



# Multi-Family Home Energy Savings Evaluation Report

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

Presented to  
Nicor Gas

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## 1. INTRODUCTION

This report presents the results of the impact evaluation of the Nicor Gas 2018 Multi-Family Home Energy Savings (MFHES) 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 covers January 1, 2018 through December 31, 2018.

## 2. PROGRAM DESCRIPTION

The MFHES Program is delivered through two channels: the direct install path, which provides free assessment and no-cost direct installation of measures in residential multi-family buildings with five or more living units; and the prescriptive path, which offers prescriptive and custom incentives to multi-family decision-makers to install energy savings measures in common areas of multi-family buildings.

The MFHES Program had 186 participants in 2018 and completed 4,746 projects as shown in the following table.

**Table 2-1. 2018 Volumetric Summary**

Participation	Direct Install	Prescriptive	Custom	Total
Participants	143	42	1	186*
Installed Projects	4,666	79	1	4,746†
Total Measures <sup>1</sup>	7,652	79	1	7,732

\* Unique participants represent property owners or managers

† Unique Installed Projects

Source: Nicor Gas tracking data and Navigant team analysis.

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

<sup>1</sup> If measure units were reported in the tracking system as linear feet or square feet, or the measure was a custom project, Navigant treated each row entry of such measure as one measure quantity in this table.

**Table 2-2. 2018 Installed Measure Quantities**

Measure	Quantity Unit	Installed Quantity
Bath Aerator (CA)	Each	19
Bath Aerator (IU)	Each	1,540
Boiler Tune-up, Space Heating	Each	1
CDHW Controls	Each	20
Condensing Boilers	Each	19
Custom	Project	1
Efficient Furnace	Each	11
Hydronic Boilers	Each	10
Kitchen Aerator (CA)	Each	3
Kitchen Aerator (IU)	Each	898
Outdoor Pool Covers	Square Feet	2,672
Pipe Insulation (HW)	Linear Feet	3,502
Pipe Insulation (Indoor HW Space Heat)	Linear Feet	19,061
Programmable Thermostat (CA)	Each	15
Programmable Thermostat (IU)	Each	1,494
Reprogrammable Thermostat (IU)	Each	110
Showerhead (CA)	Each	26
Showerhead (IU)	Each	3,497
Storage Water Heater	Each	2

*Source: Nicor Gas tracking data and Navigant team analysis.*

### 3. PROGRAM SAVINGS SUMMARY

Table 3-1 summarizes the energy savings the MFHES 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)
Prescriptive	157,930	89%	141,237	0.94	132,763
Direct Install	147,283	100%	147,200	0.95/0.94‡	139,831
Custom	35,567	100%	35,567	0.94	33,433
<b>Total</b>	<b>340,780</b>	<b>95%</b>	<b>324,004</b>	<b>NA</b>	<b>306,027</b>

\* 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. Program did not use TRM specified baseline average water flow rates for in-unit faucet aerators, hence the NTG is deemed at 0.95. 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>.

‡ For common area measures, the deemed NTG is 0.94, and In-Unit (IU) is 0.95.

Source: Nicor Gas tracking data and Navigant team analysis.

## 4. PROGRAM SAVINGS BY MEASURE

The MFHES Program includes 20 measures as shown in the following table. The pipe insulation, programmable thermostat, showerhead, and boiler measures contributed the most savings.

**Table 4-1. 2018 Annual Energy Savings by Measure**

Program Path	Research Category	Ex Ante Gross Savings (Therms)	Verified Gross RR*	Verified Gross Savings (Therms)	NTG†	Verified Net Savings (Therms)
Direct Install	Bath Aerator (CA) <sup>2</sup>	19	608%	116	0.94	109
	Bath Aerator (IU)	2,420	100%	2,423	0.95	2,302
	Kitchen Aerator (CA)	10	224%	22	0.94	21
	Kitchen Aerator (IU)	2,344	100%	2,346	0.95	2,228
	Pipe Insulation (HW)	13,961	100%	13,961	0.95	13,263
	Programmable Thermostat (CA)	233	100%	233	0.94	219
	Programmable Thermostat (IU)	60,613	100%	60,509	0.95	57,484
	Reprogrammable Thermostat (IU)	4,535	98%	4,455	0.95	4,232
	Showerhead (CA)	565	100%	563	0.94	529
	Showerhead (IU)	62,583	100%	62,573	0.95	59,444
Prescriptive	Boiler Tune-up, Space Heating	966	106%	1,026	0.94	964
	CDHW Controls	25,080	100%	25,075	0.94	23,570
	Condensing Boilers	31,227	100%	31,227	0.94	29,353
	Efficient Furnace	1,296	103%	1,341	0.94	1,260
	Hydronic Boilers	15,039	100%	15,039	0.94	14,136
	Outdoor Pool Covers	2,699	100%	2,699	0.94	2,537
	Pipe Insulation (Indoor HW Space Heat)	80,748	80%	64,265	0.94	60,409
	Programmable Thermostat (CA)	116	100%	116	0.94	109
Custom	Storage Water Heater	759	59%	450	0.94	423
	Custom	35,567	100%	35,567	0.94	33,433
<b>Total</b>		<b>340,780</b>	<b>95%</b>	<b>324,004</b>	<b>NA</b>	<b>306,027</b>

\* 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. Program did not use TRM specified baseline average water flow rates for in-unit faucet aerators, hence the NTG is deemed at 0.95. 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>.

Source: Nicor Gas tracking data and Navigant team analysis.

<sup>2</sup> The NTG for in-unit aerator measures is maintained at 0.95 since the ex ante baseline GPM values are not as specified in the TRM.

## 5. IMPACT ANALYSIS FINDINGS AND RECOMMENDATIONS

### 5.1 Parameter Estimates

Table 5-1 shows the unit therm 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 all 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)
Bath Aerator (CA)	Each	1.00	6.10	608%	Illinois TRM, v6.0† (TRM), Section 4.3.2
Bath Aerator (IU)	Each	1.57	1.57	100%	TRM Section 5.4.4
Kitchen Aerator (CA)	Each	3.32	7.44	224%	TRM Section 4.3.2
Kitchen Aerator (IU)	Each	2.61	2.61	100%	TRM Section 5.4.4
DI Pipe Insulation (HW)	Linear Feet	Vary	Vary	100%	TRM Section 4.4.14
Programmable Thermostat (CA)	Each	23.22	23.26	100%	TRM Section 4.4.18
Programmable Thermostat (IU)	Each	40.49	40.50	100%	TRM Section 5.3.11
Reprogrammable Thermostat (IU)	Each	40.49	40.50	100%	TRM Section 5.3.11
Showerhead (CA)	Each	21.73	21.64	100%	TRM Section 4.3.3
Showerhead (IU)	Each	17.90	17.89	100%	TRM Section 5.4.5
Boiler Tune-up, Space Heating	Each	966	1,026	106%	TRM Section 4.4.2
CDHW Controls	Each	1,254.00	1,253.74	100%	TRM Section 4.3.8
Condensing Boilers	Each	Vary	Vary	100%	TRM Section 4.4.10
Efficient Furnace	Each	Vary	Vary. Adjusted	103%	TRM Section 5.3.7
Hydronic Boilers	Each	Vary	Vary	100%	TRM Section 4.4.10
Outdoor Pool Covers	Square Feet	1.01	1.01	100%	TRM Section 4.3.4
Pipe Insulation (Indoor HW Space Heat)	Linear Feet	Vary	3.372	80%	TRM Section 4.4.14
Storage Water Heater	Each	379.42	225.18	59%	TRM Section 4.3.5
Custom	Project	35,567	35,567	100%	PTD & Evaluation

\* Program Tracking Data (PTD) provided by Nicor Gas, extract dated February 11, 2019.

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

### 5.2 Findings and Recommendations

#### *Pipe Insulation (Indoor HW Space Heat)*

Navigant reviewed the tracking data savings inputs and found the verified savings do not match the ex ante savings. We determined an 80 percent gross savings realization rate. Navigant revised the efficiency of the boiler from 64.8 percent (multi-family low pressure steam boiler) to 81.9 percent (water boiler) as per the IL TRM v6.0. We also updated the Thermal Regain Factor (TRF) values for this measure to match



the corresponding space type provided in the field “EquipmentLocation” of the tracking data as per the IL TRM v6.0 (Measure 4.4.14)

**Recommendation 1:** Nicor Gas and the implementation contractor should review the equation and the savings inputs in the tracking system for pipe insulation (indoor HW space heating), to ensure inputs are consistent with the calculated the ex-ante savings.

**Recommendation 2:** Nicor Gas should update the tracking data to track the appropriate deemed boiler efficiency values for the boiler type and space defined in the tracking database. Nicor Gas should ensure that the space type in the field “EquipmentLocation” of the tracking data corresponds with the Thermal Regain Factor (TRF) used in the ex ante calculations, as per the IL TRM v6.0.

### *Programmable Thermostats (CA)*

The verified gross realization rate for this measure is 100 percent. Navigant calculated verified savings using the equation from the C&I volume of the TRM for the office – low rise building type with intermittent fan mode during occupied period and 5°F of heating setback as per the tracking data.

**Recommendation 3:** Nicor Gas should consider adding a tracking field that specifies the fan mode during the occupied period as part of the tracking data.

### *Programmable Thermostats (IU) and Reprogrammable Thermostats (IU)*

Navigant identified five projects that had two programmable thermostats for a household (e.g. PID-2018.05.24-4191, PID-2018.05.24-4227, PID-2018.05.24-4238, PID-2018.06.05-5260 and PID-2018.12.03-22547). The verified total savings for these projects were capped at one thermostat per household as per the IL TRM v6.0. This adjustment does not affect the per unit savings values shown in Table 5-1 above but were applied to the final total savings from this measure.

**Recommendation 4:** Nicor Gas should collect the apartment number information for projects for thermostat measures, to verify that the savings are claimed for just one thermostat per household as required by the TRM.

### *Bath Aerator (CA), Kitchen Aerator (CA)*

The program implementer calculated ex ante savings for common area faucet aerators using savings algorithm from the residential volume of the TRM (measure section 5.4.4) and household factor, faucets per household parameter, and in-service rate values corresponding to a single-family household type. Navigant calculated verified savings using the savings algorithm from the commercial volume of the TRM (measure section 4.3.2) with Usage corresponding to the ‘Other’ building type. This resulted in 608 percent and 224 percent gross realization rates respectively for common area bathroom and kitchen aerators.

**Recommendation 5:** Nicor Gas and the program implementer should use the commercial volume of the TRM for multifamily common area faucet aerator measures with usage corresponding to the ‘Other’ building type.

### *Bath Aerator (IU)*

The gross realization rate for bathroom aerator (in unit) is 100 percent. However, for a total of 19 project IDs (Example: PID-2018.06.05-5100, PID-2018.06.05-5152), the ex ante savings for the project IDs corresponds with the ex ante savings for a quantity of one, while the quantity as per the tracking data for each project ID is two. Upon further inquiry, Nicor Gas confirmed that the quantity was supposed to be

two and that the tracking savings for the projects were to be doubled. Navigant verified and calculated a gross savings realization rate of 100 percent.

**Recommendation 6:** Nicor Gas should review the tracking data savings calculation protocol for automated calculation of total therms savings whenever a savings input parameter is changed.

### *Boiler Tune-up, Space Heating*

Navigant found that the heating equivalent full load hours (EFLH) in the tracking data correspond with the EFLH values for the Office – Mid Rise building type and are not consistent with the corresponding values in the TRM for the multi-family building type. The tracking data also showed a post installation efficiency value of 0.8, however upon additional information provided by Nicor Gas, Navigant updated the value to 0.757. The changes resulted in 106 percent gross realization rate.

**Recommendation 7:** Nicor Gas should use the EFLH values valid for the Multi-family building type for this measure as per the IL TRM v6.0. Nicor Gas should increase quality control of manual entry of post installation actual efficiency values in to the tracking data for improved accuracy of the tracking data.

### *Furnace (IU)*

Navigant verified 100 percent gross savings realization rate for several of the furnace projects, however, Navigant could not replicate the ex ante savings for the following three model numbers (Airease - A96US2V090C12S-02, American Standard - S9X2B060U3PSA\*\* and Goodman - GMSS961005CN) using the savings algorithm from the IL TRM v6.0 (Measure 5.3.7) and tracking data inputs. The overall verified gross realization rate for the furnace measure was 103 percent using the TRM v6.0.

**Recommendation 8:** Nicor Gas should be consistent with the savings algorithm and input parameters used to calculate the ex ante savings for all furnace measures.

### *CDHW Controls*

The realization rate for this measure is 100 percent. Navigant found that the number of apartments are not a tracking input, however, the ex ante savings are based on an assumption of 20 apartments per building, and with 62.7 therms value for one apartment, given a total annual gross annual therm savings as 1,254 therms.

**Recommendation 9:** Nicor Gas should add a field that specifies the number of apartments for each building as part of the tracking system.

### *Storage Water Heater*

The tracking data ex ante savings for storage water heaters were calculated using the savings algorithm and input parameters from the IL TRM v6.0 (section 4.3.1, Storage Water Heater). Navigant's verified savings are calculated using the TRM section 4.3.5 (Tankless Water Heater) since the model number of the equipment corresponds to a tankless water heater. The adjustment resulted in 59 percent gross savings realization rate.

**Recommendation 10:** Navigant recommends using the savings algorithm and input parameters from the appropriate measure of the IL TRM v6.0 based on the type of equipment installed.

*Custom*

For Project PID-2019.01.16-34099 the tracking data has 36,570 therms as the ex ante savings while the project calculator file has 35,567 therms as the ex ante savings. Upon further inquiry, Nicor Gas confirmed the calculator file ex ante is the correct value. For this project, savings are claimed for the replacement of three existing and operational 3,000 MBH input capacity natural gas fired atmospheric hot water boilers with three 3,000 MBH input capacity condensing boilers. The existing boiler plant energy usage is used along with the efficiency of the existing boilers and the efficiency of the new boilers to calculate the ex ante savings. However, no information is provided regarding the remaining useful life of the existing boilers. Additionally, the existing boiler plant usage is a hard-coded value and no source is quoted for the same. The verified savings are calculated assuming an early replacement baseline and the existing boiler plant usage as provided in the project files which results in a 100 percent realization rate as per the calculator file.

**Recommendation 11:** Nicor Gas should provide a note for hard-coded values in the savings calculator. The remaining useful life of the existing boilers should be a tracked parameter to determine the correct baseline for projects. Nicor Gas should ensure the ex ante savings in the tracking data and the project calculator file are consistent.

## 6. APPENDIX 1. IMPACT ANALYSIS METHODOLOGY

Navigant determined verified gross savings for each program measure by:

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

The deemed savings verification approach was supplemented by engineering file review of the one custom Multi-Family project. Navigant verified the measures installed and the savings reported for this project.

### *Engineering Review of Project Files*

Additionally, the evaluation team conducted engineering desk file review for of the one custom project installed in 2018, to verify project savings that were not based on measures specified in the TRM.

For the custom project, an in-depth application review was performed by a Navigant engineer to assess the engineering methods, parameters and assumptions used to generate all ex ante impact estimates. We reviewed project documentation in hardcopy application forms and supporting documentation from the applicant (invoices, measure specification sheets, pre-inspection reports, post-inspection reports and calculation spreadsheet).

Table 6-1 provides a summary of M&V results for the custom project reviewed by Navigant.

**Table 6-1. 2018 Summary of Custom M&V Results**

Project ID (PID-)	Measure Description	Ex Ante Gross Savings (Therms)	Gross Realization Rate	Verified Gross Savings (Therms)	Summary of Adjustment
2019.01.16-34099	Boiler Replacement	35,567	100%	35,567	None

Source: Navigant analysis of program data.

## 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 MFHES Program impact evaluation report. Additional required cost data (e.g., measure costs, program level incentive and non-incentive costs) are not included in the tables and will be provided to the evaluation team later. Detail in the TRC tables (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**

Program Path	Research Category	Units	Quantity	Effective Useful Life*	Ex Ante Gross Savings (Therms)	Verified Gross Savings (Therms)	Verified Net Savings (Therms)
Direct Install	Bath Aerator (CA)	Each	19	9	19	116	109
	Bath Aerator (IU)	Each	1,540	9	2,420	2,423	2,302
	Kitchen Aerator (CA)	Each	3	9	10	22	21
	Kitchen Aerator (IU)	Each	898	9	2,344	2,346	2,228
	Pipe Insulation (HW)	Ln. Ft.	3,502	15	13,961	13,961	13,263
	Programmable Thermostat (CA)	Each	10	4	233	233	219
	Programmable Thermostat (IU)	Each	1,494	5	60,613	60,509	57,484
	Reprogrammable Thermostat (IU)	Each	110	2	4,535	4,455	4,232
	Showerhead (CA)	Each	26	10	565	563	529
	Showerhead (IU)	Each	3,497	10	62,583	62,573	59,444
Prescriptive	Boiler Tune-up, Space Heating	Each	1	3	966	1,026	964
	CDHW Controls	Each	20	15	25,080	25,075	23,570
	Condensing Boilers	Each	19	20	31,227	31,227	29,353
	Efficient Furnace	Each	11	20	1,296	1,341	1,260
	Hydronic Boilers	Each	10	20	15,039	15,039	14,136
	Outdoor Pool Covers	Sq. Ft.	2,672	6	2,699	2,699	2,537
	Pipe Insulation (Indoor HW Space Heat)	Ln. Ft.	19,061	15	80,748	64,265	60,409
	Programmable Thermostat (CA)	Each	5	4	116	116	109
Custom	Storage Water Heater	Each	2	20	759	450	423
	Custom (Boiler)	Project	1	20	35,567	35,567	33,433
<b>Total</b>					<b>340,780</b>	<b>324,004</b>	<b>306,027</b>

\*State of Illinois Technical Reference Manual version 6.0 from <http://www.ilsaq.info/technical-reference-manual.html>.