Home Energy Savings Impact Evaluation Report

Energy Efficiency Impact Report: Plan Year 2018 (1/1/2018-12/31/2018)

Presented to
Nicor Gas Company

Draft

April 19, 2019

Prepared by:

Karl Walter	**Jennifer Ma**	**Charles Ampong**
Consultant	**Consultant**	**Managing Consultant**
415.356.7101	**312.583.6986**	**608.497.2336**
karl.walter@navigant.com	**jennifer.ma@navigant.com**	**charles.ampong@navigant.com**

www.navigant.com

Nicor Gas Home Energy Savings Impact Evaluation Report

Submitted to:

Nicor Gas Company
1844 Ferry Road
Naperville, IL 60563

Submitted by:

Navigant Consulting, Inc.
150 North Riverside
Suite 2100
Chicago, IL 60606
Phone 312.583.5700

Contact:

Randy Gunn
Managing Director
312.583.5714
randy.gunn@navigant.com

Kevin Grabner
Associate Director
608.497.2323
kevin.grabner@navigant.com

Laura Agapay-Read
Managing Consultant
312.583.4178
laura.agapay.read@navigant.com

TABLE OF CONTENTS

LIST OF TABLES AND FIGURES

1. INTRODUCTION

This report presents the results of the impact evaluation of the Nicor Gas 2018 Home Energy Savings (HES) Program. It presents a summary of the energy impacts for the total program and broken out by relevant measure and program structure details. The appendix presents the impact analysis methodology. The 2018 program covered January 1, 2018 through December 31, 2018.

2. PROGRAM DESCRIPTION

The HES Program includes an assessment and direct install component jointly implemented by Nicor Gas and Commonwealth Edison (ComEd) with Franklin Energy Services leading the program implementation and a rebate component for air sealing, insulation and duct sealing work completed by approved contractors. This report focuses on natural gas savings achieved by Nicor Gas program participants. Savings from electric measures are included in a separate evaluation report delivered to ComEd.

The HES Program provides a free home energy assessment performed by an energySMART energy advisor (energy advisor). The energy advisor collects information about the home's energy use by examining the heating system (e.g. furnace or boiler), cooling system (air conditioner), water heater, and attic (if accessible). The energy advisor provides a customized report with recommendations identifying additional ways the customer can save energy and money. As part of the energy assessment and when appropriate, the energy advisor installs or sets direct installation (DI) measures. These DI measures include showerheads, faucet aerators for bathrooms and kitchen, hot water pipe insulation, and installing and/or setting a programmable or advanced thermostat. In addition to the free home energy assessment and free direct install measures, the HES Program also offers rebates for air sealing, duct sealing, and building shell insulation (ASI) measures for eligible homes installed by an energySMART-approved contractor. Measures include air sealing, attic insulation, duct sealing, basement sidewall, and wall insulation. Air sealing includes sealing gaps and cracks in the wall where air can get in and out. The contractor performs a blower door test to measure the air leakage in the home. In order for participants to receive the instant discount for attic insulation, they must have air sealing and attic insulation installed at the same time.

The HES program reached 12,034 participant homes in 2018 (including those that received an assessment or other program services but did not result in claimed natural gas energy savings) and completed 9,380 gas energy saving projects at 9,284 unique homes as shown in Table 2-1.

Table 2-1. 2018 Volumetric Summary

Participation	ASI	DI	Total*
Total Participants †	1,477	10,607	12,034
Participants with Gas Energy Savings Projects	1,477	7,843	9,284
Installed Projects ‡	1,479	7,901	9,380

* Unique totals do not sum as there is overlap between participants that received ASI and DI measures.
† Participants are defined as unique building account numbers.
‡ Installed Projects are defined as unique Vendor Project IDs.
Source: Nicor Gas tracking data and Navigant team analysis.

Table 2-2 summarizes the installed measure quantities that are the basis for verified energy savings.

Table 2-2. 2018 Installed Measure Quantities

Measure	Quantity Unit	Installed Quantity*	Verified Quantity
Duct Sealing	Home	810	810
Air Sealing	Home	1,469	1,469
Basement/Sidewall Insulation	Square Feet	9,682	9,682
Attic Insulation	Square Feet	747,502	747,502
Wall Insulation	Square Feet	42,886	42,886
Programmable Thermostat – Single Family (SF)	Each	1,257	1,236
Thermostat Education – SF	Each	1,189	1,172
Advanced Thermostat (Manual Baseline) – SF	Each	392	378
Advanced Thermostat (Programmable Baseline) – SF	Each	516	510
Hot Water (HW) Pipe Insulation	Linear Feet	13,629	13,629
Bathroom Aerator	Each	7,679	7,679
Kitchen Aerator	Each	1,310	1,310
Showerhead	Each	9,155	9,155

* Installed Quantity is the sum of the reported quantity of measures which claimed savings. The quantity totals exclude measures with zero gross therms savings reported. Three measure types had instances of zero reported therms: Advanced Thermostat (DI) Blended, Programmable Thermostat, and Thermostat Education. We observed that measures with zero therms were paired with similar or identical measures in the same project that claimed savings. For example, in project PID-2018.03.30-0611, Advanced Thermostat Blended had zero savings, but Advanced Thermostat Manual reported savings for the project.
Source: Nicor Gas tracking data and Navigant team analysis.

3. PROGRAM SAVINGS SUMMARY

Table 3-1 summarizes the energy savings the HES Program achieved by path in 2018.

Table 3-1. 2018 Annual Energy Savings Summary

Program Path	Ex Ante Gross Savings (Therms)	Verified Gross RR†	Verified Gross Savings (Therms)	NTG‡	Verified Net Savings (Therms)
ASI	315,092	115%	363,204	1.05	381,364
DI – Faucet Aerators	10,436	100%	10,415	1.14§	11,872
DI – Advanced Thermostats	67,508	92%	62,210	NA§	62,210
DI – All Other Measures	291,892	99%	290,208	1.05	304,718
Total 2018*	**684,927**	**106%**	**726,037**		**760,165**

* Program Path savings values may not add up to Total due to rounding.
† Realization Rate (RR) is the ratio of verified gross savings to ex ante gross savings, based on evaluation research findings.
‡ Net-to-Gross (NTG) is the ratio of verified net savings to verified gross savings. The NTG is a deemed value. Source: Nicor Gas GPY7 NTG Values 2017-03-01 Final Faucet Aerator Correction 2019-03-20.xlsx, which is to be found on the Illinois SAG web site: http://ilsag.info/net-to-gross-framework.html.
§ Aerator measures are adjusted with a 1.14 NTG value. The IL TRM algorithm for advanced thermostat savings calculates net savings, so no NTG adjustment is applicable.
Source: Nicor Gas tracking data and Navigant team analysis.

4. PROGRAM SAVINGS BY MEASURE

The program includes 13 measure types as shown in Table 4-1. Thermostats, duct sealing, air sealing, and showerheads contributed the most savings respectively.

Table 4-1. 2018 Annual Energy Savings by Measure

Program Path	Measure Types	Ex Ante Gross Savings (Therms)	Verified Gross RR†	Verified Gross Savings (Therms)	NTG‡	Verified Net Savings (Therms)
ASI	Duct Sealing	158,634	103%	163,981	1.05	172,180
	Air Sealing	124,548	115%	143,654	1.05	150,837
	Basement/Sidewall Insulation	369	302%	1,116	1.05	1,172
	Attic Insulation	27,456	182%	49,840	1.05	52,332
	Wall Insulation	4,085	113%	4,613	1.05	4,843
Direct Install	Programmable Thermostat – SF	78,169	99%	77,346	1.05	81,213
	Thermostat Education – SF	74,064	99%	73,145	1.05	76,802
	Advanced Thermostat (Manual Baseline) – SF	29,144	115%	33,499	NA§	33,499
	Advanced Thermostat (Programmable Baseline) – SF	38,364	75%	28,711	NA§	28,711
	HW Pipe Insulation	11,125	100%	11,150	1.05	11,707
	Bathroom Aerator	6,698	100%	6,681	1.14	7,616
	Kitchen Aerator	3,738	100%	3,734	1.14	4,256
	Showerhead	128,534	100%	128,567	1.05	134,996
	Total 2018*	**684,927**	**106%**	**726,037**		**760,165**

* Measure-level savings values do not add up to Total due to rounding.

† Realization Rate (RR) is the ratio of verified gross to ex ante gross savings, based on evaluation research findings.

‡ Net-to-Gross (NTG) is the ratio of verified net savings to verified gross savings. The NTG is a deemed value. Source: Nicor Gas GPY7 NTG Values 2017-03-01 Final Faucet Aerator Correction 2019-03-20.xlsx, which is to be found on the Illinois SAG web site: http://ilsag.info/net-to-gross-framework.html.

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

Source: Nicor Gas tracking data and Navigant team analysis.

5. IMPACT ANALYSIS FINDINGS AND RECOMMENDATIONS

5.1 Impact Parameter Estimates

Table 5-1 shows the unit therm gross savings and realization rate findings by measure from our review. The realization rate is the ratio of the verified savings to the ex ante savings. Following the table, we provide findings and recommendations, including discussion of measures with realization rates above or below 100 percent. Appendix 1 provides a description of the impact analysis methodology.

Table 5-1. Verified Gross Savings Parameters

Measure	Unit Basis	Ex Ante Gross (therms/unit)*	Verified Gross (therms/unit)*	Realization Rate	Data Source(s)†
Duct Sealing	Home	195.84	202.45	103%	IL TRM v6.0, Section 5.3.4
Air Sealing	Home	84.78	97.79	115%	IL TRM v6.0, Section 5.6.1
Basement/Sidewall Insulation	Square Feet	0.04	0.12	302%	IL TRM v6.0, Section 5.6.2
Attic Insulation	Square Feet	0.04	0.07	182%	IL TRM v6.0, Section 5.6.4
Wall Insulation	Square Feet	0.09	0.11	113%	IL TRM v6.0, Section 5.6.4
Programmable Thermostat – SF	Each	Varies	Varies	99%	IL TRM v6.0, Section 5.3.11
Thermostat Education – SF	Each	Varies	Varies	99%	IL TRM v6.0, Section 5.3.11
Advanced Thermostat (Manual Baseline) – SF	Each	81.67	88.54	115%	IL TRM v6.0, Section 5.3.16
Advanced Thermostat (Programmable Baseline) – SF	Each	Varies	Varies	75%	IL TRM v6.0, Section 5.3.16
HW Pipe Insulation	Linear Feet	0.82	0.82	100%	IL TRM v6.0, Section 5.4.1
Bathroom Aerator	Each	0.87	0.87	100%	IL TRM v6.0, Section 5.4.4
Kitchen Aerator	Each	2.85	2.85	100%	IL TRM v6.0, Section 5.4.4
Showerhead	Each	14.04	14.04	100%	IL TRM v6.0, Section 5.4.5

* Per unit savings for duct sealing, air sealing, building shell insulation, and thermostat measures are project specific. The per unit savings values shown for these measures are averages across all participants.

† State of Illinois Technical Reference Manual version 6.0 from http://www.ilsag.info/technical-reference-manual.html.

5.2 Findings and Recommendations

All Measures: Climate Zone Mapping

Navigant found that certain zip codes in the tracking database had incorrect climate zones mapping.[1]

---

[1] Illinois Zip Codes and Climate Zones Mapping.xlsx

Table 5-2. Climate Zone Mapping by Zip Code

IL Zip Code	Tracking Climate Zone	TRM Climate Zone
61111	2	1
61114	2	1
60559	1	2
61764	3	2

Source: Nicor Gas tracking data and Navigant team analysis.

Recommendation 1: Navigant recommends the implementer correct the climate zones of projects installed in the zip codes identified in Table 5-2 to match the Illinois TRM.

Duct Sealing

Duct sealing has a gross energy savings realization rate of 103 percent. The realization rate for some projects are either 103 percent (762 measures) or 113 percent (48 measures).

The tracking system indicates that the implementer used Methodology 1: Modified Blower Door Subtraction from TRM (v6.0, section 5.3.4) Duct Insulation and Sealing to calculate savings.

$$\Delta Therm = (((\Delta CFM25_{DL} / (InputCapacityHeat * 0.0123)) * FLHheat * InputCapacityHeat * TRFheat * (\eta Equipment / \eta System)) / 100{,}000$$

Navigant relied on the tracking "CapacityHeatingEquipment" as the "InputCapacityHeat" of the system and the quantity field (which is the difference in pre and post install $\Delta CFM25DL$) to calculate the verified savings. Given the inconsistent differences between the verified and ex ante gross therms savings for duct sealing measures, Navigant includes an example duct sealing calculation in Appendix 1.

Recommendation 2: Navigant recommends the implementer investigate the duct sealing calculation inputs and algorithm in the tracking system to determine why the tracking inputs do not produce the verified savings and correct any errors (see Appendix 1 for example verified savings inputs for duct sealing).

Air Sealing, Attic and Wall Insulation

Air sealing has a gross energy savings realization rate of 115 percent; attic insulation and wall insulation have gross energy realization rates of 182 percent and 113 percent, respectively.

Navigant was unable to determine the exact cause of the difference in gross savings realization rates for air sealing, attic and wall insulation savings. However, Navigant spot-checked projects from this program year and last year and found that measures with similar savings' inputs have substantial differences in ex ante savings from GPY6 to 2018. Table 5-3 provides pairs of projects with similar (or identical) inputs; one project from GPY6 and the other project from 2018. In the case of the attic insulation and wall insulation projects, all inputs are identical within project pairs, and the verified savings is consistent between program years. However, the ex ante savings decreases from GPY6 to 2018. This suggests that there may be an error within the ex ante savings algorithm or that there are inputs being used that are not presented in the tracking data.

Table 5-3. Pairs of PY6 and 2018 Air Sealing and Insulation Projects with Inconsistent Ex Ante Savings

Year	Measure	VendorProjectID	PreInstall Value	PostInstall Value	Area	Ex Ante Savings	Verified Savings	Realization Rate
GPY6	Air Sealing	PRJ-149179	2580	1460	NA	97.52	97.52	100%
2018	Air Sealing	PID-2018.06.29-6326	2585	1395	NA	93.43	103.81	111%
GPY6	Attic Insulation	EA-0000245124	12	49	1500	89.70	89.70	100%
2018	Attic Insulation	PID-2018.05.17-2364	12	49	1500	41.81	89.70	215%
GPY6	Wall Insulation	PRJ-989483	5	19	150	16.94	16.94	100%
2018	Wall Insulation	PID-2018.06.05-4858	5	19	150	13.25	16.94	128%

Source: Navigant analysis of tracking data.

Air Sealing

From the tracking database, it appears the implementation contractor used TRM (v6.0, section 5.6.1) Methodology 1: Blower Door Test, to calculate savings for air sealing.

$$\Delta Therms = (((CFM50\_existing - CFM50\_new)/N\_heat) * 60 * 24 * HDD * 0.018) / (\eta Heat * 100{,}000)$$

Navigant verified the savings assumptions were consistent with the TRM deemed inputs, except for the custom input: infiltration at 50 Pascals as measured by blower door before and after air sealing (CFM50_existing and CFM50_new, labelled as "PreInstallValue" and "PostInstallValue" in the tracking database). Upon verification, we determined a gross savings realization rate of 115 percent. Navigant could not identify the cause of the savings discrepancy from the tracking data provided.

Given the inconsistent differences between the verified and ex ante gross therms savings for air sealing measures, Navigant has provided an example air sealing calculation in Appendix 1.

> **Recommendation 3:** The program implementer should investigate the tracking savings inputs and algorithm for air sealing to determine how they differ from the verified savings and correct any errors (see Appendix 1 for example verified savings inputs for air sealing).

Attic and Wall Insulation

From the tracking database, it appears the implementation contractor used TRM (v6.0, section 5.6.4) to determine gas savings.

$$\Delta Therms = ((((1/R\_old - 1/R\_wall) * A\_wall * (1-Framing\_factor\_wall)) + ((1/R\_old - 1/R\_attic) * A\_attic * (1-Framing\_factor\_attic))) * 24 * HDD) / (\eta Heat * 100{,}067 \text{ Btu/therm}) * ADJ_{WallAtticHeat}$$

Given the inconsistent differences between the verified and ex ante gross therms savings for attic and wall insulation, Navigant has provided an example attic insulation calculation in Appendix 1.

Recommendation 4: The program implementer should investigate the tracking savings inputs and algorithms for attic and wall insulation to determine how they differ from the verified savings and correct any errors (see Appendix 1 for example verified savings inputs for attic and wall insulation).

Basement/Sidewall Insulation

Basement/Sidewall insulation has a gross energy savings realization rate of 302 percent. All projects have a realization rate above 100 percent: realization rates ranged from 228 percent to 348 percent. The tracking data indicated all projects had a conditioned basement.

Navigant used the following formula from the TRM (v6.0, section 5.6.2) to determine gas savings.

$$\Delta Therms = [((([((1/R\_old\_AG - 1/(R\_added+R\_old\_AG)) * L\_basement\_wall\_total * H\_basement\_wall\_AG * (1-Framing\_factor) + (1/(R\_old\_BG - 1/(R\_added+R\_old\_BG)) * L\_basement\_wall\_total * (H\_basement\_wall\_total - H\_basement\_wall\_AG) * (1-Framing\_factor)] * 24 * HDD) / (\eta Heat * 100,067)] * ADJ_{BasementHeat}$$

Recommendation 5: The program implementer should investigate the tracking savings inputs and algorithm for basement and sidewall insulation to determine how they differ from the verified savings and correct any errors (see Appendix 1 for example verified savings inputs for basement/sidewall insulation).

HW Pipe Insulation

Hot Water (HW) pipe insulation has a gross energy savings realization rate of approximately 100 percent.

Navigant found that certain tracking data values are inputs for boiler pipe insulation (TRM v6.0, section 5.3.2), such as the tracking value 1,840 EFLH for climate zone 2 and bare pipe heat loss coefficient of 0.5 for boiler pipe insulation. However, the tracking data did not indicate that any of the measures were boiler pipe insulation measures in the measure name.

Navigant used the TRM inputs to calculate all projects' savings, except for the custom Rnew values from the tracking database. Navigant used the gas savings formula for hot water pipe insulation in TRM (v6.0, section 5.4.1).

$$\Delta Therm = ((1/Rexist – 1/Rnew) * (L*C) * \Delta T * 8,766) / nDHW / 100,000$$

Although the overall realization rate is approximately 100 percent for HW pipe insulation, there are several projects that do not have 100 percent realization rates. Navigant was unable to identify the cause for each project's discrepancy but has included observations in Table 5-4 below. The table shows there are projects with the same tracking data inputs but different gross savings realization rates.

Table 5-4. Tracking Data Pipe Insulation Project Savings Inputs and Gross Realization Rates

Project IDs	Total Number of Projects	Hours Value	ΔT	Rexist	Rnew	Realization Rate
PID-2018.0.3.30-1298, PID-2018.0.3.30-1744	2	8766	60	1.0	3.5	84%
PID-2018.0.3.30-0480, PID-2018.0.3.30-1743, plus others	6	8766	60	1.0	3.5	146%
PID-2018.05.23-3484, PID-2018.03.30-0604, plus others	113	1840	90	0.5	3.5	104-105%

Source: Navigant analysis of tracking data.

Recommendation 6. Navigant recommends the implementer distinguish between domestic hot water pipe insulation and boiler pipe insulation projects in the measure name.

Recommendation 7. Navigant recommends the implementer investigate and correct the ex ante savings calculations of the pipe insulation projects highlighted in Table 5-4.

Thermostats

There are four thermostat measures which are differentiated by thermostat and installation type offered in this program: Programmable Thermostat - DI, Thermostat Education, Advanced Thermostat - Manual Baseline, and Advanced Thermostat - Programmable Baseline.

Navigant used the TRM gas savings formula for Advanced Thermostats (v6.0, section 5.3.16), or (v6.0, section 5.3.11).

$$\Delta Therms = \%FossilHeat * Gas\_Heating\_Consumption * Heating\_Reduction * HF * Eff\_ISR$$

Navigant identified five inconsistencies in the thermostat ex ante savings calculations. These were related to multiple thermostats installed in a single home, climate zone dependent inputs, climate zone mapping, inconsistent residential building type, or wrong input value for installed thermostat baseline. Table 5-5 below lists these discrepancies.

Table 5-5. Discrepancies from Thermostat Ex Ante Savings

Measure	Example Project IDs	No. of Projects with Discrepancy	Discrepancy
Programmable Thermostat	PID-2018.03.30-0747, PID-2018.03.30-1160, plus others	39	**Multiple Thermostat Measures per Home** More than one thermostat or thermostat measures claimed at the same home
Programmable Thermostat	PID-2018.03.30-0404, PID-2018.03.30-0426, plus others	116	**Climate Zone Inputs** Ex ante savings calculated using climate zone 2 rather than site's climate zone
Programmable Thermostat	PID-2018.12.14-24634, PID-2019.01.14-30081, PID-2019.01.14-30709, PID-2019.01.14-30815	4	**Residential Building Type** Ex ante savings use a multi-family household factor for measures in single family homes (indicated in Residential building type field)
Thermostat Education	PID-2018.03.30-0468, PID-2018.03.30-0747, plus others	27	**Multiple Thermostat Measures per Home** More than one thermostat or thermostat measures claimed at the same home
Thermostat Education	PID-2018.03.30-0432, PID-2018.03.30-0783, plus others	55	**Climate Zone Inputs** Ex ante savings calculated using climate zone 2 rather than site's climate zone
Thermostat Education	PID-2018.07.26-7692, PID-2018.2019.01.14-29979	2	**Climate Zone Mapping** Tracking data improperly mapped zip code to climate zone. Climate zone is actually 1, not 2.
Advanced Thermostat (Programmable Baseline)	PID-2018.03.30-0401, PID-2018.03.30-0468, plus others	11	**Multiple Thermostat Measures per Home** More than one thermostat or thermostat measures claimed at the same home
Advanced Thermostat (Programmable Baseline)	PID-2018.03.30-0401, PID-2018.03.30-0407, plus others	515 (all)	**Baseline** Ex ante savings were calculated using a weighted baseline instead of site-specific values
Advanced Thermostat (Programmable Baseline)	PID-2018.03.30-0401, PID-2018.03.30-0407, plus others	515 (all)	**Climate Zone Inputs** Ex ante savings were calculated using a weighted climate zone instead of site-specific values
Advanced Thermostat (Manual Baseline)	PID-2018.03.30-0813, PID-2018.05.23-2933, plus others	17	**Multiple Thermostat Measures per Home** More than one thermostat or thermostat measures claimed at the same home
Advanced Thermostat (Manual Baseline)	PID-2018.03.30-0398, PID-03.30-0423, plus others	387 (all)	**Baseline** Ex ante savings were calculated using a weighted baseline instead of site-specific values.
Advanced Thermostat (Manual Baseline)	PID-2018.03.30-0398, PID-03.30-0423, plus others	387 (all)	**Climate Zone Inputs** Ex ante savings were calculated using a weighted climate zone instead of site-specific values

Source: Nicor Gas tracking data and Navigant team analysis.

(1) Multiple Thermostat Measures per Home

In approximately one percent of projects, Nicor Gas claimed savings for more than one thermostat or thermostat measure for a single "VendorProjectID." Claiming savings from more than one thermostat measure per household is prohibited by the IL TRM.

The TRM thermostat measures assign "household energy savings." To determine the verified savings, Navigant assumed that all installed thermostats shared equal responsibility for this "household energy savings." Thus, we averaged savings of all thermostats for a given project ID. For example, a home which installed two thermostats, one with 60 therm savings and another with 90 therm savings would be given 75 therm total savings.

> **Recommendation 8.** Navigant recommends the program claim savings for only one programmable thermostat, one advanced thermostat, or one thermostat education performed per household.

(2) Climate Zone Dependent Inputs

Navigant assigned site-specific climate zones using each project's zip code in the tracking data. The climate zones determined by Navigant were identical to those given in the tracking data (ClimateZone column), except for two projects. However, the implementer did not use these climate zones to inform the inputs used to calculate savings. The result of choosing the wrong climate zone is that the annual household heating consumption for gas heated single-family homes (Gas_Heating_Consumption) is inaccurate.

Navigant found that the ex ante per unit savings were the same for all advanced thermostat measures, regardless of a project's climate zone, residential building type, or baseline thermostat type. This suggests that an average was calculated, rather than calculating savings for projects individually using data available in the tracking system.

> **Recommendation 9.** Navigant recommends savings be determined on a project-specific basis and that the Gas_Heating_Consumption value used for each project correspond to that project's climate zone. Navigant recommends the program implementer add quality control steps to ensure the tracking system references the appropriate inputs based on the reported climate zones.

(3) Climate Zone Mapping

Two thermostat education projects (PID-2018.07.26-7692, PID-2018.2019.01.14-29979) were found to have the incorrect climate zone in the tracking data. The zip codes for the projects (61114, 61111) are in climate zone 1, not climate zone 2.

> **Recommendation 10.** Navigant recommends the implementer correct the ClimateZone field in the tracking system so it is consistent with the TRM mapping values. [2]

(4) Residential Building Type

Four programmable single-family thermostat projects used a multifamily household factor (65%) rather than a single family household factor (100%). Navigant found that the ex ante per unit savings were the same for all advanced thermostat measures, regardless of a project's climate zone, residential building type, or baseline thermostat type. This suggests that an average was calculated, rather than calculating savings for projects individually.

> **Recommendation 11.** Navigant recommends that the correct household factor for the residential buildings types participating in the HES Program be used in ex ante therms savings

---

[2] Illinois Zip Codes and Climate Zones Mapping.xlsx

calculations and that savings be calculated on a project-specific basis for thermostat measures.

(5) Thermostat Baseline

Navigant found that the ex ante per unit savings were the same for all advanced thermostat measures, regardless of a project's climate zone, residential building type, or baseline thermostat type. This suggests that an average was calculated, rather than calculating savings for projects individually using data that exists in the tracking system.

> **Recommendation 12.** Navigant recommends that the site-specific baseline be used in ex ante therms savings calculations and that savings be calculated on a project-specific basis for advanced thermostat measures, using data fields that exist in the tracking system.

6. APPENDIX 1. IMPACT ANALYSIS METHODOLOGY

6.1 Verified Gross Program Savings Analysis Approach

Navigant determined verified gross savings for each program measure by conducting a tracking system review. Navigant used the Illinois TRM version 6.0 methodology to calculate verified gross savings or relied on custom inputs as provided in the tracking database.

Given the inconsistent differences between the verified and ex ante therms savings for insulation and air and duct sealing measures, Navigant has provided example calculations below.

Duct Sealing Calculation: PID-2018.06.29-6205

$$\Delta Therm = (((\Delta CFM25_{DL} / (InputCapacityHeat * 0.0123)) * FLHheat * InputCapacityHeat * TRFheat * (\eta Equipment / \eta System)) / 100,000$$

- $\Delta CFM25_{DL}$ = Quantity = 315

- InputCapacityHeat = Capacity Existing Equipment = 75000

- FLHheat ((from TRM v6.0, CZ = 2) = 1840

- TRFheat ((from TRM v6.0, CZ = 2) = 0.4

- ηEquipment = Equipment Efficiency = 0.8

- ηSystem = 0.7

$$\Delta Therm = (((315 / (75000 * 0.0123)) * 1840 * 75000 * 0.4 * (0.8 / 0.7)) / 100,000$$

Verified gross ΔTherm = 215.41 therms
Ex ante gross therms = 209.43 therms

Air Sealing Calculation: PID-2018.06.29-6326

$$\Delta Therms = (((CFM50\_existing - CFM50\_new)/N\_heat) * 60 * 24 * HDD * 0.018) / (\eta Heat * 100,000)$$

- CFM50_existing = PreInstallValue = 2585

- CFM50_new = PostInstallValue = 1395

- N_heat (from TRM v6.0, CZ = 2) = 21.1

- HDD (from TRM v6.0, CZ = 2) = 5,113

- ηHeat (from TRM v6.0) = 0.72

$$\Delta Therms = (((2585 - 1395)/21.1) * 60 * 24 * 5113 * 0.018) / (0.72 * 100,000)$$

Verified gross ΔTherms = 103.81 therms
Ex ante gross therms = 93.43 therms

Attic Insulation Calculation: PID-2018.05.17-2364

The following calculation is for an attic insulation measure. The same formula is used for wall insulation measures.

$$\Delta Therms = ((((1/R\_old - 1/R\_wall) * A\_wall * (1-Framing\_factor\_wall)) + ((1/R\_old - 1/R\_attic) * A\_attic * (1-Framing\_factor\_attic))) * 24 * HDD) / (\eta Heat * 100{,}067\ Btu/therm) * ADJ_{WallAtticHeat}$$

- R_old = PreInstallValue = 12

- R_attic = PostInstallValue = 49

- A_attic = Quantity = 1500

- Framing_factor_attic (TRM v6.0) = 0.07

- HDD (TRM v6.0, CZ = 2) = 5113

- nHeat (TRM v6.0) = 0.72

- ADJ_wallatticheat (TRM v6.0) = 0.6

$\Delta Therms = ((1/12 - 1/49) * 1500 * (1 - 0.07) * 24 * 5113) * 0.6 / (0.72 * 100067)$

Verified gross ΔTherms = 89.70 therms
Ex ante gross therms = 41.81 therms

Basement Sidewall Insulation Calculation: PID-2018.05.17-2336

$$\Delta Therms = [(((((1/R\_old\_AG - 1/(R\_added+R\_old\_AG)) * L\_basement\_wall\_total * H\_basement\_wall\_AG * (1-Framing\_factor) + (1/(R\_old\_BG - 1/(R\_added+R\_old\_BG)) * L\_basement\_wall\_total * (H\_basement\_wall\_total - H\_basement\_wall\_AG) * (1-Framing\_factor)] * 24 * HDD) / (\eta Heat * 100{,}067)] * ADJ_{BasementHeat}$$

- R_old_ag = RValueExistingAboveground = 5

- R_added = PostInstallValue = 15

- L_basement * H_basement_AG = TotalSqFeetAboveGrade = Quantity = 74

- Framing_factor (TRM v6.0) = 0.25

- R_old_BG = RValueExistingBelowGround = 5

- L_basement * H_basement_BG = TotalSqFeetBelowGrade = 0

- HDD (TRM v6.0, CZ = 2) = 5,113

- nHeat (TRM v6.0) = 0.72

- ADJ_BasementHeat = 0.6

ΔTherms = ((1/5 − 1/(15+5)) * 1 * (1 − 0.25) + (1/5 - 1/(15+5)) * 0 * (1 − 0.25)) * 24 * 5113 / (0.72 * 100067) * 0.6

Verified gross ΔTherms = 8.51 therms
Ex ante gross therms = 2.79 therms

6.2 Verified Net Program Savings Analysis Approach

Navigant calculated verified net energy savings by multiplying the verified gross savings estimates by a net-to-gross (NTG) ratio. In 2018, the NTG estimates used to calculate the net verified savings were based on past evaluation research and defined by a consensus process through SAG, as documented in a spreadsheet.[3]

---

[3] Source: Nicor Gas GPY7 NTG Values 2017-03-01 Final Faucet Aerator Correction 2019-03-20.xlsx, which is to be found on the IL SAG web site here: http://ilsag.info/net-to-gross-framework.html. The NTG corrected for aerators is 1.14 (based on zero free ridership and 14 percent spillover) and the NTG is 1.05 for all other measures except advanced thermostats. The Illinois TRM version 6.0 algorithm for advanced thermostats calculates net savings – no further NTG adjustment is required.

7. APPENDIX 2. PROGRAM-SPECIFIC INPUTS FOR THE ILLINOIS TRC

Table 7-1, the Total Resource Cost (TRC) variable table, only includes cost-effectiveness analysis inputs available at the time of finalizing the 2018 HES 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 the evaluation later. Detail in this table (e.g., EULs), other than final 2018 savings and program data, are subject to change and are not final.

Table 7-1. Total Resource Cost Savings Summary

Measure	Units	Quantity	Effective Useful Life	Ex Ante Gross Savings (Therms)	Verified Gross Savings (Therms)	Verified Net Savings (Therms)
Air Sealing	Home	1,469	15	124,548	143,654	150,837
Attic Insulation	Square Feet	747,502	25	27,456	49,840	52,332
Basement/Sidewall Insulation	Square Feet	9,682	25	369	1,116	1,172
Bathroom Aerator	Each	7,679	9	6,698	6,681	7,616
Duct Sealing	Home	810	20	158,634	163,981	172,180
HW Pipe Insulation	Linear Feet	13,629	15	11,125	11,150	11,707
Kitchen Aerator	Each	1,310	9	3,738	3,734	4,256
Programmable Thermostat – SF	Each	1,236	5	78,169	77,346	81,213
Showerhead	Each	9,155	10	128,534	128,567	134,996
Advanced Thermostat (Manual Baseline) – SF	Each	378	10	29,144	33,499	33,499
Advanced Thermostat (Programmable Baseline) – SF	Each	510	10	38,364	28,711	28,711
Thermostat Education – SF	Each	1,172	2	74,064	73,145	76,802
Wall Insulation	Square Feet	42,886	25	4,085	4,613	4,843
Total/Weighted Average		**837,418**	**13**	**684,927**	**726,037**	**760,165**

Source: Nicor Gas tracking data and Navigant team analysis.