250,021	9,250,021

Note: The green highlighted cell shows program total first year electric savings.
* A deemed value. Source: ComEd_NTG_History_and_PY10_Recommendations_2017-03-01.xlsx, which is to be found on the IL Stakeholder Advisory Group (SAG) web site here: http://ilsag.info/net-to-gross-framework.html.
† Lifetime savings are the sum of CPAS savings through the EUL.
‡ Expiring savings are equal to CPAS Yn-1 - CPAS Yn + Expiring Savings Yn-1.
§ The IL TRM algorithm calculates net savings for advanced thermostats.
Source: Navigant analysis

Table 3-2. Cumulative Persisting Annual Savings (CPAS) – Gas

End Use Type	Research Category	EUL	CY2018 Verified Gross Savings (Therms)	NTG*	Lifetime Net Savings†	Verified Net Therms Savings								
						2018	2019	2020	2021	2022	2023	2024	2025	2026
Hot Water	Heat Pump Water Heater	13.0	0	0.76	0									
HVAC	Advanced Thermostat	10.0	214,057	NA¶	2,140,567	214,057	214,057	214,057	214,057	214,057	214,057	214,057	214,057	214,057
HVAC	Air Source Heat Pump	18.0	0	0.57	0									
HVAC	Central Air Conditioning	18.0	0	0.69	0									
HVAC	Ductless Heat Pump	18.0	134,597	0.68	1,059,497	91,526	91,526	91,526	91,526	91,526	91,526	42,528	42,528	42,528
HVAC	ECM Furnace Motor - Factory Installed	20.0	0	0.68	0									
HVAC	ECM Furnace Motor - Retrofit	20.0	0	0.80	0									
HVAC	Ground Source Heat Pump	25.0	0	0.59	0									
CY2018 Program Total Gas CPAS (Therms)			348,654		3,200,064	305,583	305,583	305,583	305,583	305,583	305,583	256,585	256,585	256,585
CY2018 Program Total Gas CPAS (kWh Equivalent)‡					93,793,869	8,956,632	8,956,632	8,956,632	8,956,632	8,956,632	8,956,632	7,520,508	7,520,508	7,520,508
CY2018 Program Expiring Gas Savings (Therms)§							0	0	0	0	0	48,998	48,998	48,998
CY2018 Program Expiring Gas Savings (kWh Equivalent)‡§							0	0	0	0	0	1,436,124	1,436,124	1,436,124

End Use Type	Research Category	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038
Hot Water	Heat Pump Water Heater												
HVAC	Advanced Thermostat	214,057											
HVAC	Air Source Heat Pump												
HVAC	Central Air Conditioning												
HVAC	Ductless Heat Pump	42,528	42,528	42,528	42,528	42,528	42,528	42,528	42,528	42,528			
HVAC	ECM Furnace Motor - Factory Installed												
HVAC	ECM Furnace Motor - Retrofit												
HVAC	Ground Source Heat Pump												
CY2018 Program Total Gas CPAS (Therms)		256,585	42,528	42,528	42,528	42,528	42,528	42,528	42,528	42,528	0	0	0
CY2018 Program Total Gas CPAS (kWh Equivalent)‡		7,520,508	1,246,506	1,246,506	1,246,506	1,246,506	1,246,506	1,246,506	1,246,506	1,246,506	0	0	0
CY2018 Program Expiring Gas Savings (Therms)§		48,998	263,054	263,054	263,054	263,054	263,054	263,054	263,054	263,054	305,583	305,583	305,583
CY2018 Program Expiring Gas Savings (kWh Equivalent)‡		1,436,124	7,710,126	7,710,126	7,710,126	7,710,126	7,710,126	7,710,126	7,710,126	7,710,126	8,956,632	8,956,632	8,956,632

Note: The green highlighted cell shows program total first year gas savings in kWh equivalents.

* A deemed value. Source: ComEd_NTG_History_and_PY10_Recommendations_2017-03-01.xlsx, which is to be found on the IL SAG web site here: http://ilsag.info/net-to-gross-framework.html.

† Lifetime savings are the sum of CPAS savings through the EUL.

‡ kWh equivalent savings are calculated by multiplying therm savings by 29.31.

§ Expiring savings are equal to CPAS Yn-1 - CPAS Yn + Expiring Savings Yn-1.

¶ The IL TRM algorithm calculates net savings for advanced thermostats.

Source: Navigant analysis

Table 3-3. Cumulative Persisting Annual Savings (CPAS) – Total

End Use Type	Research Category	EUL	CY2018 Verified Gross Savings	NTG*	Lifetime Net Savings†	Verified Net kWh Savings (Including Those Converted from Gas Savings) 2018	2019	2020	2021	2022	2023	2024	2025	2026
Hot Water	Heat Pump Water Heater	13.0	16,823	0.76	166,206	12,785	12,785	12,785	12,785	12,785	12,785	12,785	12,785	12,785
HVAC	Advanced Thermostat	10.0	7,396,275	NA§	73,962,747	7,396,275	7,396,275	7,396,275	7,396,275	7,396,275	7,396,275	7,396,275	7,396,275	7,396,275
HVAC	Air Source Heat Pump	18.0	396,130	0.57	1,775,718	225,794	225,794	225,794	225,794	225,794	225,794	35,079	35,079	35,079
HVAC	Central Air Conditioning	18.0	2,923,771	0.69	15,142,657	2,017,402	2,017,402	2,017,402	2,017,402	2,017,402	2,017,402	253,187	253,187	253,187
HVAC	Ductless Heat Pump	18.0	5,077,945	0.68	37,714,450	3,453,003	3,453,003	3,453,003	3,453,003	3,453,003	3,453,003	1,416,370	1,416,370	1,416,370
HVAC	ECM Furnace Motor - Factory Installed	20.0	7,349,294	0.68	99,950,398	4,997,520	4,997,520	4,997,520	4,997,520	4,997,520	4,997,520	4,997,520	4,997,520	4,997,520
HVAC	ECM Furnace Motor - Retrofit	20.0	66,442	0.80	1,063,072	53,154	53,154	53,154	53,154	53,154	53,154	53,154	53,154	53,154
HVAC	Ground Source Heat Pump	25.0	85,967	0.00	801,269	50,721	50,721	50,721	50,721	50,721	50,721	50,721	50,721	23,265
CY2018 Program Total CPAS			**23,312,647**		**230,576,518**	**18,206,653**	18,206,653	18,206,653	18,206,653	18,206,653	18,206,653	14,215,090	14,215,090	14,187,634
CY2018 Program Expiring Savings‡							0	0	0	0	0	3,991,563	3,991,563	4,019,019

End Use Type	Research Category	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038
Hot Water	Heat Pump Water Heater	12,785	12,785	12,785	12,785								
HVAC	Advanced Thermostat	7,396,275											
HVAC	Air Source Heat Pump	35,079	35,079	35,079	35,079	35,079	35,079	35,079	35,079	35,079			
HVAC	Central Air Conditioning	253,187	253,187	253,187	253,187	253,187	253,187	253,187	253,187	253,187			
HVAC	Ductless Heat Pump	1,416,370	1,416,370	1,416,370	1,416,370	1,416,370	1,416,370	1,416,370	1,416,370	1,416,370			
HVAC	ECM Furnace Motor - Factory Installed	4,997,520	4,997,520	4,997,520	4,997,520	4,997,520	4,997,520	4,997,520	4,997,520	4,997,520	4,997,520	4,997,520	
HVAC	ECM Furnace Motor - Retrofit	53,154	53,154	53,154	53,154	53,154	53,154	53,154	53,154	53,154	53,154	53,154	
HVAC	Ground Source Heat Pump	23,265	23,265	23,265	23,265	23,265	23,265	23,265	23,265	23,265	23,265	23,265	23,265
CY2018 Program Total CPAS		**14,187,634**	**6,791,360**	**6,791,360**	**6,791,360**	**6,778,574**	**6,778,574**	**6,778,574**	**6,778,574**	**6,778,574**	**5,073,938**	**5,073,938**	**23,265**
CY2018 Program Expiring Savings‡		**4,019,019**	**11,415,293**	**11,415,293**	**11,415,293**	**11,428,078**	**11,428,078**	**11,428,078**	**11,428,078**	**11,428,078**	**13,132,714**	**13,132,714**	**18,183,388**

End Use Type	Research Category	2039	2040	2041	2042	2043	2044	2045	2046	2047	2048	2049	2050
Hot Water	Heat Pump Water Heater												
HVAC	Advanced Thermostat												
HVAC	Air Source Heat Pump												
HVAC	Central Air Conditioning												
HVAC	Ductless Heat Pump												
HVAC	ECM Furnace Motor - Factory Installed												
HVAC	ECM Furnace Motor - Retrofit												
HVAC	Ground Source Heat Pump	23,265	23,265	23,265	23,265								
CY2018 Program Total CPAS		**23,265**	**23,265**	**23,265**	**23,265**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
CY2018 Program Expiring Savings‡		**18,183,388**	**18,183,388**	**18,183,388**	**18,183,388**	**18,206,653**	**18,206,653**	**18,206,653**	**18,206,653**	**18,206,653**	**18,206,653**	**18,206,653**	**18,206,653**

Note: The green highlighted cell shows program total first year electric savings (including direct electric savings and those converted from gas).

* A deemed value. Source: ComEd_NTG_History_and_PY10_Recommendations_2017-03-01.xlsx, which is to be found on the IL SAG web site here: http://ilsag.info/net-to-gross-framework.html.

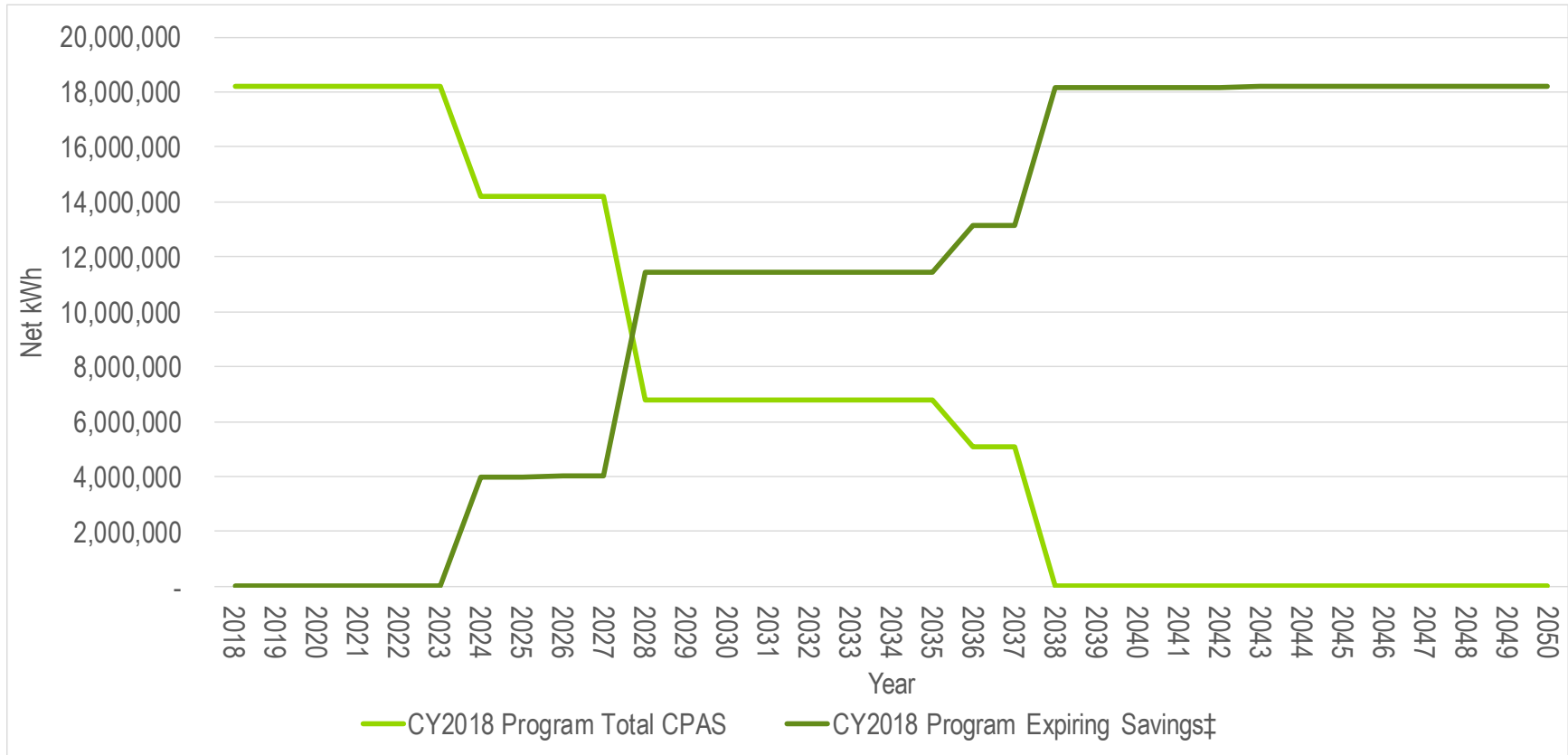†Lifetime savings are the sum of CPAS savings through the EUL.

‡ Expiring savings are equal to CPAS Yn-1 - CPAS Yn + Expiring Savings Yn-1.

§ The IL TRM algorithm calculates net savings for advanced thermostats.

Source: Navigant analysis

Figure 3-1. Cumulative Persisting Annual Savings

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

4. PROGRAM SAVINGS DETAIL

Table 4-1 summarizes the incremental energy and demand savings the Heating and Cooling (HVAC) Rebates Program achieved in CY2018. The gas savings are only those that the gas utilities are not claiming and ComEd can claim.[2]

Table 4-1. CY2018 Total Annual Incremental Electric Savings

Savings Category	Energy Savings (kWh)	Demand Savings (kW)	Summer Peak Demand Savings (kW)
Electricity			
Ex Ante Gross Savings	12,973,090	NR†	4,444
Program Gross Realization Rate	1.01	NA	1.01
Verified Gross Savings	13,093,601	10,317	4,471
Program Net-to-Gross Ratio (NTG)	Varies	Varies	Varies
Verified Net Savings	9,250,021	7,492	3,160
Converted from Gas*			
Ex Ante Gross Savings	11,121,957	NA	NA
Program Gross Realization Rate	0.92	NA	NA
Verified Gross Savings	10,219,046	NA	NA
Program Net-to-Gross Ratio (NTG)	Varies	NA	NA
Verified Net Savings	8,956,632	NA	NA
Total Electric Plus Gas			
Ex Ante Gross Savings	24,095,047	NR	4,444
Program Gross Realization Rate	0.97	NA	1.01
Verified Gross Savings	23,312,647	10,317	4,471
Program Net-to-Gross Ratio (NTG)	Varies	Varies	Varies
Verified Net Savings	18,206,653	7,492	3,160

* Gas savings converted to kWh by multiplying therms * 29.31 (which is based on 100,000 Btu/therm and 3,412 Btu/kWh).
† NR = Not Reported
‡ Ex Ante Gross Savings accounts for both HVAC and Geothermal measures.
Note: The coincident Summer Peak period is defined as 1:00-5:00 PM Central Prevailing Time on non-holiday weekdays, June through August.
Note: Demand savings are defined as difference in kW in the baseline and post installation period for measures installed in year 2018.
Source: ComEd tracking data and Navigant team analysis.

5. PROGRAM SAVINGS BY MEASURE

The program includes seven measures as shown in the following tables. The Furnace Blower Motor (ECM) and Central Air Conditioning measures contributed the most savings.

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[2] The evaluation will determine which gas savings will be counted toward goal while producing the portfolio-wide Summary Report.

Table 5-1. CY2018 Energy Savings by Measure – 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
Hot Water	Heat Pump Water Heater	17,235	0.98	16,823	0.76	12,785	13.0
HVAC	Advanced Thermostat	1,121,633	1.00	1,122,272	NA‡	1,122,272	10.0
HVAC	Air Source Heat Pump	369,326	1.07	396,130	0.57	225,794	18.0
HVAC	Central Air Conditioning	2,849,916	1.03	2,923,771	0.69	2,017,402	18.0
HVAC	Ductless Heat Pump	1,098,642	1.03	1,132,901	0.68	770,373	18.0
HVAC	ECM Furnace Motor - Factory Installed	7,337,282	1.00	7,349,294	0.68	4,997,520	20.0
HVAC	ECM Furnace Motor - Retrofit	66,046	1.01	66,442	0.80	53,154	20.0
HVAC	Ground Source Heat Pump	113,009	0.76	85,967	0.59	50,721	25.0
	Total	**12,973,090**	**1.01**	**13,093,601**		**9,250,021**	

* A deemed value. Source: ComEd_NTG_History_and_PY10_Recommendations_2017-03-01.xlsx, which is to be found on the IL SAG web site here: http://ilsag.info/net-to-gross-framework.html.
‡ The IL TRM algorithm calculates net savings for advanced thermostats.
Source: ComEd tracking data and Navigant team analysis.

Table 5-2. CY2018 Demand Savings by Measure

End Use Type	Research Category	Ex Ante Gross Demand Reduction (kW)	Verified Gross Realization Rate	Verified Gross Demand Reduction (kW)	NTG *	Verified Net Demand Reduction (kW)
Hot Water	Heat Pump Water Heater	NR†	NA	6.64	0.76	5.05
HVAC	Advanced Thermostat	NR	NA	1,367.21	NA‡	1,367.21
HVAC	Air Source Heat Pump	NR	NA	21.71	0.57	12.38
HVAC	Central Air Conditioning	NR	NA	3,994.44	0.69	2,756.16
HVAC	Ductless Heat Pump	NR	NA	101.03	0.68	68.70
HVAC	ECM Furnace Motor - Factory Installed	NR	NA	4,738.06	0.68	3,221.88
HVAC	ECM Furnace Motor - Retrofit	NR	NA	43.46	0.80	34.77
HVAC	Ground Source Heat Pump	NR	NA	44.20	0.59	26.08
	Total	**NR**		**10,316.75**		**7,492.22**

* A deemed value. Source: ComEd_NTG_History_and_PY10_Recommendations_2017-03-01.xlsx, which is to be found on the IL SAG web site here: http://ilsag.info/net-to-gross-framework.html.
† NR = Not Reported
‡ The IL TRM algorithm calculates net savings for advanced thermostats.
Source: ComEd tracking data and Navigant team analysis.

Table 5-3. CY2018 Summer 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)	NTG *	Verified Net Peak Demand Reduction (kW)
Hot Water	Heat Pump Water Heater	0.82	0.98	0.80	0.76	0.61
HVAC	Advanced Thermostat	344.17	0.93	318.56	NA‡	318.56
HVAC	Air Source Heat Pump	9.99	0.97	9.71	0.57	5.53
HVAC	Central Air Conditioning	1,805.18	1.03	1,861.41	0.69	1,284.37
HVAC	Ductless Heat Pump	29.38	1.07	31.45	0.68	21.39
HVAC	ECM Furnace Motor - Factory Installed	2,197.68	1.00	2,207.94	0.68	1,501.40
HVAC	ECM Furnace Motor - Retrofit	19.91	1.02	20.25	0.80	16.20
HVAC	Ground Source Heat Pump	36.90	0.56	20.60	0.59	12.15
	Total	**4,444.03**	**1.01**	**4,470.71**		**3,160.21**

* A deemed value. Source: ComEd_NTG_History_and_PY10_Recommendations_2017-03-01.xlsx, which is to be found on the IL SAG web site here: http://ilsag.info/net-to-gross-framework.html.
‡ The IL TRM algorithm calculates net savings for advanced thermostats.
Source: ComEd tracking data and Navigant team analysis.

Table 5-4. CY2018 Energy Savings by Measure – Gas

End Use Type	Research Category	Ex Ante Gross Savings	Verified Gross Realization Rate	Verified Gross Savings	NTG *	Verified Net Savings	Effective Useful Life
Hot Water	Heat Pump Water Heater	0		0	0.76	0	13.0
HVAC	Advanced Thermostat	229,434	0.93	214,057	NA‡	214,057	10.0
HVAC	Air Source Heat Pump	0		0	0.57	0	18.0
HVAC	Central Air Conditioning	0		0	0.69	0	18.0
HVAC	Ductless Heat Pump	150,026	0.90	134,597	0.68	91,526	18.0
HVAC	ECM Furnace Motor - Factory Installed	0		0	0.68	0	20.0
HVAC	ECM Furnace Motor - Retrofit	0		0	0.80	0	20.0
HVAC	Ground Source Heat Pump	0		0	0.59	0	25.0
	Total Therms	**379,459**	**0.92**	**348,654**		**305,583**	
	Total kWh Converted from Therms†	**11,121,957**	**0.92**	**10,219,046**		**8,956,632**	

* A deemed value. Source: ComEd_NTG_History_and_PY10_Recommendations_2017-03-01.xlsx, which is to be found on the IL SAG web site here: http://ilsag.info/net-to-gross-framework.html.
† Gas savings converted to kWh by multiplying therms * 29.31 (which is based on 100,000 Btu/therm and 3,412 Btu/kWh).
‡ The IL TRM algorithm calculates net savings for advanced thermostats.
Source: ComEd tracking data and Navigant team analysis.

Table 5-5. CY2018 Energy Savings by Measure – Total Combining Electricity and Gas

End Use Type	Research Category	Ex Ante Gross Savings (kWh)	Verified Gross Realization Rate	Verified Gross Savings (kWh)	NTG *	Verified Net Savings (kWh)
Hot Water	Heat Pump Water Heater	17,235	0.98	16,823	0.76	12,785
HVAC	Advanced Thermostat	7,846,338	0.94	7,396,275	NA‡	7,396,275
HVAC	Air Source Heat Pump	369,326	1.07	396,130	0.57	225,794
HVAC	Central Air Conditioning	2,849,916	1.03	2,923,771	0.69	2,017,402
HVAC	Ductless Heat Pump	5,495,895	0.92	5,077,945	0.68	3,453,003
HVAC	ECM Furnace Motor - Factory Installed	7,337,282	1.00	7,349,294	0.68	4,997,520
HVAC	ECM Furnace Motor - Retrofit	66,046	1.01	66,442	0.80	53,154
HVAC	Ground Source Heat Pump	113,009	0.76	85,967	0.59	50,721
	Total†	**24,095,047**	**0.97**	**23,312,647**		**18,206,653**

* A deemed value. Source: ComEd_NTG_History_and_PY10_Recommendations_2017-03-01.xlsx, which is to be found on the IL SAG web site here: http://ilsag.info/net-to-gross-framework.html.
† The total includes the electric equivalent of the total therms.
‡ The IL TRM algorithm calculates net savings for advanced thermostats.
Source: ComEd tracking data and Navigant team analysis.

6. IMPACT ANALYSIS FINDINGS AND RECOMMENDATIONS

6.1 Impact Parameter Estimates

Navigant calculated verified gross and net program impacts for the above seven measures. These measures account for all quantifiable CY2018 electric savings. Navigant calculated verified gross energy and demand savings using the algorithms in the Illinois TRM, version 6. The following table presents the deemed input parameter source that Navigant used by measure. The Illinois TRM v6.0 allows for custom or actual values to be used for some of the input parameters. Navigant based these values on the program tracking database when available.

Navigant calculated verified net energy and demand (coincident peak and overall) savings by multiplying the verified gross savings estimates by a net-to-gross ratio (NTG). In CY2018, the Illinois Stakeholder Advisory Group (IL SAG) defined NTG estimates used to calculate net verified savings[3].

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[3] Source: ComEd_NTG_History_and_PY10_Recommendations_2017-03-01.xlsx, which is to be found on the IL SAG web site here: http://ilsag.info/net-to-gross-framework.html.

Table 6-1. Savings Parameters

Gross Savings Input Parameters	Value	Units	Deemed * or Evaluated?	Source
Quantity	Varies	# measures	Evaluated	ComEd Tracking Data and Navigant Evaluation
NTG	Varies		Deemed	IL SAG Consensus†
Heat Pump Water Heat	Varies	Each	Deemed	IL TRM v6.0 – Section 5.4.03
Advanced Thermostat	Varies	Each	Deemed	IL TRM v6.0 – Section 5.3.16
Air Source Heat Pump	Varies	Each	Deemed	IL TRM v6.0 – Section 5.3.01
Ductless Heat Pump	Varies	Each	Deemed	IL TRM v6.0 – Section 5.3.12
Central Air Conditioning	Varies	Each	Deemed	IL TRM v6.0 – Section 5.3.03
Furnace Blower Motor	Varies	Each	Deemed	IL TRM v6.0 – Section 5.3.05
Ground Source Heat Pump	Varies	Each	Deemed	IL TRM v6.0 – Section 5.3.08

* State of Illinois Technical Reference Manual version 6.0 from http://www.ilsag.info/technical-reference-manual.html.
† A deemed value. Source: ComEd_NTG_History_and_PY10_Recommendations_2017-03-01.xlsx, which is to be found on the IL SAG web site here: http://ilsag.info/net-to-gross-framework.html.

6.2 Other Impact Findings and Recommendations

The evaluation team has developed several recommendations based on findings from the CY2018 evaluation listed below. Some of the measure-level findings by Navigant were addressed by the implementer in the CY2018 Wave 1 analysis but not corrected for by the implementer in the end of year analysis. This resulted in several repeat findings and recommendations from the CY2018 Wave 1 analysis.

6.2.1 Air Source Heat Pumps

Finding 1. The IL TRM specifies separate savings algorithms for Air Source Heat Pumps (ASHPs) "time of sale" projects and "early replacement" projects. There are 29 out of 192 projects that have a non-100% energy realization rate and 10 projects with a non-100% demand realization rate. This is due to Navigant and the implementer designating projects differently if they are "early replacement" or "time of sale". This was addressed in PY9; the implementer provided methodology to determine early replacement in their data validations workbook. For example, an ASHP project is deemed "early replacement" if:

- the existing cooling unit is operational,
- the existing unit Seasonal Energy Efficiency Ratio (SEER) is ≤10,
- the existing unit is <18 years of age,
- and the unit does not need repairs or only needs minor repairs.

Navigant used this methodology, yet there are projects that Navigant still has designated differently than the implementer. One potential reason for the savings discrepancies found in these projects which do not produce a realization rate of 100% is that Navigant and the implementer are handling missing values differently. See below for specific project examples:

- EA-0001058150: Navigant and implementer both designated the cooling side savings as "early replacement". However, Navigant calculated heating side savings as early replacement when the implementer calculated it as "time of sale". For this particular project, the existing heating type was an operational air source heat pump which

didn't need repairs, but the Existing_Heating_System_Age was missing. Navigant populated this with a value of eight years, which was the average age from CY2018 Wave 1 data. This discrepancy resulted in a 300% energy realization rate.

- EA-0002233394: Navigant and the implementer both designated the cooling side savings as "time of sale". However, Navigant calculated heating side savings as "time of sale" because the Existing_Heating_System_Condition is "No". However, the implementer calculated heating savings as "early replacement". This resulted in a 15% energy realization rate.

Recommendation 1. Navigant recommends the implementer calculate energy and demand savings using the proper IL TRM savings algorithm with regards to "time of sale" and "early replacement" ASHP projects. Navigant also requests explanation as to why the implementer uses "time of sale" and "early replacement" distinction logic that differs from the IL TRM.

6.2.2 Central Air Conditioners

Finding 2. The IL TRM specifies separate savings algorithms for Central Air Conditioners (CACs) "time of sale" projects and "early replacement" projects. There are a total of 672 out of 8,912 CY2018 CAC projects that have both energy and demand non-100% realization rates. Of the 672 projects, there are 239 projects that Navigant calculated as "time of sale" when the implementer calculated them as "early replacement". This resulted in realization rates less than 100%. The remaining 433 projects with non-100% realization rates occur when Navigant calculated them as "early replacement" and the implementer calculated them as "time of sale". This resulted in realization rates greater than 100%. Below are example project IDs where this occurred:

- EA-0000024126. Navigant designated this project as "time of sale" when the implementer designated it as "early replacement". This resulted in an energy realization rate of 31%. This project had an "Existing_Cooling_System_Type" of Central Air Conditioner that was operational, but it was 27 years old. This deemed it time of sale.
- EA-0000114984. Navigant designated this project as "time of sale" when the implementer designated it as "early replacement". This resulted in an energy realization rate of 38%. This project had an "Existing_Cooling_System_Type" of Central Air Conditioner that was operational, but it was 20 years old. This deemed it time of sale.
- EA-0000075393. Navigant designated this project as "early replacement" when the implementer designated it as "time of sale". This resulted in an energy realization rate of 325%. This project had an "Existing_Cooling_System_Type" of Central Air Conditioner that operation and didn't need repairs. The age and SEER of the existing equipment were missing.

Recommendation 2. Navigant recommends the implementer calculate the energy and demand savings using the proper IL TRM savings algorithm with regards to "time of sale" and "early replacement" ASHP projects.

Finding 3. There are 338 out of 8,912 projects with negative demand savings from the implementer. These negative savings occur when a project is classified as "time of sale", but the new energy efficient equipment's EER is less efficient than the IL TRM baseline EER. If the IL TRM v6.0 logic is used to designate "early replacement" versus "time of sale", at least 131 of these projects would be early replacement and result in positive demand savings. Example projects with negative demand savings include:

- EA-0000486994
- EA-0000474275
- EA-0000583010

Recommendation 3. Navigant recommends the implementer calculate the energy and demand savings using the proper IL TRM savings algorithm with regards to "time of sale" and "early replacement" ASHP projects.

6.2.3 Ductless Mini-Split Heat Pumps

Finding 4. There were 12 Ductless Mini-Split Heat Pump (DMSHP) projects out of 351 that the implementer did not calculate demand savings for. These projects had "none" as the existing cooling type, so the EER_{exist} was 0 and the EER_{base} was 11. It is assumed that the implementer classified these projects as "early replacement" and did not calculate demand savings because it results in an undefined demand savings value when $EER_{exist} = 0$ in the denominator of the following equation:

Equation 1. DMSHP Early Replacement Demand Calculation

$$\Delta kW = Capacity_{cool} * (1/EER_{exist} - 1/EER_{ee})) / 1000) * CF$$

The IL TRM v6.0 states the $1/EER_{exist}$ value becomes equal to 0 in this situation, thus resulting in negative ΔkW values.

Recommendation 4. Navigant recommends that the implementer account for the negative cooling demand savings for early replacement projects with "none" as the "Existing_HVAC_Type". Regarding the $1/EER_{exist}$ values, section 5.3.12 reference 427 in the IL TRM v6.0 states that, "If there is no existing cooling in place but the incentive encourages installation of a new DMSHP with cooling, the added cooling load should be subtracted from any heating benefits". Furthermore, Navigant recommends designating projects that have "none" as the existing cooling type to be "time of sale" to align with the guidance provided in the implementer's data validations workbook.

Finding 5. There are 48 out of 351 DMSHP projects with non-100% demand realization rates and 156 DMSHP projects with non-100% energy realization rates. Like other measures in this program, this discrepancy could be caused by Navigant and the implementer designating "time of sale" and "early replacement" measure using different logic.

Recommendation 5. Navigant recommends calculating the energy and demand savings using the proper IL TRM savings algorithm with regards to "time of sale" and "early replacement" ductless heat pump projects.

Finding 6. Navigant forced seven projects to heating type as "time of sale" because ComEd provided further AFUE information in the notes in the tracking data. This resulted in 100% energy and demand realization rates for the seven projects. If it weren't for the ComEd provided notes on AFUE, Navigant would have calculated the heating type as "early replacement". The project IDs were:
- EA-0002586323
- EA-0002390978
- EA-0002390978
- EA-0002679730
- EA-0002586323
- EA-0003462939
- EA-0002596151

Recommendation 6. Navigant recommends the implementer provide AFUE information in the tracking data and not in tracking data notes.

6.2.4 ECM Furnace Motor

Finding 7. There are 214 out of 10,248 ECM Furnace Motor projects that have energy and demand realization rates greater than 100%. Of these projects, 175 have "Other" listed as the "Existing_Cooling_System_Type", and the implementer treats these projects as having "No central AC" when Navigant treats "Other" cooling system as "Unknown". The other 39 projects with realization rates greater than 100% are those that have "Central AC" as the "Existing_Cooling_System_Type", but the implementer calculates them using "Unknown" savings values.

Recommendation 7. Navigant recommends the implementer treat the existing cooling system of "Other" as "Unknown" and consistently calculating cooling savings per the IL TRM v6.0 for Central AC systems as Central AC.

6.2.5 Geothermal Heat Pump

Finding 8. Energy realization rates are less than 100% for five out of 15 Geothermal Heat Pump projects. These five projects have an "Existing_HVAC_Type" as a ground or air source heat pump. Navigant was unable to isolate the source of the discrepancies causing the difference between the ex ante and verified savings for these Geothermal Heat Pump measures. Navigant reviewed the algorithms the implementer used and agrees with the savings equations, leading Navigant to believe the discrepancies stem from difference in variable inputs rather than the savings algorithms themselves. There are four variables that are determined by the "Existing_HVAC_Type". Table 6-2 displays the four variables and the corresponding values Navigant used associated with the "Existing_HVAC_Types" of interest. Navigant obtained deemed values from the IL TRM v6.0 where possible unless they're not provided. In which case, the IL TRM v7.0 was referenced and denoted.

Table 6-2. Variable Inputs Specific to "Existing_HVAC_Type"

Variable	Air Source Heat Pump	Ground Source Heat Pump
$SEER_{base}$	14	13*
$SEER_{exist}$	9.12	10*
EER_{base}	11.8	13.4*
EER_{exist}	8.55	11*

* State of Illinois Technical Reference Manual version 7.0 from http://www.ilsag.info/technical-reference-manual.html.

Recommendation 8. Navigant recommends that the implementer provide the variable values listed in Table 6-2 when the "Existing_HVAC_Type" is Air Source Heat Pump or Ground Source Heat Pump.

Finding 9. Navigant found that the implementer likely used the summer system peak coincidence factor (CF_{SSP}) of 72% rather than the Pennsylvania-New Jersey-Maryland coincidence factor (CF_{PJM}) of 46.6% for all projects which resulted in total demand realization rate of 56%.

Recommendation 9. Navigant recommends that the CF_{PJM} is used to calculate demand savings for all geothermal heat pump projects.

6.2.6 Heat Pump Water Heaters

Finding 10. One Heat Pump Water Heater project, EA-0003033041-MLI-3100219, out of eight total projects, had a realization rate of 82% for energy and demand savings. This project was marked as a multi-family home. Navigant calculated savings based on multi-family home

assumptions. However, it is likely that the implementer calculated savings as if it were a single-family home. When the household value is changed from 2.10 (multi-family) to 2.56 (single family) the realization rates increase to 100%.

Recommendation 10. Navigant recommends that project savings be calculated based on the household type specified in the tracking data.

6.2.7 Smart Thermostats

Finding 11. For all smart thermostat projects that have a "Dwelling_Type" of "Multi-Family Home" the implementer uses a "New_System_Capacity_Cooling" of 21,840 Btu/hr. Navigant uses cooling capacity value of 28,000 Btu/hr when the dwelling type is "Multi-Family Home". The only guidance the IL TRM v6.0 provides with regards to cooling capacity is to use the actual collected cooling capacity or use 33,600 for a single-family home if the cooling capacity is unknown. Navigant obtained the value of 28,000 Btu/hr from the IL TRM v7.0 which does provide a default value for an unknown cooling capacity in a multi-family home[4].

Recommendation 11. Navigant recommends using the cooling capacity of 28,000 Btu/hr for "Unknown" multi-family homes per the IL TRM v7.0.

Finding 12. The EM&V team found that if the "Thermostat_Replacing" was "unknown," a value of 1 was assumed for the percentage of AC. Navigant assumed 0.87 for the percentage of AC with an unknown existing thermostat type per the IL TRM v6.0.

Recommendation 12. Navigant recommends the implementer assume the percentage of AC to be 0.87 when the existing thermostat is "unknown".

Finding 13. The EM&V team found that for 17% of the projects (a total of 788 projects) that the demand realization rate was 69%. This is because the implementer likely used the CF_{SSP} of 34% rather than the CF_{PJM} of 23.3%.

Recommendation 13. Navigant recommends that the CF_{PJM} is used to calculate demand savings for all advanced thermostat projects.

Finding 14. The EM&V team found that for the two projects that had an "Existing_HVAC_type" of "Electric Resistance Heat (No Central Air Conditioner)" the electric energy realization rates were less than 100%. Table 6-3 specifies the inputs Navigant used to calculate savings.

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[4] Source: Discussed in an email sent to ComEd on 09/25/2018, "0.65 MF Household Factor".

Table 6-3. Navigant Algorithm Inputs for Selected Projects

Variable	Project ID: EA-0002881919	Project ID: EA-0003168827
Existing_HVAC_Type	Electric Resistance Heat (No Central Air Conditioner)	Electric Resistance Heat (No Central Air Conditioner)
Dwelling_Type	Single-Family Home	Single-Family Home
%ElectricHeat	0.065	0.065
Electric Heating Consumption	20771	20771
Heat Reduction	0.088	0.088
HF	1	1
Eff_ISR	1	1
Fe	0.0314	0.0314
%AC	1	1
FLH	512	570
Cooling Capacity	33600	33600
SEER	1	1
Cooling Reduction	0.08	0.08
EER	1	1
CF	0.233	0.233
kWh Ex Ante Savings	1827.848	1827.848
kW Realization Rate	63%	63%
kWh Realization Rate	86%	94%

Recommendation 14. Navigant recommends the implementer reconcile their values with Table 6-3 or provide their inputs to Navigant.

Finding 15. Navigant found that the realization rate for gas savings was 93% because Navigant caps the thermostat savings for a household at one thermostat per IL TRM v6.0. Those residences that have multiple thermostats do not receive additional savings.

Recommendation 15. Navigant recommends that the implementer only calculates savings for one thermostat per household.

6.2.8 Miscellaneous

Finding 16. Navigant noted that eight geothermal projects and 3,695 standard HVAC projects had installation dates in 2017. The implementer calculated savings for these projects using the IL TRM v5.0, due to the timing of the rebate application process. Navigant used the IL TRM v6.0, because these measures are a part of the 2018 program.

Recommendation 16. Navigant recommends that the implementer calculates savings using the applicable IL TRM version (v6.0 for CY2018) regardless of installation date.

7. APPENDIX 1. IMPACT ANALYSIS METHODOLOGY

7.1 Verified Gross Program Savings Analysis Approach

Navigant determined verified gross savings for each program measure by:

1. Reviewing the savings algorithm inputs in the measure workbook for agreement with the IL TRM v6.0.
2. Validating that the savings algorithm was applied correctly.
3. Cross-checking per-unit savings values in the tracking data with the verified values in the measure workbook or in Navigant's calculations if the workbook did not agree with the IL TRM.
4. Multiplying the verified per-unit savings value by the quantity reported in the tracking data.

7.2 Verified Net Program Savings Analysis Approach

Navigant calculated verified net energy and demand (coincident peak and overall) savings by multiplying the verified gross savings estimates by a net-to-gross (NTG) ratio. In CY2018, the NTG estimates used to calculate the net verified savings were based on past evaluation research and defined by a consensus process through the Illinois Stakeholder Advisory Group (SAG).

8. APPENDIX 2. IMPACT ANALYSIS DETAIL

Navigant downloaded the final tracking data and measure workbook for the CY2018 impact evaluation from the ComEd Evaluation Share file site. Navigant relied on the following documents to verify the per-unit savings for each program measure:

- Final CY2018 tracking database files:
  - HVAC: "HVAC_2018_EOY_Data_Rev2_02062019.xlsx"
  - Geothermal Heat Pumps: "GEO_2018_EOY_Data_Rev0_01172019.xlsx"
- Illinois Technical Reference Manual (IL TRM v6.0) for deemed input parameters or secondary evaluation research to verify any custom inputs used in the ex ante calculations.

The following sections provide an outline of the differences between the ex ante and verified savings estimates for each measure by end-use. Each section contains a table that provides the quantity installed[5], ex ante and verified ex post values, and realization rates.

8.1 Air Source Heat Pump

Air source heat pumps had an electric energy realization rate of 107% and accounted for 2% of the HVAC Rebate's overall verified gross energy savings. There were four project types associated with Air Source Heat Pumps, early retirement and time of sale on both the heating and cooling side. This resulted in four different scenarios of savings calculations. The high realization rate for early retirement projects was due to the implementer calculating several projects as time of sale, and the low realization rate for time of sale projects is from the implementer calculating some as early replacement.

Table 8-1. Air Source Heat Pump Measure Impact Detail

Measure	Project Type	Quantity	Ex Ante Gross Savings (kWh)	Verified Gross Savings (kWh)	Verified Gross kWh Realization Rate
ASHP	Early Replacement, Cooling Early Replacement, Heating	17	88,437	122,454	138%
ASHP	Early Replacement, Cooling Time of Sale, Heating	16	32,938	34,561	105%
ASHP	Time of Sale, Cooling Early Replacement, Heating	15	35,900	68,470	191%
ASHP	Time of Sale, Cooling Time of Sale, Heating	144	212,051	170,645	80%
ASHP	Total	192	369,326	396,130	107%

Source: ComEd tracking data and Navigant team analysis.

8.2 Central Air Conditioners

Central Air Conditioners (CAC) had an electric energy realization rate of 103% and accounted for 13% of the HVAC Rebate's overall verified gross energy savings. There were time of sale and early replacement CAC project types implemented in CY2018. The project type determined which savings algorithm was used to calculate energy savings. The incorrect project type was applied to several projects which resulted in a higher overall realization rate.

Table 8-2. Central Air Conditioners Measure Impact Detail

Measure	Project Type	Quantity	Ex Ante Gross Savings (kWh)	Verified Gross Savings (kWh)	Verified Gross kWh Realization Rate
CAC	Early Replacement	1,423	838,604	1,032,175	123%
CAC	Time of Sale	7,489	2,011,312	1,891,595	94%
CAC	Total	8,912	2,849,916	2,923,770	103%

Source: ComEd tracking data and Navigant team analysis.

8.3 Ductless Mini-Split Heat Pumps

Ductless Mini-Split (DMS) Heat Pumps (DMSHP) had an electric energy realization rate of 103% and accounted for 22% of the HVAC Rebate's overall verified gross energy savings. There were eight different scenarios used to calculate savings for DMSHPs dependent on if savings were for cooling or

heating, time of sale or early retirement, and if a fuel switch was involved or not in the installation of new equipment. A realization rate greater than 100% shown in Table 8-3 is caused by Navigant calculating projects as early replacement when the implementer calculated them as time of sale. Conversely, a realization rate less than 100% is from Navigant calculating projects using time of sale algorithms when the implementer calculated savings using early retirement algorithms.

Table 8-3. DMS Heat Pumps Measure Impact Detail

Measure	Project Type	Quantity	Ex Ante Gross Savings (kWh)	Verified Gross Savings (kWh)	Verified Gross kWh Realization Rate
DMS	Early Replacement, Cooling, Fuel Switch Early Replacement, Heating, Fuel Switch	38	16,213	45,485	281%
DMS	Early Replacement, Cooling, Fuel Switch Time of Sale, Heating, Fuel Switch	1	812	812	100%
DMS	Time of Sale, Cooling Early Replacement, Heating	6	11,981	26,185	219%
DMS	Time of Sale, Cooling, Fuel Switch Time of Sale, Heating, Fuel Switch	70	53,309	83,073	156%
DMS	Early Replacement, Cooling Early Replacement, Heating	10	31,397	33,192	106%
DMS	Early Replacement, Cooling Time of Sale, Heating	18	159,348	159,479	100%
DMS	Time of Sale, Cooling, Fuel Switch Early Replacement, Heating, Fuel Switch	27	10,784	34,070	316%
DMS	Time of Sale, Cooling Time of Sale, Heating	181	814,797	750,605	92%
DMS	Total	351	1,098,642	1,132,902	103%

Source: ComEd tracking data and Navigant team analysis.

8.4 ECM Furnace Motors

ECM Furnace motors had an overall electric energy realization rate of 100% and contributed to 32% of the HVAC Rebate's overall verified gross energy savings. Verified savings deviate from the ex ante savings when the Existing_Cooling_System_Type is "Other". Additionally, the Existing_Cooling_System_Type of "Central AC" has a realization rate of 100%, but the verified gross savings is greater than the ex ante savings due to a few projects described in Section 6.2.4.

Table 8-4. ECM Measure Impact Detail

Measure	Existing_Cooling _System_Type	Quantity	Ex Ante Gross Savings (kWh)	Verified Gross Savings (kWh)	Verified Gross kWh Realization Rate
ECM	Central AC	6,348	4,645,878	4,646,736	100%
ECM	Other	176	113,410	124,960	110%
ECM	Unknown	2,917	2,071,070	2,071,070	100%
ECM	NA	807	572,970	572,970	100%
ECM	Total	10,248	7,403,328	7,415,736	100%

Source: ComEd tracking data and Navigant team analysis.

8.5 Geothermal Heat Pump

Geothermal heat pumps (GHP) had an energy realization rate of 76% and accounted for <1% of the HVAC Rebate Program's overall verified gross energy savings. There were five Existing_Cooling_System_Types for GHP projects. The realization rate was 100% for all existing cooling system types except for when the existing cooling type was an air or ground source heat pump. Further detail is provided in Section 6.2.5.

Table 8-5. Geothermal Heat Pump Measure Impact Detail

Measure	Existing_Cooling_System_Type	Quantity	Ex Ante Gross Savings (kWh)	Verified Gross Savings (kWh)	Verified Gross kWh Realization Rate
GHP	Air Source Heat Pump	1	9,608	5,373	56%
GHP	Central Air Conditioner	5	29,799	29,799	100%
GHP	Ground Source Heat Pump	4	45,223	22,416	50%
GHP	New Construction	4	22,526	22,526	100%
GHP	None	1	5,853	5,853	100%
GHP	Total	15	113,009	85,967	76%

Source: ComEd tracking data and Navigant team analysis.

8.6 Heat Pump Water Heater

Heat Pump Water Heaters had a realization rate of 98% and accounted for <1% of the HVAC Rebate's overall verified gross energy savings. The electric energy realization rate is 98% because of one multi-family project detailed in Section 6.2.6.

Table 8-6. Heat Pump Water Heater Measure Impact Detail

Measure	Dwelling_Type	Quantity	Ex Ante Gross Savings (kWh)	Verified Gross Savings (kWh)	Verified Gross kWh Realization Rate
HPWH	Multi-Family Home	1	2,294	1,882	82%
HPWH	Single-Family Home	7	14,940	14,940	100%
HPWH	Total	8	17,235	16,823	98%

Source: ComEd tracking data and Navigant team analysis.

8.7 Smart Thermostats

Smart Thermostats had an electric energy realization rate of 100% and accounted for 32% of the HVAC Rebate's overall verified gross energy savings. One finding that contributed to the 104% electric energy realization rate for multi-family homes was the difference in default values for cooling capacity of a multi-family home, further detailed in Section 6.2.7. The 99% realization rate for single-family homes can be attributed to Navigant using 87% as the percent AC when the existing thermostat is unknown and the implementer using 100% as the percent AC. Further details can also be found in Section Smart Thermostats 6.2.7.

Table 8-7. Smart Thermostats Measure Impact Detail

Measure	Dwelling_Type	Quantity	Ex Ante Gross Savings (kWh)	Verified Gross Savings (kWh)	Verified Gross kWh Realization Rate
ST	Multi-Family Home	337	164,938	171,173	104%
ST	Single-Family Home	4,264	956,695	951,099	99%
ST	Total	4,601	1,121,634	1,122,273	100%

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	Ex Ante Gross Savings (kWh)	Ex Ante Gross Peak Demand Reduction (kW)	Verified Gross Savings (kWh)	Verified Gross Peak Demand Reduction (kW)	NTG*	Verified Net Savings (kWh)	Verified Net Peak Demand Reduction (kW)
Hot Water	Heat Pump Water Heater	Each	8	13.0	17,235	0.82	16,823	0.80	0.76	12,785	0.61
HVAC	Advanced Thermostat	Each	4,601	10.0	1,121,633	344.17	1,122,272	318.56	NA‡	1,122,272	318.56
HVAC	Air Source Heat Pump	Each	192	18.0	369,326	9.99	396,130	9.71	0.57	225,794	5.53
HVAC	Central Air Conditioning	Each	8,912	18.0	2,849,916	1,805.18	2,923,771	1,861.41	0.69	2,017,402	1,284.37
HVAC	Ductless Heat Pump	Each	351	18.0	1,098,642	29.38	1,132,901	31.45	0.68	770,373	21.39
HVAC	ECM Furnace Motor - Factory Installed	Each	10,156	20.0	7,337,282	2,197.68	7,349,294	2,207.94	0.68	4,997,520	1,501.40
HVAC	ECM Furnace Motor - Retrofit	Each	92	20.0	66,046	19.91	66,442	20.25	0.80	53,154	16.20
HVAC	Ground Source Heat Pump	Each	15	25.0	113,009	36.90	85,967	20.60	0.59	50,721	12.15

Source: ComEd tracking data and Navigant team analysis.