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ComEd Home Energy Assessment Combined Evaluation Report

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

Presented to
ComEd

February 14, 2019

Prepared by:

Navigant

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ComEd Home Energy Assessment Combined Evaluation Report

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	Jeff Erickson, Director	Patricia Plympton, Associate Director
312.583.5714	608.497.2322	202.253.9356
Randy.Gunn@Navigant.com	Jeff.Erickson@Navigant.com	Patricia.Plympton@Navigant.com

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1. INTRODUCTION

This report combines the key deliverables from the evaluation of the Home Energy Assessment Program for PY9. Each of these deliverables were drafted, reviewed and finalized during the course of the PY9 evaluation.

APPENDIX A. COMED PY9 HEA IMPACT EVALUATION REPORT 2018-04-17 FINAL

NAVIGANT

ComEd Home Energy Assessment Impact Evaluation Report

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

Presented to
ComEd

FINAL

April 17, 2018

Prepared by:

Christine Zook
Navigant

Jennifer Ma
Navigant

www.navigant.com

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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 Home Energy Assessments (HEA) 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 method. PY9 covers June 1, 2016 through December 31, 2017.

2. PROGRAM DESCRIPTION

The HEA program is an assessment and direct install program jointly implemented by ComEd and Peoples Gas and North Shore Gas (PGL/NSG) with Franklin Energy Services implementing the program in the PGL/NSG territory. The program is also jointly implemented by ComEd and Nicor Gas with CLEAResult implementing the program in the Nicor Gas territory. This report focuses solely on the electric savings from the program. Savings from natural gas measures are included in separate evaluation reports. The primary objective of this residential direct install program was to secure energy savings through direct installation of low-cost efficiency measures such as: water efficient showerheads and faucet aerators, pipe insulation, programmable thermostats, reprogramming programmable thermostats, co-pay smart thermostats, advanced power strips (APS), compact florescent lamps (CFLs), and LEDs at eligible single-family residences.

The secondary objective of this program was to function as the "gateway" for homeowners to participate in other residential programs. HEA performs a brief assessment of the major retrofit opportunities (e.g., furnace, boiler, air conditioning, insulation, and air sealing) and brings heightened awareness to the homeowners about efficiency programs offered by ComEd, Peoples Gas, North Shore Gas, and Nicor Gas.

In PY9, the program had 23,278 participants, performed 23,907 unique projects, performed 23,736 assessments and installed 664,112 measures as shown in the following table and graph.

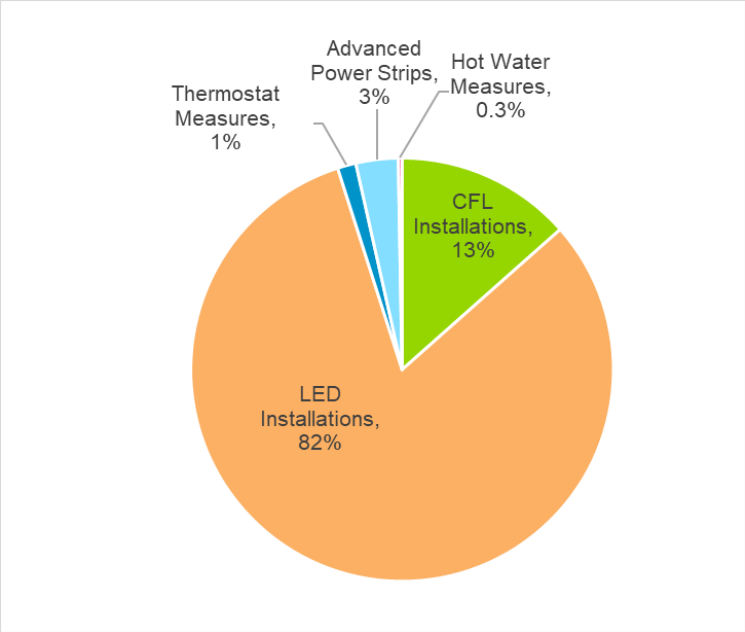
Table 2-1. PY9 Volumetric Findings Detail

Participation	Franklin Energy in PGL NSG Territory	CLEAResult in Nicor Gas Territory	Program Overall
Participants*	12,801	10,482	23,278
Unique Projects†	13,262	10,645	23,907
Assessments	13,194	10,542	23,736
Total Measures	383,688	280,424	664,112
Number of Units/Project	28.9	26.3	27.8
Direct Install Measures (non-CFLs or LEDs)	22,010	10,755	32,765
CFL Installations	56,165	33,269	89,434
LED Installations	305,513	236,400	541,913
Programmable Thermostats	2,663	1,044	3,707
Reprogramming Thermostats/Thermostat Education	2,654	931	3,585
Smart Thermostats	1,076	1,032	2,108
Bathroom Faucet Aerator	133	357	490
Kitchen Faucet Aerator	56	101	157
Pipe Insulation	262	396	658
Showerheads	171	409	580
APS – Tier 1	6,828	2,518	9,346
APS – Tier 2	8,167	3,967	12,134

* Participants are defined as unique ComEd account numbers
† Unique Projects are defined as unique Project ID's
Source: ComEd tracking data and Navigant team analysis.

Figure 2-1 shows measure installations by type.

Figure 2-1. Distribution of Measures Installed by Type



Source: Evaluation Analysis

3. Program Savings

Table 3-1 summarizes the incremental energy and demand savings the HEA 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	30,797,725	NA	4,284
Program Gross Realization Rate	100%	NA	84%
Verified Gross Savings	30,688,042	31,337	3,581
Program Net-to-Gross Ratio (NTGR)	Varies	Varies	Varies
Verified Net Savings	25,223,277	25,316	2,983

Source: ComEd tracking data and Navigant team analysis.

4. Program Savings by Measure

The following tables show energy savings, demand savings, and coincidence peak demand savings by measure group. In PY9, the program included 12 measures with savings. LED and CFL installations had 21 individual measures with distinct baseline fixtures, retrofit fixtures, and installation locations. LED installations contributed most of the savings at 77 percent, followed by APS Tier 1 and Tier 2 combined at 11 percent, and CFL installations at eight percent.

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)†
Lighting	CFL Installations	2,321,762	100%	2,316,461	0.80	1,853,169	NA	NA	4
Lighting	LED Installations	23,706,616	100%	23,648,986	0.80	18,919,189	NA	NA	11
HVAC	Programmable Thermostats	270,826	90%	244,440	0.90	219,996	10	50%	5
HVAC	Reprogramming Thermostats	165,324	93%	153,637	0.90	138,273	5	40%	2
HVAC	Thermostat Education	88,948	91%	80,806	0.90	72,726	5	40%	2
HVAC	Smart Thermostats	496,428	99%	491,696	NA‡	491,696	NA	NA	10
Hot Water	Bathroom Faucet Aerator	7,965	118%	9,359	0.80	7,487	NA	NA	9
Hot Water	Kitchen Faucet Aerator	20,520	90%	18,480	0.80	14,784	NA	NA	9
Hot Water	Pipe Insulation	17,856	87%	15,617	0.80	12,494	NA	NA	15
Hot Water	Showerheads	190,240	104%	197,782	0.80	158,226	NA	NA	10
Electronics	APS - Tier 1	962,741	100%	962,638	0.95	914,506	NA	NA	4
Electronics	APS - Tier 2	2,548,500	100%	2,548,140	0.95	2,420,733	NA	NA	7
	Total§	30,797,725	100%	30,688,042	Varies	25,223,277			

* 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.
† EUL is a combination of technical measure life and persistence.
‡ The IL TRM algorithm calculates net savings for smart thermostats.
§ Values may not add 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)
Lighting	CFL Installations	NA*	NA	3,051	0.80	2,440
Lighting	LED Installations	NA	NA	25,387	0.80	20,309
HVAC	Programmable Thermostats	NA	NA	NA	0.90	NA
HVAC	Reprogramming Thermostats	NA	NA	0	0.90	0
HVAC	Thermostat Education	NA	NA	0	0.90	0
HVAC	Smart Thermostats	NA	NA	695	NA‡	695
Hot Water	Bathroom Faucet Aerator	NA	NA	554	0.80	443
Hot Water	Kitchen Faucet Aerator	NA	NA	214	0.80	171
Hot Water	Pipe Insulation	NA	NA	2	0.80	1
Hot Water	Showerheads	NA	NA	718	0.80	574
Electronics	APS - Tier 1	NA	NA	135	0.95	128
Electronics	APS - Tier 2	NA	NA	582	0.95	553
	Total§	NA	NA	31,337	Varies	25,316

*Implementation contractors did not report ex ante gross demand reduction.
†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 IL TRM algorithm calculates net savings for smart thermostats.
§ Values may not add due to rounding.
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)
Lighting	CFL Installations	228	99%	226	0.80	181
Lighting	LED Installations	2,562	101%	2,581	0.80	2,065
HVAC	Programmable Thermostats	691	NA	NA	0.90	NA
HVAC	Reprogramming Thermostats	0	NA	0	0.90	0
HVAC	Thermostat Education	0	NA	0	0.90	0
HVAC	Smart Thermostats	199	81%	162	NA†	162
Hot Water	Bathroom Faucet Aerator	12	98%	12	0.80	10
Hot Water	Kitchen Faucet Aerator	5	98%	5	0.80	4
Hot Water	Pipe Insulation	2	86%	2	0.80	1
Hot Water	Showerheads	17	115%	20	0.80	16
Electronics	APS - Tier 1	108	100%	108	0.95	103
Electronics	APS - Tier 2	460	101%	465	0.95	442
	Total‡	4,284	84%	3,581	Varies	2,983

* 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 IL TRM algorithm calculates net savings for smart thermostats.
‡ Values may not add due to rounding.
Source: ComEd tracking data and Navigant team analysis.

5. Impact Analysis Findings and Recommendations

5.1 Impact Parameter Estimates

Table 5-1 summarizes the parameters and references used in the verified gross and net savings calculations. Navigant calculated savings for each measure following algorithms defined by the Illinois TRM version 5.0 which can be found in Appendix 1.

Table 5-1. Verified Gross Savings Parameters

Research Category	Ex Ante and Verified Gross Savings (kWh/unit)	Deemed or Evaluated?	Source
Quantity	Varies	Evaluated	Program Tracking Data
NTGR	Varies	Deemed	IL SAG Consensus*
CFL Installations	Varies		IL TRM v5.0 - Section 5.5†
LED Installations	Varies		IL TRM v5.0 - Section 5.5†
Programmable Thermostats	Varies		IL TRM v5.0 - Section 5.3.11†
Reprogramming Thermostats/Thermostat Education	Varies		IL TRM v5.0 - Section 5.3.11†
Smart Thermostats	Varies		IL TRM v5.0 - Section 5.3.16†
Bathroom Faucet Aerator	Varies		IL TRM v5.0 - Section 5.4.4†
Kitchen Faucet Aerator	Varies		IL TRM v5.0 - Section 5.4.4†
Pipe Insulation	Varies		IL TRM v5.0 - Section 5.4.1†
Showerheads	Varies		IL TRM v5.0 - Section 5.4.5†
APS – Tier 1	103		IL TRM v5.0 - Section 5.2.1†
APS – Tier 2	210		IL TRM v5.0 - Section 5.2.2†

* 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

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

5.2 Other Impact Findings and Recommendations

The following provides insight into key program findings and recommendations.

Program Participation

Finding 1. In PY9, the program had 23,278 participants, performed 23,907 unique projects, performed 23,736 assessments and installed 664,112 measures. Navigant found that 586 participants who had assessments (2 percent of the assessments) did not have any of the recommended direct install measures installed in their home.

Recommendation 1. Navigant recommends interviewing participants in CY2018 to better understand the reasons why some request the assessment but do not follow through with installing measures to better understand customers' decision-making and decrease the number of home with assessments but no installed measures. In addition, Navigant recommends that the interview include questions about the participants' participation in other ComEd programs as well as other energy reduction steps they may have taken following the assessments.

Tracking System Review

Finding 2. The TRM does not give a concrete definition to distinguish single-family homes from smaller multi-family homes such as duplex, tri-plex, quadplex and households when selecting TRM assumptions for several measures. In the tracking database's measure description, the implementers included identifiers for home types such as two-unit, condo, and triplex. However, the implementers applied single-family input parameters to all home types. To increase the accuracy of the savings associated with these measures, Navigant applied multi-family parameters to home types defined as multi-family, as detailed in Table 7-1[1]. This home type discrepancy affected savings for CFL installations, LED installations,

[1] Per email from Navigant to ComEd "RE: Navigant Request: Res Building Types", 1/29/2018.

programmable thermostats, re-programming thermostats, thermostat education, smart thermostats, aerators, and showerheads.

Recommendation 2. Navigant recommends the implementers follow the Energy Information Administration (EIA)'s definition of single-family and multi-family homes for building types[2]. In 2015, the EIA defined single-detached, single-family and duplex as single-family and two-unit, condo, triplex, quadplex, and five or more units as multi-family.

Verified Gross Impacts and Realization Rate

Finding 3. The PY9 HEA program achieved 30,688,042 kWh of verified gross energy savings. The overall gross program realization rate for energy savings is 100 percent. Although the overall program realization rate is 100 percent, there was some variability in realization rates at the measure level. Recommendations three through 11 summarize the recommendations at the measure level from Appendix 2. Impact Analysis Detail.

Recommendation 3. Navigant recommends the implementers verify that the coincidence factors (CF) for LED candelabra bulbs match the install locations to prevent the use of interior CF values for bulbs installed in exterior locations.
Note: The program resolved this discrepancy mid-PY9.

Recommendation 4. Navigant recommends the implementers update their tracking data savings for LED 15W bulbs to accurately represent the retrofit wattage as 15W instead of 19W.
Note: The program resolved this discrepancy mid-PY9.

Recommendation 5. Navigant recommends the implementers use 40W as the baseline for LED 5W Globe bulbs 350 lumens, which is consistent with the TRM.

Recommendation 6. Navigant recommends the implementer cap thermostat savings at one per single family home when multiple thermostats are installed at different dates.

Recommendation 7. Navigant recommends the implementers do not claim peak demand savings for programmable thermostats. Guidelines in the IL TRM state that summer coincident peak demand savings are not applicable due to there being no savings from cooling during the summer peak period.

Recommendation 8. Navigant recommends the implementers ensure that the baseline shown in the measure name and in the "Baseline" field are consistent for smart thermostat installations to avoid calculating baseline energy using an incorrect baseline thermostat.

Recommendation 9. Navigant recommends the implementer ensure that cooling system information shown in the "Cooling_System_Type" field of the tracking data is consistent with the requirements for smart thermostat installations to avoid miscalculation of smart thermostat coincident peak demand savings.

Recommendation 10. Navigant recommends both implementers use CF_{PJM} to calculate smart thermostat peak demand savings to support ComEd's PJM compliance requirements.

Recommendation 11. Navigant recommends the implementers make sure that R_new values for "Pipe Insulation – Electric" measures are recorded as 3.8 and not 38.

Finding 4. The PY9 HEA program achieved 31,337 kW of verified gross demand reduction and 3,581 kW of verified gross peak demand reduction. We cannot calculate the gross program realization rate for demand savings as the implementers did not track gross demand reduction. The gross program realization rate for peak demand savings is 84 percent. The reason for this discrepancy is because the implementers claimed peak demand savings for programmable thermostats where the evaluation did not, using the guidelines in the IL TRM for this measure. See Recommendation 7 above.

Verified Net Impacts

[2] https://www.eia.gov/consumption/residential/terminology.php#s

Finding 5. The evaluation used varying deemed net-to-gross (NTG) values depending on the measure to calculate verified net savings of 25,223,277 kWh, verified net demand reduction of 25,316 kW and verified net peak demand reduction of 2,983 kW. In PY9, the HEA program exceeded its net savings forecast of 24,490 MWh by 733 MWh.

6. Appendix 1. Impact Analysis Methodology

Navigant calculated verified gross and net savings using the following algorithms as defined by the IL TRM v5.0 in PY9.

6.1 CFL and LED Replacement

Verified Gross Annual kWh Savings = Program Bulb Quantity * ΔWatts/1000 * ISR * HOU * WHF_{energy}

Where:

- ΔWatts = Difference between Baseline Wattage and Efficient (LED) Wattage, Evaluated
- HOU = Annual Hours of Use, Deemed
- WHF_{energy} = Energy Waste Heat Factor, Deemed

Verified Gross Annual kW Savings = Program Bulb Quantity * ΔWatts/1000
Verified Gross Annual Peak kW Savings = Gross Annual kW Savings * Peak Load Coincidence Factor * WHF_{demand}

Where:

- Peak Load Coincidence Factor is calculated as the percentage of program bulbs turned on during peak hours (weekdays from 1 to 5 p.m.) throughout the summer.
- WHF_{demand} = Demand Waste Heat Factor

6.2 Low Flow Faucet Aerators

Verified Gross Annual kWh Savings = $((GPM_{base} * L_{base} – GPM_{low} * L_{low}) * Household * 365.25 * DF / FPH) * EPG_{electric} * ISR$

Where:

- GPM_{base} = Average baseline flowrate, Gallons per minute, Deemed
- L_{base} = Average baseline daily faucet use per capita, Deemed
- GPM_{low} = Average low flowrate, Gallons per minute, Deemed
- L_{low} = Average baseline daily faucet use per capita, Deemed
- Household = Average number of people per household, Deemed
- 365.25 = Number of days per year
- DF = Drain Factor, Deemed
- FPH = Faucets per household, Deemed
- $EPG_{electric}$ = Energy per gallon of water used supplied by electric water heater, Deemed
- ISR = In Service Rate, Deemed

Verified Gross Annual Peak kW Savings = Gross Annual Energy Savings / HOU
Verified Gross Annual Peak kW Savings = Gross Annual Energy Savings / HOU * CF

6.3 Low Flow Showerheads

Verified Gross Annual kWh Savings = ((GPM$_{base}$ * L$_{base}$ – GPM$_{low}$ * L$_{low}$) * Household * SPCD * 365.25 SPH) * EPG$_{electric}$ *ISR

Where:

- SPCD = Showers per capita per day, Deemed
- SPH = Showers per household, Deemed

Verified Gross Annual Peak kW Savings = Gross Annual Energy Savings / HOU
Verified Gross Annual Peak kW Savings = Gross Annual Energy Savings / HOU * CF

6.4 Advanced Power Strips

Tier 1:

Verified Gross Annual kWh savings = Deemed Energy Savings Per Unit
Verified Gross Annual Peak kW Savings = Gross Annual Energy Savings / HOU
Verified Gross Annual Peak kW Savings = Gross Annual Energy Savings / HOU * CF

Tier 2:

Verified Gross Annual kWh savings = Energy Reduction Percentage (ERP) * Baseline Energy * ISR
Verified Gross Annual Peak kW Savings = Gross Annual Energy Savings / HOU
Verified Gross Annual Peak kW Savings = Gross Annual Energy Savings / HOU * CF

6.5 Programmable Thermostats, Reprogramming Thermostats, Thermostat Education

Verified Gross Annual kWh Savings = Electric Heating Consumption * Heating Reduction * HF * ISR + (ΔTherms * F$_e$ * 29.3)

Where:

- Heating Reduction = Assumed percentage reduction in total household heating energy consumption due to programmable thermostat, Deemed
- HF = Household Factor, Deemed
- ISR = In Service Rate, Deemed
- F$_e$ = Furnace fan energy consumption as a percentage of annual fuel consumption, Deemed
- 29.3 = kWh per therm conversion
- ΔTherms is calculated as follows

ΔTherms = %Fossil Heat * Gas Heating Consumption * Heating Reduction * HF * ISR

6.6 Water Heater Pipe Insulation

Verified Gross Annual kWh Savings = ((1/R$_{exist}$ = 1/R$_{new}$) * Length of Insulation * Circumference of Pipe * ΔT * 8,766) / (Water Heater Efficiency * 3,413)

Where:

- R$_{exist}$ = Existing pipe thermal resistance, Deemed

- R_{new} = Total pipe thermal resistance after adding insulation, claimed based on pipe insulation used
- ΔT = Temperature difference between the water in the pipe and the surrounding air, Deemed
- 3,413 = Conversion from BTU to kWh

6.7 Deemed Values

Navigant calculated verified gross direct install savings for the PY9 HEA program using algorithms, assumptions, and input parameters defined in the Illinois TRM v5.0. Table 6-1 shows the deemed input values used in these algorithms and calculations

Table 6-1. TRM Deemed Savings Input Parameters Used in Ex Post Analysis

Verified Gross and Net Input Parameters	Value	Data Source
CFL In-Service Rate (ISR)	0.969	IL TRM v5.0, Section 5.5.1
CFL HOU (Interior / Exterior)	793 / 2,475	IL TRM v5.0, Section 5.5.1
CFL WHF_{energy} (SF Interior / MF Interior / Exterior)	1.06 / 1.04 / 1.00	IL TRM v5.0, Section 5.5.1
CFL WHF_{demand} (SF Interior / MF Interior / Exterior)	1.11 / 1.07 / 1.00	IL TRM v5.0, Section 5.5.1
CFL CF	0.074	IL TRM v5.0, Section 5.5.1
LED ISR	0.969	IL TRM v5.0, Section 5.5.8
LED HOU (Interior / Exterior)	759 / 2,475	IL TRM v5.0, Section 5.5.8
LED WHF_{energy} (SF Interior / MF Interior / Exterior)	1.06 / 1.04 / 1.00	IL TRM v5.0, Section 5.5.8
LED WHF_{demand} (SF Interior / MF Interior / Exterior)	1.11 / 1.07 / 1.00	IL TRM v5.0, Section 5.5.8
LED CF	0.071	IL TRM v5.0, Section 5.5.8
Faucet Aerator GPM_{base}	1.39	IL TRM v5.0, Section 5.4.4
Faucet Aerator L_{base} (Kitchen / Bathroom)	4.5 / 1.6	IL TRM v5.0, Section 5.4.4
Faucet Aerator GPM_{low}	0.94	IL TRM v5.0, Section 5.4.4
Faucet Aerator L_{low} (Kitchen / Bathroom)	4.5 / 1.6	IL TRM v5.0, Section 5.4.4
Faucet Aerator Household (Single Family / Multi Family)	2.56 / 2.1	IL TRM v5.0, Section 5.4.4
Faucet Aerator DF (Kitchen / Bathroom)	0.75 / 0.90	IL TRM v5.0, Section 5.4.4
Faucet Aerator FPH (Kitchen / SF Bath / MF Bath)	1 / 2.83 / 1.5	IL TRM v5.0, Section 5.4.4
Faucet Aerator $EPG_{electric}$ (Kitchen / Bath)	0.0969 / 0.0795	IL TRM v5.0, Section 5.4.4
Faucet Aerator ISR (SF / MF Kitchen / MF Bath)	0.95 / 0.91 / 0.95	IL TRM v5.0, Section 5.4.4
Faucet Aerator HOU (SF K / SF B / MF K / MF B)	94 / 14 / 77 / 22	IL TRM v5.0, Section 5.4.4
Faucet Aerator CF	0.022	IL TRM v5.0, Section 5.4.4
Shower GPM_{base}	2.67	IL TRM v5.0, Section 5.4.5
Shower L_{base}	7.8	IL TRM v5.0, Section 5.4.5
Shower GPM_{low}	1.5	IL TRM v5.0, Section 5.4.5
Shower L_{low}	7.8	IL TRM v5.0, Section 5.4.5
Shower Household (Single Family / Multi Family)	2.56 / 2.1	IL TRM v5.0, Section 5.4.5
Shower SPCD	0.6	IL TRM v5.0, Section 5.4.5
SPH (Single Family / Multi Family)	1.79 / 1.3	IL TRM v5.0, Section 5.4.5
Shower $EPG_{electric}$	0.117	IL TRM v5.0, Section 5.4.5
Shower ISR (SF / MF)	0.98 / 0.95	IL TRM v5.0, Section 5.4.5
Shower HOU (SF / MF)	302 / 248	IL TRM v5.0, Section 5.4.5
Shower CF	0.0278	IL TRM v5.0, Section 5.4.5
Advanced Power Strip Energy Savings (Tier 1)	103	IL TRM v5.0, Section 5.2.1
Advanced Power Strip Energy ERP	0.5	IL TRM v5.0, Section 5.2.2
Advanced Power Strip Baseline Energy	600	IL TRM v5.0, Section 5.2.2
Advanced Power Strip ISR	0.7	IL TRM v5.0, Section 5.2.2
Advanced Power Strip CF	0.80	IL TRM v5.0, Section 5.2.1/5.2.2

Verified Gross and Net Input Parameters	Value	Data Source
Advanced Power Strip HOU (Tier 1 / Tier 2)	7129 / 4380	IL TRM v5.0, Section 5.2.1/5.2.2
Programmable Thermostat Electric Heating Consumption (Electric Resistance / Heat Pump / Gas)	20,771 / 12,218 / 0	IL TRM v5.0, Section 5.3.11
Programmable Thermostat Gas Heating Consumption [Therms] (Electric Resistance / Heat Pump / Gas)	0 / 0 / 1,005	IL TRM v5.0, Section 5.3.11
Programmable Thermostat Heating Reduction	0.062	IL TRM v5.0, Section 5.3.11
Programmable Thermostat HF (Single Family / Multi Family)	1 / 0.65	IL TRM v5.0, Section 5.3.11
Programmable Thermostat ISR	1	IL TRM v5.0, Section 5.3.11
Programmable Thermostat F_e	0.0314	IL TRM v5.0, Section 5.3.11
DHW R_{exist}	1	IL TRM v5.0, Section 5.4.1
DHW R_{new}	2.8 / 3.8	IL TRM v5.0, Section 5.4.1
DHW ΔT	60	IL TRM v5.0, Section 5.4.1
DHW ηDHW	.98	IL TRM v5.0, Section 5.4.1
DHW Circumference of Pipe	0.196	IL TRM v5.0, Section 5.4.1

6.8 Smart Thermostats

The savings for smart, or "advanced," thermostats were calculated using deemed savings values based on application type and heating fuel that were discussed and agreed upon prior to this program year. The calculations done by Navigant used the algorithms presented below from the Illinois TRM v5.0, Section 5.3.16. Navigant also used population data specific to the HEA participants to more accurately represent the target population.

Verified Gross Annual kWh Savings = Electric Heating Consumption * Heating Reduction * HF * ISR + (ΔTherms * F_e * 29.3)

Where:

- Heating Reduction = Assumed percentage reduction in total household heating energy consumption due to programmable thermostat, Deemed
- HF = Household Factor, Deemed
- ISR = In Service Rate, Deemed
- F_e = Furnace fan energy consumption as a percentage of annual fuel consumption, Deemed
- 29.3 = kWh per therm conversion

The deemed input parameters for smart thermostats are summarized in the table below.

Table 6-2. Deemed Savings Input Parameters and Sources

Verified Gross and Net Input Parameters	Value	Data Source
Smart Thermostat Electric Heating Consumption (Electric Resistance / Heat Pump / Gas)	20,771 / 12,218 / 0	IL TRM v5.0, Section 5.3.16
Smart Thermostat Heating Reduction (Manual Baseline / Programmable BL / Unknown BL)	0.088 / 0.056 / 0.074	IL TRM v5.0, Section 5.3.16
Smart Thermostat HF (Single Family / Multi Family)	1 / 0.65	IL TRM v5.0, Section 5.3.16
Smart Thermostat ISR	1	IL TRM v5.0, Section 5.3.16
Smart Thermostat F_e	0.0314	IL TRM v5.0, Section 5.3.16

7. APPENDIX 2. IMPACT ANALYSIS DETAIL

This Appendix provides more detail on the impact analysis. The recommendations presented in this appendix are the same as those presented in Section 5. They are repeated here so they can be reviewed in context with the expanded discussion of the issue.

7.1 Home Type Definition

The TRM does not give a concrete definition to distinguish single family from smaller multi-family buildings such as duplex, tri-plex, quadplex and households when selecting TRM assumptions on several measures. Navigant defined building types for this program[3] differently compared to the implementers, which reflects a change from how we analyzed the impacts in the PY9 Wave 1 memo. For this report, Navigant used nationally-recognized definitions in the EIA 2015 Residential Energy Consumption Survey[4].

The EIA single-family home definition is: “A housing unit either detached from or attached to another housing unit that typically provides living space for one household or family. Housing units that are connected side-by-side by a wall that extends ground to roof are considered single-family attached units (i.e., a townhouse, row house, or duplex.) A mobile home is not classified as a single-family home.”

The EIA multi-family home definition is: “A self-contained housing unit that occupies only part of a multi-family residential building that has two or more housing units. Apartments may be owned by an owner/occupier or rented by tenants. This category includes condominium apartments (i.e. individually owned apartments), basement apartments, or other residential structures where units are stacked vertically. Housing units that are connected side-by-side by a wall that extends ground to roof are considered single-family attached units (i.e., a townhouse, row house, or duplex.) RECS categorizes apartments into those that are in buildings with two to four units—this category also includes houses originally intended for occupancy by one household (or for some other use) that have since been converted to separate dwellings for two to four households—and that are buildings with five or more units.”

The following table details how each building type was categorized for the HEA program in PY9.

[3] Per email from Navigant to ComEd “RE: Navigant Request: Res Building Types”, 1/29/2018.
[4] https://www.eia.gov/consumption/residential/terminology.php#s

Table 7-1. Home Type Definition

Identified Building Types	Implementers' Treatment	Navigant's Treatment
Two-Unit	SF	MF
Condo	SF	MF
Duplex	SF	SF
Five or More Units	SF	MF
Quadplex	SF	MF
Single-Detached	SF	SF
Single-Family	SF	SF
Triplex	SF	MF

Source: ComEd tracking data and Navigant analysis

The discrepancy between the implementers' treatment and Navigant's treatment of home types affected savings for CFL installations, LED installations, programmable thermostats, re-programming thermostats, thermostat education, and smart thermostats, aerators, and showerheads. For CFL installations, re-programming thermostats, aerators, and showerheads, the home type discrepancy is the sole reason for deviation of the verified gross realization rate from 100 percent.

Recommendation 2. Navigant recommends the implementers follow the EIA's definition of single family and multi-family homes for building types. In 2015, the EIA defined single-detached, single-family and duplex as single-family and two-unit, condo, triplex, quadplex, and five or more units as multi-family.

7.2 CFL Installations

CFL Installations have a realization rate of 100 percent and represent eight percent of overall energy savings. Table 7-2 shows the results from analysis of individual CFL measures.

Table 7-2. CFL Measure Impact Detail

Research Category	Measures Installed	Ex Ante Gross Savings (kWh)	Verified Gross Realization Rate	Verified Gross Savings (kWh)	NTGR	Verified Net Savings (kWh)
CFL 13W	70,909	1,731,181	100%	1,727,521	0.80	1,382,016
CFL 18W	7,465	212,764	100%	212,185	0.80	169,748
CFL 23W	8,370	333,987	100%	333,041	0.80	266,433
CFL 9W	2,690	43,830	100%	43,714	0.80	34,971

Source: ComEd tracking data and Navigant team analysis.

7.3 LED Installations

LED Installations have a realization rate of 100 percent and represent 77 percent of overall energy savings.

Table 7-3 shows the results from analysis of individual LED measures.

Table 7-3. LED Measure Impact Detail

Research Category	Measures Installed	Ex Ante Gross Savings (kWh)	Verified Gross Realization Rate	Verified Gross Savings (kWh)	NTGR	Verified Net Savings (kWh)
LED - 19W PAR38	985	238,568	100%	238,592	0.80	190,874
LED - BR30	42,089	2,106,567	100%	2,111,312	0.80	1,689,049
LED - Globe	31,951	955,238	100%	952,187	0.80	761,749
LED 11W	8,115	344,271	100%	343,952	0.80	275,161
LED 15W	13,302	1,687,038	103%	1,729,523	0.80	1,383,619
LED 16W	1,671	93,259	100%	93,225	0.80	74,580
LED 17W	1,560	230,716	100%	230,702	0.80	184,562
LED 5.5W	5,581	110,613	100%	110,471	0.80	88,377
LED 5W	10,407	273,687	87%	238,614	0.80	190,891
LED 6.5W	3,016	116,026	100%	115,836	0.80	92,669
LED 6W	52,411	1,480,711	101%	1,488,807	0.80	1,191,045
LED 8W	125,289	6,361,832	100%	6,349,719	0.80	5,079,775
LED 9W	101,092	3,055,854	100%	3,051,004	0.80	2,440,803
LED A-Line 13W	4,482	332,770	100%	332,787	0.80	266,230
LED A-Line 7W	972	24,019	100%	23,973	0.80	19,179
LED Candelabra	124,006	5,726,053	99%	5,670,657	0.80	4,536,525
LED Track Light	14,984	569,394	100%	567,625	0.80	454,100

Source: ComEd tracking data and Navigant team analysis.

Navigant observed that while calculating the ex post savings for exterior LED candelabra bulbs that the calculator used a CF of 0.121 for interior installations instead of the 0.273 deemed by the IL TRM v5.0.

> **Recommendation 3**. Navigant recommends the implementers verify that the CF for LED candelabra bulbs match the install locations to prevent the use of interior CF values for bulbs installed in exterior locations. Note: The program resolved this discrepancy mid-PY9.

Navigant observed that while calculating the ex post savings for LED 15W that Franklin has been installing 15W LED bulbs instead of 19W bulbs in the ex ante calculation as in previous years. Franklin has noted the change and increase in savings but has not yet update the calculator or tracking savings to reflect the change in retrofit wattage.

> **Recommendation 4.** Navigant recommends the implementers update their tracking data savings for LED 15W bulbs to accurately represent the retrofit wattage as 15W instead of 19W. Note: The program resolved this discrepancy mid-PY9.

Navigant observed while calculating the ex post savings for exterior LED 5W Globe bulbs that the calculator lists the baseline as a 50/50 blend of 60W and 40W. Navigant reviewed the specification for the installed 5W Globe bulb and found the lumens to be 350. The IL TRM deems 40W as the baseline wattage for Globe bulbs 350-749 lumens, and Navigant calculated verified savings using 40W as the baseline wattage.

Recommendation 5. Navigant recommends the implementers use 40W as the baseline for LED 5W Globe bulbs 350 lumens, which is consistent with the TRM.

All other differences between reported ex ante gross savings and verified gross savings were due to the home type discrepancy.

7.4 All Thermostats

In Section 5.3.11 Programmable Thermostats and Section 5.3.16 Advanced Thermostats, the IL TRM indicates that "installation of multiple programmable thermostats per home does not accrue additional savings." Navigant and the implementer capped savings for thermostats to reflect one installation per project for single-family homes and the number of units for multi-family buildings (i.e., duplexes were capped at two measures; triplexes at three measures; and quadplexes were capped at four measures) for smart thermostats, programmable thermostats, re-programming thermostats, and thermostat education. However, Navigant found instances of multiple records with different project IDs that show two thermostats installed at different dates in the same home, resulting in double counting of ex ante savings. The quantity of programmable thermostats that resulted in verified savings was 3,707, which was 74 less than the reported quantity of 3,781. The quantity of thermostat education measures that resulted in verified savings was 931, 44 less than the reported quantity of 975. The quantity of smart thermostats that resulted in verified savings was 2,108, 113 less than the reported quantity of 2,221, and the quantity of re-programmed thermostats that resulted in verified savings was 2,654, 28 less than the reported quantity of 2,682

Recommendation 6. Navigant recommends the implementer cap thermostat savings at one per single family home when multiple thermostats are installed at different dates.

7.5 Programmable Thermostats

Programmable thermostats have a realization rate of 91 percent and represent one percent of overall energy savings. The implementers reported ex ante kW savings for programmable thermostats, but Navigant did not verify any demand savings. Section 5.3.11 of the IL TRM states that summer coincident peak demand savings are not applicable due to there being no savings from cooling during the summer peak period. Additional data would be required to calculate non-peak demand savings. For these reasons the verified gross peak demand savings and realization rate is NA and the peak demand realization rate is NA. This discrepancy in programmable thermostat peak demand savings was the reason why the peak demand realization rate for the HEA program in PY9 is 83 percent.

Recommendation 7. Navigant recommends the implementers do not claim peak demand savings for programmable thermostats. Guidelines in the IL TRM state that summer coincident peak demand savings are not applicable due to there being no savings from cooling during the summer peak period.

7.6 Smart Thermostats

Smart thermostats have a realization rate of 96 percent and represent one percent of overall energy savings.

Navigant observed that there were inconsistencies between the baseline information in the "Existing Thermostat Type" field and the "Measure_Name" field of the tracking data. For instance, despite being named "Gas Tstat - Smart Stat ($150) Baseline Manual NSG/ComEd SF PY6/9" the "Baseline" field stated that the "Existing Thermostat Type" was "Programmable". The implementer informed Navigant that

secondary home characteristics are less accurate and measure name should take precedence. Navigant used information in the measure name to determine baselines as well as the "Existing Thermostat Type" field if no baseline was included in the measure name. In some cases, no baseline information was included in the measure name and the "Existing Thermostat Type" field indicated that the baseline was "Smart". Since the IL TRM does not deem any values for these cases of "Smart" baseline, the existing thermostat type was considered "unknown".

> **Recommendation 8.** Navigant recommends the implementers ensure that the baseline shown in the measure name and in the "Baseline" field are consistent for smart thermostat installations to avoid calculating baseline energy using an incorrect baseline thermostat.

In less than four percent of projects, the "Cooling_System_Type" field showed that the home had something other than central air conditioning or lacked central air conditioning. The IL TRM instructs that projects without central air conditioning cannot claim smart thermostat coincident peak demand savings. Navigant considered all smart thermostat projects to have central air conditioning as the program guidelines require homes to have central air conditioning to be eligible for smart thermostats.

> **Recommendation 9.** Navigant recommends the implementer ensure that cooling system information shown in the "Cooling_System_Type" field is consistent with the requirements for smart thermostat installations to avoid miscalculation of smart thermostat coincident peak demand savings.

Navigant further observed that while CLEAResult used the CF_{PJM} to calculate the ex ante peak demand savings, Franklin Energy used the $CF_{SSP.}$ Navigant used the CF_{PJM} value to calculate the ex post peak demand savings to support ComEd's PJM compliance requirements, resulting in a gross peak demand realization rate of 78 percent.

> **Recommendation 10.** Navigant recommends both implementers use CF_{PJM} to calculate smart thermostat peak demand savings to support ComEd's PJM compliance requirements.

7.7 Pipe Insulation

Pipe insulation has a realization rate of 87 percent and represents 0.05 percent of overall energy savings. The low realization rate is attributed to measures labeled "Pipe Insulation – Electric" with R_new = 3.8 according to the implementer's calculator. The realization rate of these measures is 81 percent. Navigant noted that verified savings matched ex ante savings if R_new was inputted as 38. It is possible that the implementer's calculator accidentally inserted the period in the wrong place, turning R_new = 3.8 to R_new = 38.

> **Recommendation 11.** Navigant recommends the implementers make sure that R_new values for "Pipe Insulation – Electric" measures are recorded as 3.8 and not 38.

8. Appendix 3. Total Resource Cost Detail

Table 8-1, below, shows the Total Resource Cost (TRC) variable table, which only includes cost-effectiveness analysis inputs available at the time of finalizing the PY9 HEA 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. EUL information in this table is subject to change and is 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)
Lighting	CFL Installations	Each	89,434	4	2,321,762	228	2,316,461	226
Lighting	LED Installations - Track and Recessed	Each	93,281	15	5,550,470	612	5,594,069	618
Lighting	LED Installations - All Other	Each	448,632	10	18,156,146	1,950	18,054,917	1,963
HVAC	Programmable Thermostats	Each	3,707	5	270,826	691	244,440	NA
HVAC	Reprogramming Thermostats	Each	2,654	2	165,324	0	153,637	0
HVAC	Thermostat Education	Each	931	2	88,948	0	80,806	0
HVAC	Smart Thermostats	Each	2,108	10	496,428	199	491,696	162
Hot Water	Bathroom Faucet Aerator	Each	490	9	7,965	12	9,359	12
Hot Water	Kitchen Faucet Aerator	Each	157	9	20,520	5	18,480	5
Hot Water	Pipe Insulation	Linear Feet	658	15	17,856	2	15,617	2
Hot Water	Showerheads	Each	580	10	190,240	17	197,782	20
Electronics	APS - Tier 1	Each	9,346	4	962,741	108	962,638	108
Electronics	APS - Tier 2	Each	12,134	7	2,548,500	460	2,548,140	465

Source: ComEd tracking data and Navigant team analysis.

APPENDIX B. COMED HOME ENERGY ASSESSMENT PY9 NTG MEMO 2018-08-25

NAVIGANT

150 N Riverside Plaza
Suite 2100
Chicago, IL 60606
www.navigant.com

To:	Vincent Gutierrez, ComEd
CC:	Jennifer Morris, ICC Staff; Randy Gunn, Jeff Erickson, Nishant Mehta, Navigant
From:	Jane Hummer, Christy Zook, Sagar Deo, Laura Agapay-Read
Date:	August 25, 2018
Re:	Net-to-Gross Research Results from PY8 and PY9 for the ComEd Home Energy Assessment Program

INTRODUCTION

This memo presents our free ridership and spillover research results for the PY8 and PY9 ComEd Home Energy Assessment (HEA) Program using the Illinois TRM version 6.0 methodologies.[1] While the program is coordinated with Nicor Gas and with Peoples Gas and North Shore Gas, this memo focuses solely on the free ridership and electric spillover of ComEd program participants. The net-to-gross (NTG) research was conducted in December 2016 with PY8 and PY9 participants and again in Fall 2017 with PY9 participants. Navigant conducted telephone surveys with 80 PY8 participants to assess spillover as well as 150 PY9 participants to assess free ridership of specific measures: smart thermostats, smart power strips, and LEDs all of which were new in PY8. The PY8 participant spillover and PY9 free ridership results provide updated findings relative to the previous NTG research conducted in PY4 for this program as well as the use of secondary research conducted in 2010.

Table 1 below provides a summary of the HEA Program PY9 participant free ridership and PY8 spillover research findings. Navigant estimated free ridership for four measure categories: smart thermostats, smart power strips, copay LEDs, and free LEDs. Together, these four categories comprise 90 percent of the PY9 evaluated program savings.[2] Smart thermostat free ridership was investigated for informational purposes only and will not factor into program-level NTG estimates because the savings for smart thermostats in the TRM, and thus used in our analysis, are already net savings; this has little effect on the program-level NTG because smart thermostats comprise less than two percent of total program savings. To estimate the program-level free ridership, Navigant weighted each measure category's free ridership estimate by the category's share of total program energy savings.

[1] Illinois Statewide Technical Reference Manual for Energy Efficiency, Version 6.0, Volume 4: Cross-Cutting Measures and Attachments, effective January 1st, 2018.
[2] Measures not included in the free ridership analysis include CFLs, programmable thermostats, water saving measures (aerators, shower heads, etc.), and pipe insulation.

Table 1. Participant Free Ridership and Spillover Results (PY8 and PY9 Participants)

End-use	Participant Free Ridership	Weight (% of Program Savings)	Participant Spillover	Relative Precision @ 90% CI
Advanced Power Strips	0.19	0.12		3%
Copay LEDs	0.12	0.003		7%
Free LEDs	0.20	0.88		3%
*Smart Thermostats**	*0.19*	*n/a*		*3%*
Population Roll-up	**0.20**		**0.04**	

*Free ridership for smart thermostats is provided for informational purposes only and will not be used to calculate net savings or the population roll-up number because the TRM calculation for this measure yields net savings.
Source: Navigant analysis of data from a telephone survey conducted by the evaluation team with PY8 and PY9 Home Energy Assessment Program participants.

Free Ridership and Spillover Comparison

For comparison, the free ridership and spillover values and NTG ratios that were deemed by SAG for PY9 are presented in the table below.

Table 2. PY9 Deemed NTG Ratios

Measure Category	Free Ridership	Spillover	NTG Ratio
Lighting Measures*	0.23	0.03	0.80
Hot Water Measures*	0.23	0.03	0.80
Programmable Thermostat†			0.90
Advanced Power Strip‡	0.05	0.00	0.95

* Based on Navigant PY4 evaluation research
† Based on secondary Massachusetts and Vermont research in 2010
‡ Based on MF Elevate and PY6 Desktop Power Management
Source: ComEd Programs NTG Approach for EPY10. March 1, 2017

The values for the direct install measures (lighting and hot water) are based on evaluation research conducted in PY4 and PY5 and have been the SAG-approved NTG ratio and component values for the Home Energy Assessment Program since PY7. The value for programmable thermostats is based on secondary 2010 MA and VT research and the value for advanced power strips is based on the Multi-family Elevate and PY6 Desktop Power Management programs and have been the SAG-approved NTG ratio and component values for the Program since PY8.

PY8 and PY9 Free Ridership and Spillover Research Data Collection

The PY8 and PY9 free ridership and spillover research was conducted following a customer self-report approach through a telephone survey with 230 participants (80 participants for the spillover research and 150 participants for the free ridership research) from a randomized sample of 15,132 participants. The counts for the completed participant interviews and sample design are provided in Table 3 below.

Table 3. Free Ridership and Spillover Research Survey Disposition

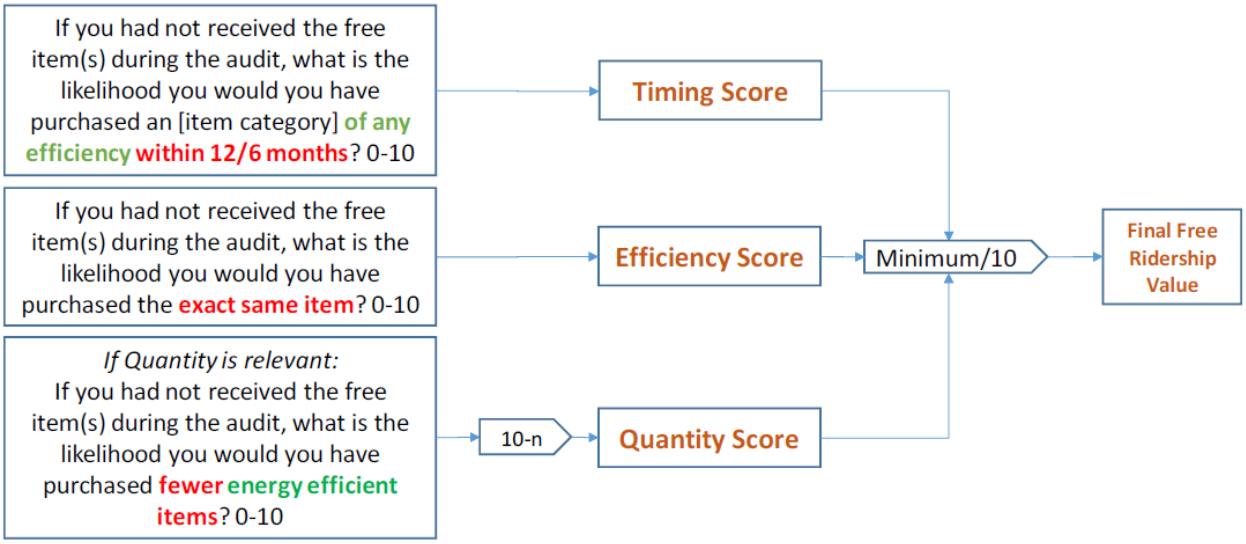
End-use	Number of Usable Contacts	Target Completes	Actual Completes
Smart Thermostat	606	60	48
Copay LEDs	276	40	31
Free LEDs	6,474	45	93
Advanced Power Strips	5,782	45	76
Spillover	1,994	70	80
Overall Population	**15,132**	**260**	**230***

*Rows do not sum to the total because participants completed free ridership surveys about more than one measure. The total row reflects the number of completed surveys.
Source: Home Energy Assessment Program PY8 and PY9 Tracking Data and evaluation analysis

FREE RIDERSHIP ESTIMATES USING ALGORITHMS IN THE TRM VERSION 6.0

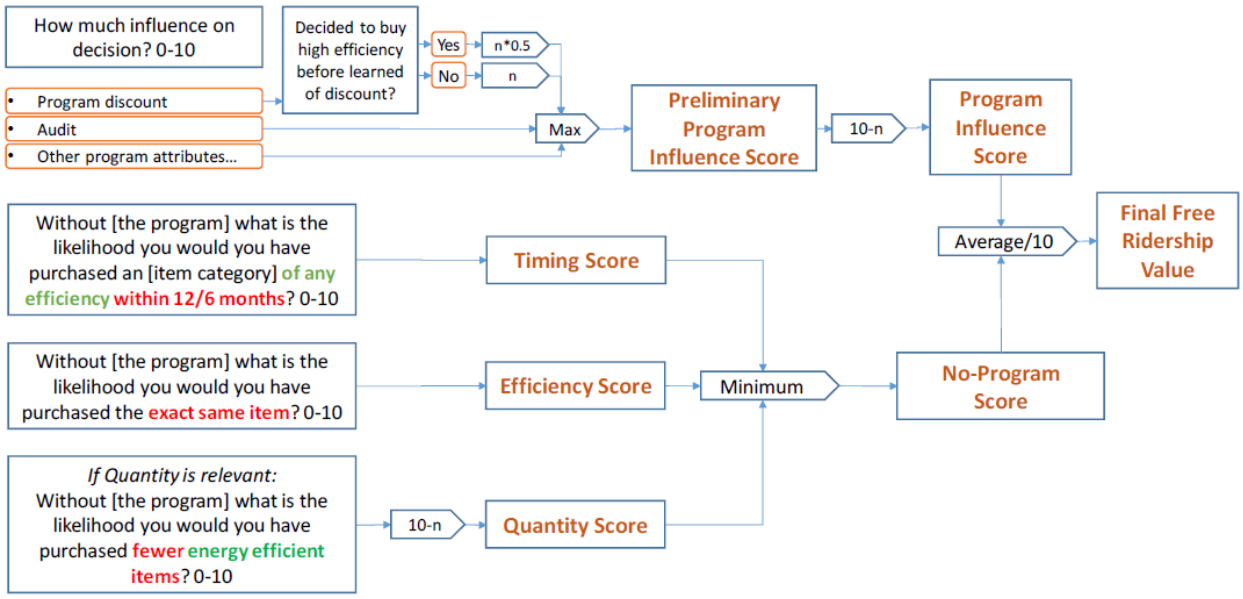
The following diagrams describes the TRM free ridership algorithms for residential single-family home energy audit programs.

Figure 1. Residential Single-Family Home Energy Audit Free Ridership - No Cost Measures



Source: Illinois TRM Version 6, Volume 4. Cross-Cutting Measures and Attachments, final February 8, 2017, effective January 1st, 2018.

Figure 2. Residential Single-Family Home Energy Audit Free Ridership - Discounted Measures



Source: Illinois TRM Version 6, Volume 4. Cross-Cutting Measures and Attachments, final February 8, 2017, effective January 1st, 2018.

Navigant applied the free ridership algorithm from the Single-Family Home Energy Audit Protocol in the Illinois Statewide Technical Reference Manual- Attachment A: IL-NTG Methodologies v6 document.[3] Free ridership estimates for smart strips and free LEDs were calculated using the algorithm for no cost measures shown in Figure 1 above and free ridership estimates for smart thermostats and copay LEDs were calculated using the algorithm for discounted measures shown in Figure 2 above.

PARTICIPANT SPILLOVER ESTIMATION

Navigant estimated spillover consistent with the method laid out in the Residential Cross-Cutting Approaches: Participant Spillover section of the IL-TRM. Respondents were asked in the telephone survey if they have made additional energy efficiency improvements to reduce energy consumption since participating in the Program. Navigant included 17 questions to identify spillover candidates and estimate savings. These questions addressed three general aspects, paraphrased below:

1. Since participating in the Home Energy Assessment Program, have you purchased and installed any additional energy efficient measures that you did not receive any rebate for?

2. Did the program influence you in any way to make to make additional energy efficiency improvements?
    a. On a zero to ten scale, where zero is not at all important and ten is extremely important, how important was your participation in the Home Energy Assessment Program on your decision to make additional energy efficiency improvements outside of utility program? [Attribution Score 1.]
    b. If you had not participated in the Home Energy Assessment Program, how likely is it that you would have made additional energy efficiency improvements? Please use a zero to ten scale, where zero means that you definitely would not have made additional energy

[3] The referenced TRM document can be accessed here: http://ilsagfiles.org/SAG_files/Technical_Reference_Manual/Version_6/Final/IL-TRM_Effective_010118_v6.0_Vol_4_X-Cutting_Measures_and_Attach_020817_Final.pdf.

efficiency improvements and ten means that you definitely would have purchased them, even if you had not participated in the program? [Attribution Score 2.]

3. What were details of the energy efficiency improvements (equipment, efficiency level, quantity, etc.)?

Navigant attributed spillover to the Home Energy Assessment Program if the following condition is met: the average of Attribution Score 1 and (10 minus Attribution Score 2) must exceed 5.0.

Of the 80 survey respondents, 28 installed additional energy efficient equipment, but only 16 indicated that participating in the Home Energy Assessment Program influenced them to make these additional purchases. Navigant determined that only nine of the 16 potential spillover candidates had spillover averaged attribution scores greater than 5.0 and installed equipment with quantifiable electric savings which included refrigerators, CFL and LED light bulbs, and smart thermostats. Table 4 below lists the respondents' improvements and savings.

Table 4. Reported Energy Savings

End-use Measure	kWh	Qty	Per Unit Savings (kW)
LEDs	709.52	14	50.68
CFLs	341.04	14	24.36
Refrigerators	128.40	2	64.20
Smart Thermostats	466.50	2	233.25
Spillover Total	**1,645.46**		

Source: Navigant analysis of data from spillover telephone surveys conducted by Navigant with PY8 Home Energy Assessment Program participants.

Together, the kWh savings from these improvements amounted to 3.8 percent of program savings for the 80 respondents. Because the 80 were selected as a simple random sample, their spillover savings rate is representative of the population of PY8 program participants

NTG Results

The NTG research results for the Home Energy Assessments Program are summarized in Table 5 below.

Table 5. Summary of Free Ridership, Spillover and NTGR Research Results for HEA Program

End-use	Free Ridership	Participant Spillover	NTGR
Advanced Power Strips	0.19		
Copay LEDs	0.12		
Free LEDs	0.20		
*Smart Thermostats**	*0.19*		
Population Roll-up	**0.20**	**0.04**	**0.84**

*FR for smart thermostats is provided for informational purposes only and will not be used to calculate net savings because the TRM calculation for this measure yields net savings.
NTGR = 1 – FR + PSO + TSO + NPSO
FR = Participant Free Ridership; PSO = Participant Spillover; TSO = Trade Ally Spillover, NPSO = Nonparticipant Spillover
Source: Navigant analysis of data from telephone surveys conducted by Navigant with PY8 and PY9 Home Energy Assessment Program participants.

APPENDIX: COMED HOME ENERGY ASSESSMENT PROGRAM NTG HISTORY

<table>
<tr><th></th><th>Home Energy Assessment (Single Family Retrofit)</th></tr>
<tr><td>EPY1</td><td>NTG 0.80
Free-Ridership 0.20
Spillover NA
Method: ComEd Program Assumption. The EPY1 evaluation did not estimate the net to gross ratio. The value of 80% is drawn from the program plan presented in ComEd's 2008-2010 Energy Efficiency and Demand Response Plan (November 15, 2007). Page D-2 of the ComEd plan provides a footnote stating the net to gross ratio of 80% is drawn from the California Energy Efficiency Policy Manual, version 2 (2003).</td></tr>
<tr><td>EPY2</td><td>NTG 0.87
Free-Ridership 26%
Spillover 3.5%
Method: Customer self-reports. 130 surveys completed from a population of 760.
<table>
<tr><th>Measure</th><th>NTG Ratio</th><th>FR</th><th>SO</th></tr>
<tr><td>CFL</td><td>0.72</td><td>34%</td><td>6.4%</td></tr>
<tr><td>Kitchen Aerators</td><td>0.97</td><td>3%</td><td>0.0%</td></tr>
<tr><td>Bathroom Aerators</td><td>0.97</td><td>3%</td><td>0.0%</td></tr>
<tr><td>Showerheads</td><td>0.93</td><td>8%</td><td>0.5%</td></tr>
<tr><td>Pipe Insulation</td><td>1.02</td><td>7%</td><td>9.0%</td></tr>
<tr><td>Total Direct Install</td><td>0.87</td><td>26%</td><td>3.5%</td></tr>
</table></td></tr>
<tr><td>EPY3</td><td>NTG 0.74
Free-Ridership 27%
Spillover 4%
Method: Customer self-reports. 122 full participant (direct install and weatherization measures) and direct install-only participant surveys completed from a population of 413 full participants and 962 direct install-only participants.
<table>
<tr><th>Measure</th><th>NTG</th><th>FR</th><th>SO</th></tr>
<tr><td>Compact Fluorescent Bulbs</td><td>0.68</td><td>34%</td><td>3%</td></tr>
<tr><td>Air Sealing</td><td>0.99</td><td>8%</td><td rowspan="11">7%</td></tr>
<tr><td>Attic Insulation</td><td>0.98</td><td>9%</td></tr>
<tr><td>Floored Attic Insulation</td><td>0.98</td><td>9%</td></tr>
<tr><td>Exterior Wall Insulation</td><td>0.96</td><td>11%</td></tr>
<tr><td>Sloped Insulation</td><td>0.96</td><td>11%</td></tr>
<tr><td>Knee Wall Insulation</td><td>0.96</td><td>11%</td></tr>
<tr><td>Crawl Space Insulation</td><td>0.96</td><td>11%</td></tr>
<tr><td>Duct Insulation</td><td>0.99</td><td>8%</td></tr>
<tr><td>Rim Joist Insulation</td><td>0.96</td><td>11%</td></tr>
<tr><td>Seal and Repair Ducts</td><td>0.93</td><td>-</td></tr>
<tr><td>Overall</td><td>0.74</td><td>27%</td><td>4%</td></tr>
</table></td></tr>
</table>

Home Energy Assessment (Single Family Retrofit)

EPY4

Retroactive application of NTG* 0.83 (Preliminary)
Overall Free-Ridership* 18% (Preliminary)
Overall Spillover* 1% (Preliminary)
**A final draft of the report has not been submitted yet, thus these values may change.*
Method: Customer self-reports. 54 full-participant (direct Install and weatherization measures) surveys completed from a population of 1,081 audits and 320 full-participants.

	Measure	NTG*	Free Ridership*	Spillover*
Direct-Install Measures	9 Watt CFL	0.79	0.25	0.04
	14 Watt CFL	0.79	0.25	0.04
	19 Watt CFL	0.79	0.25	0.04
	23 Watt CFL	0.79	0.25	0.04
	9 Watt Globe CFL	0.79	0.25	0.04
	Low Flow Shower Head	0.93	0.07	0.00
	Kitchen Aerator	1.00	0.01	0.01
	Bathroom Aerator	1.00	0.01	0.01
	Hot Water Temperature Setback	0.88	0.12	0.00
	Pipe Insulation	0.89	0.18	0.07
	Programmable Thermostat	0.85	-	-
	Programmable Thermostat Education	0.85	-	-
Retrofit Measures	Attic Insulation	0.75	0.27	0.02
	Wall Insulation	0.78	0.22	0.00
	Floor Insulation (Other)	0.76	0.24	0.00
	Duct Insulation & Sealing	0.80	-	-
	Air Sealing	0.84	0.16	0.00
Overall Program		0.83	0.18	0.01

**A final draft of the report has not been submitted yet, thus these values may change.*

EPY5
EPY6

Sag Consensus:

	EPY5	EPY6
Lighting	0.89	0.79
Single Family with Gas _ Showerhead	0.94	0.75
Single Family with Gas_ Kitchen Aerator	0.94	
Single Family with Gas _ Bath Aerator	0.94	
Single Family with Gas _ Water Heater Temp Setback	0.94	
Single Family with Gas _ Pipe Insulation	0.94	

Home Energy Assessment (Single Family Retrofit)

Weatherization Measures	0.80	0.80	
Attic Insulation	0.80		
Wall Insulation	0.80		
Floor Insulation (other)	0.80		
Duct Sealing	0.80		
Air Sealing	0.80		

EPY7

Direct Install NTG: 0.80
Weatherization NTG: 1.02
Source: Participant surveys in EPY4 and EPY5, Trade ally surveys in EPY5. For Weatherization free ridership, trade ally value was weighted 75% and participants 25%.

Supporting Information

	Free Ridership	Participant Spillover	NTG
Direct Install	0.23	0.03	0.80
Weatherization	0.10	0.11	1.02
Program Wide	0.20	0.05	0.85

EPY8

Recommendation (based upon PY7 NTG recommended values):
NTG CFL: 0.79 – *(used in PY6 Report based upon PY4 research)*
NTG Hot Water Measures with gas: 0.75 – *(used in PY6 Report based upon PY4 research)*
NTG Direct Install Measures: 0.80 – *(from PY7 Recommendation based upon PY5 research)*
NTG Weatherization Measures: 1.02 – *(from PY7 Recommendation based upon PY5 research)*
NTG Thermostat: 0.90 – *(secondary 2010 MA and VT research)*

FR CFL: NA
FR Hot Water: NA
FR Direct Install: 0.23
FR Weatherization: 0.10
FR Thermostat: NA MA/VT secondary research

SO CFL: na
SO Hot Water: NA
SO Direct Install: 0.03
SO Weatherization: 0.11
SO Thermostat: NA MA/VT secondary research

EPY6 research on thermostat NTG was based on secondary research. There was no EPY6 research for other measures, thus the evaluation team recommends using the EPY7 values – see detail above for EPY7.

EPY9

NTG CFL: 0.80 – *(used in PY6 Report based upon PY4 research)*
NTG Hot Water Measures with gas: 0.80 – *(used in PY6 Report based upon PY4 research)*
NTG Direct Install Measures: 0.80 – *(from PY7 Recommendation based upon PY5 research)*
NTG Weatherization Measures: 1.01 – *(from PY7 Recommendation based upon PY5 research)*
NTG Thermostat: 0.90 – *(secondary 2010 MA and VT research)*

FR CFL: NA

	Home Energy Assessment (Single Family Retrofit)
	FR Hot Water: NA FR Direct Install: 0.23 FR Weatherization: 0.10 FR Thermostat: NA SO CFL: NA SO Hot Water: NA SO Direct Install: 0.03 SO Weatherization: 0.11 SO Thermostat: NA NTG Source: PY6 SAG consensus value (no new research)
EPY10	NTG Lighting: 0.80 – *(used in PY6 Report based upon PY4 research)* NTG Hot Water Measures: 0.80 – *(used in PY6 Report based upon PY4 research)* NTG Other Direct Install Measures: 0.80 – *(from PY7 Recommendation based upon PY5 research)* NTG Programmable Thermostat and Programmable Thermostat Education: 0.90 – *(secondary 2010 MA and VT research)* NTG Smart Power Strips: 0.95 – *(based on MF Elevate and PY6 Desktop Power Management)* NTG Smart Thermostat: NA. The savings value in the IL TRM is based on regression analysis on consumption data and thus is a net savings number. FR Lighting: NA FR Hot Water: NA FR Other Direct Install: 0.23 FR Thermostat: 0.23 FR Smart Power Strips: NA SO Lighting: NA SO Hot Water: NA SO Other Direct Install: 0.03 SO Thermostat: 0.03 SO Smart Power Strips: NA NTG Source: PY6 SAG consensus value (no new research)

Source: http://ilsagfiles.org/SAG_files/NTG/2017_NTG_Meetings/Final/ComEd_NTG_History_and_PY10_Recommendations_2017-03-01.pdf