



Multi-Family Energy Savings Program Impact Evaluation Report

Energy Efficiency Plan: Plan Year 2019
(1/1/2019-12/31/2019)

Presented to
Nicor Gas Company

FINAL

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Multi-Family Energy Savings Evaluation Report

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1. INTRODUCTION

This report presents the results of the impact evaluation of the Nicor Gas 2019 Multi-Family Energy Savings (MFES) Program for market-rate properties. 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. Program year 2019 covers January 1, 2019 through December 31, 2019.

2. PROGRAM DESCRIPTION

The MFES Program is delivered through three channels: the direct install path offered jointly with ComEd, which provides free assessment and no-cost direct installation in-unit (IU) of measures in residential multi-family buildings with five or more living units; and prescriptive and custom paths where incentives are offered to multi-family decision-makers to install energy saving measures in common areas (CA) of multi-family buildings.

The MFES Program had 276 participants in 2019 and completed 7,594 projects as shown in the following table. A total of 11,250 measures were implemented, including 10,962 from the direct install path.

Table 2-1. 2019 Volumetric Summary

| Participation | Direct Install | Prescriptive | Custom | Total |
|----------------------|----------------|--------------|--------|--------|
| Participants * | 128 | 147 | 1 | 276 |
| Installed Projects † | 7,339 | 254 | 1 | 7,594 |
| Total Measures‡ | 10,962 | 287 | 1 | 11,250 |

* Participants are defined as unique building account numbers

† Installed Projects are defined as unique vendor project ID

‡ If measure units were reported in the tracking system as linear feet or square feet, or the measure was a custom project, Guidehouse treated each row entry of such measure as one measure quantity in this table.

Source: Nicor Gas tracking data and Guidehouse team analysis.

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

Table 2-2. 2019 Installed Measure Quantities

| Program Path | Measure | Quantity Unit | Installed Quantity |
|------------------|---|---------------|--------------------|
| Direct Install | Programmable Thermostat (IU) | Unit | 2,004 |
| | Showerhead (IU) | Unit | 3,569 |
| | Hot Water (HW) Pipe Insulation | Linear Feet | 18,241 |
| | Advanced Thermostat | Unit | 345 |
| | Kitchen Aerator (IU) | Unit | 1,898 |
| | Bath Aerator (IU) | Unit | 2,939 |
| | Showerhead (CA) | Unit | 19 |
| | Reprogram Thermostat (IU) | Unit | 12 |
| | Bath Aerator (CA) | Unit | 50 |
| | Programmable Thermostat (CA) | Unit | 13 |
| | Kitchen Aerator (CA) | Unit | 20 |
| Prescriptive | Condensing Boilers | Unit | 30 |
| | Boiler Tune Up | Unit | 132 |
| | Boiler Reset Controls | Unit | 17 |
| | Outdoor Pool Covers | Square Feet | 5,455 |
| | Steam Traps | Unit | 34 |
| | Furnace | Unit | 39 |
| | Pipe Insulation - Indoor Domestic Hot Water (DHW) | Linear Feet | 1,299 |
| | Pipe Insulation – Indoor Space Heat | Linear Feet | 2,353 |
| | Programmable Thermostat (CA) | Unit | 26 |
| Hydronic Boilers | Unit | 1 | |
| Custom | Custom | Unit | 1 |

Source: Nicor Gas tracking data and Guidehouse team analysis.

3. SAVINGS SUMMARY

Table 3-1 summarizes the energy savings the MFES Program achieved by path in 2019.

Table 3-1. 2019 Annual Energy Savings Summary

| Program Path | Ex Ante Gross Savings (Therms) | Verified Gross RR* | Verified Gross Savings (Therms) | NTG† | Verified Net Savings (Therms) |
|----------------|--------------------------------|--------------------|---------------------------------|---------------|-------------------------------|
| Direct Install | 220,320 | 100% | 220,339 | 0.95/1.02/NA‡ | 213,259 |
| Prescriptive | 158,228 | 104% | 164,269 | 0.94 | 154,413 |
| Custom | 20,724 | 120% | 24,888 | 0.94 | 23,394 |
| Total | 399,272 | 103% | 409,495 | NA | 391,066 |

NA = Not applicable

* 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_NTG_History_and_2019_Recommendations_2018-10-01_Final Aerator Showerhead Correction 2019-04-12.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, so no NTG adjustment is applicable

Source: Nicor Gas tracking data and Guidehouse team analysis.

4. PROGRAM SAVINGS BY MEASURE

The program includes 21 measures as shown in the following table. The Programmable Thermostat (IU) and Condensing Boiler measures contributed the most savings.

Table 4-1. 2019 Annual Energy Savings by Measure - Program Total

| Program Path | Research Category | Ex Ante Gross Savings (Therms) | Verified Gross RR* | Verified Gross Savings (Therms) | NTG† | Verified Net Savings (Therms) |
|----------------|-------------------------------------|--------------------------------|--------------------|---------------------------------|-----------|-------------------------------|
| Direct Install | Programmable Thermostat (IU) | 92,215 | 100% | 92,256 | 0.95 | 87,643 |
| | HW Pipe Insulation | 55,784 | 100% | 55,802 | 0.95 | 53,012 |
| | Showerhead (IU) | 40,432 | 100% | 40,391 | 1.02 | 41,199 |
| | Advanced Thermostat ¹ | 19,833 | 100% | 19,833 | NA | 19,833 |
| | Kitchen Aerator (IU) ² | 4,958 | 100% | 4,958 | 0.95 | 4,710 |
| | Bath Aerator (IU) | 4,624 | 100% | 4,624 | 0.95 | 4,393 |
| | Showerhead (CA) | 1,233 | 100% | 1,233 | 1.02 | 1,258 |
| | Reprogram Thermostat (IU) | 486 | 100% | 486 | 0.95 | 462 |
| | Bath Aerator (CA) | 305 | 100% | 305 | 1.02 | 311 |
| | Programmable Thermostat (CA) | 302 | 100% | 302 | 0.95 | 287 |
| Prescriptive | Kitchen Aerator (CA) | 149 | 100% | 149 | 1.02 | 152 |
| | Condensing Boilers | 81,795 | 107% | 87,836 | 0.94 | 82,566 |
| | Boiler Tune Up | 43,225 | 100% | 43,225 | 0.94 | 40,631 |
| | Boiler Reset Controls | 9,453 | 100% | 9,453 | 0.94 | 8,886 |
| | Outdoor Pool Covers | 5,510 | 100% | 5,510 | 0.94 | 5,179 |
| | Steam Traps | 5,020 | 100% | 5,020 | 0.94 | 4,719 |
| | Furnace | 4,056 | 100% | 4,056 | 0.94 | 3,812 |
| | Pipe Insulation – Indoor DHW | 3,771 | 100% | 3,771 | 0.94 | 3,545 |
| | Pipe Insulation – Indoor Space Heat | 4,262 | 100% | 4,262 | 0.94 | 4,006 |
| | Programmable Thermostats (CA) | 605 | 100% | 605 | 0.94 | 568 |
| Custom | Hydronic Boilers | 533 | 100% | 532 | 0.94 | 501 |
| | Custom | 20,724 | 120% | 24,888 | 0.94 | 23,394 |
| Total | | 399,272 | 103% | 409,495 | NA | 391,066 |

NA = Not applicable

* 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_NTG_History_and_2019_Recommendations_2018-10-01_Final Aerator Showerhead Correction 2019-04-12.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 Guidehouse team analysis.

¹ The IL TRM algorithm for advanced thermostat savings calculates net savings, so no NTG adjustment is applicable.

² The NTG for In-unit (IU) 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 Impact 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%. 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)* |
|-------------------------------------|------------|-----------------------------|------------------------------|------------------|----------------------------------|
| Programmable Thermostat (IU) | Unit | Varies | Varies | 100% | TRM† Section 5.3.11 |
| HW Pipe Insulation | LN FT | Varies | Varies | 100% | TRM Section 4.4.14 |
| Showerhead (IU) | Unit | 11.32 | 11.32 | 100% | TRM Section 5.4.5 |
| Advanced Thermostat | Unit | 57.49 | 57.49 | 100% | TRM Section 5.3.16 |
| Kitchen Aerator (IU) | Unit | 2.61 | 2.61 | 100% | TRM Section 5.4.4 |
| Bath Aerator (IU) | Unit | 1.57 | 1.57 | 100% | TRM Section 5.4.4 |
| Showerhead (CA) | Unit | 64.90 | 64.90 | 100% | TRM Section 4.3.3 |
| Reprogram Thermostat (IU) | Unit | Varies | Varies | 100% | TRM Section 5.3.11 |
| Bath Aerator (CA) | Unit | 6.10 | 6.10 | 100% | TRM Section 4.3.2 |
| Kitchen Aerator (CA) | Unit | 7.44 | 7.44 | 100% | TRM Section 4.3.2 |
| Condensing Boilers | Unit | Varies | Varies | 107% | TRM Section 4.4.10 |
| Boiler Tune Up | Unit | Varies | Varies | 100% | TRM Section 4.4.2 and 4.4.3 |
| Boiler Reset Controls | Unit | Varies | Varies | 100% | TRM Section 4.4.4 |
| Outdoor Pool Covers | SQ FT | 1.01 | 1.01 | 100% | TRM Section 4.3.4 |
| Steam Traps | Unit | 147.64 | 147.64 | 100% | TRM Section 4.4.16 |
| Furnace | Unit | Varies | Varies | 100% | TRM Section 5.3.7 |
| Pipe Insulation - Indoor DHW | LN FT | Varies | Varies | 100% | TRM Section 4.4.14 |
| Pipe Insulation - Indoor Space Heat | LN FT | Varies | Varies | 100% | TRM Section 4.4.14 |
| Programmable Thermostat (CA) | Unit | 23.26 | 23.26 | 100% | TRM Section 4.4.18 |
| Hydronic Boiler | Unit | Varies | Varies | 100% | TRM Section 4.4.10 |
| Custom | Project | 20,724 | 24,888 | 120% | Project File Review, Evaluation‡ |

* Program Tracking Data (PTD) provided by Nicor Gas, extract dated January 31, 2020.

† State of Illinois Technical Reference Manual version 7.0 from <http://www.ilsaq.info/technical-reference-manual.html>.

‡ Project files and monthly billing data provided by Nicor Gas. May include additional measure and site-specific research conducted by Guidehouse.

5.1.1 Programmable and Reprogram Thermostat (IU)

The tracking data did not provide climate zone information for 425 out of 2,016 measures. The verified savings for these 425 measures were calculated using climate zone values corresponding to the county in which the measures were installed.

Recommendation 1. Guidehouse recommends providing climate zone information for all measures installed.

5.1.2 HW Pipe Insulation and Pipe Insulation – Indoor Space Heat

The program implementer calculated ex ante savings for these measures using 8,766 or 8,760 hours as the equivalent full load hours (EFLH) for heating, while the “System Type” in the tracking data is indicated to be Hydronic Heating or Space Heating application. The 8,766 EFLH would be valid if the application has year round recirculation, however the tracking data currently does not include any additional information regarding the application type for the measure installed. The evaluation team calculated verified savings using 8,766 as the EFLH for heating for these measures based on a similar finding in the interim program impact review conducted during 2019.

Recommendation 2. Guidehouse recommends that the implementer add a field to the tracking data to indicate and confirm that the system was verified to have year round recirculation or heating season recirculation as applicable for space heating pipe insulation measures.

5.1.3 Condensing Boilers

The program implementer calculated ex ante savings for Condensing Boilers using a baseline boiler efficiency of 80% AFUE irrespective of the capacity of the boiler. The verified savings for this measure are calculated using baseline boiler efficiency values corresponding to the capacity of the boiler as per Section 4.4.10 of the TRM v7.0.

Recommendation 3. Guidehouse recommends using the baseline boiler efficiency of 80% AFUE for steam boilers less than 300,000 Btu/hr and 79% thermal Efficiency (TE) for steam boilers greater than 300,000 Btu/hr as per Section 4.4.10 of the TRM v7.0.

5.1.4 Showerhead (IU)

The following Project IDs PID-2019.02.27-34830, PID-2019.02.27-35129, and PID-2019.02.27-35133 claimed ex ante savings for two showerheads per project despite the tracking data indicating the “Number of Bathrooms” parameter for these project IDs to be one. The evaluation team verified savings for these project IDs by capping applicable showerheads at one showerhead per bathroom.

Recommendation 4. Guidehouse recommends claiming savings for only one showerhead per bathroom in the absence of any additional data indicating presence of multiple showerheads per bathroom.

5.1.5 Advanced Thermostats

The ex ante net savings for the Advanced Thermostat measure are calculated using a net to gross (NTG) of 0.95. However, the savings algorithm in IL TRM Section 5.3.16 calculates net savings, hence the gross savings for this measure should be equal to the net savings in the tracking system.

Recommendation 5. Guidehouse recommends updating the ex ante net savings for the advanced thermostat measure to be equal to the ex ante gross savings in the tracking system.

5.1.6 Custom

For Project PID-2019.11.20-57384, Nicor Gas claimed savings for the replacement of two existing 5,000 MBH boilers with three 3,000 MBH high efficiency gas-fired boilers used for space heating. The existing boilers were operational hence Guidehouse determined the project is an early replacement with an existing boiler efficiency of 78% as per the supporting documentation. Both ex ante and verified savings for this project are calculated using billing analysis. The ex ante billing analysis is based on monthly therms usage at the facility as a function of monthly heating degree days (HDD₅₅) at 55°F base temperature for a period of 37 months. The ex ante savings were calculated using a baseline boiler efficiency of 78% and an installed boiler efficiency of 88%.

The verified billing analysis is based on monthly therms usage at the facility as a function of monthly HDD₆₅ at 65°F base temperature for a period of 24 months. The base temperature in the verified calculations was updated from 55°F to 65°F based on the balance temperature for the facility as indicated by the therms usage for the facility. The verified savings are calculated using a baseline boiler efficiency of 78% and an installed boiler efficiency of 87% as per specification sheets for the installed boiler.

Recommendation 6. For projects where more than 24 months of billing data is available, Guidehouse recommends basing the regression analysis on the latest 24 months of usage data for the facility in order to avoid incorporating the effects of any undocumented past action. Guidehouse also recommends basing the HDD base temperature on the balance temperature for the facility as indicated by the therms usage at the facility.

6. APPENDIX 1. IMPACT ANALYSIS METHODOLOGY

The evaluation team 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 the evaluation team'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 evaluation team also conducted an engineering desk file review for the one custom project installed in 2019, 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 Guidehouse engineer to assess the engineering methods, parameters and assumptions used to generate all ex ante impact estimates. We reviewed project documentation in application forms and supporting documentation from the applicant.

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

Table 6-1. 2019 Summary of Custom M&V Results

| Project ID | Measure Description | Ex Ante Gross Savings (Therms) | Gross Realization Rate | Verified Gross Savings (Therms) | Summary of Adjustment |
|----------------------|---------------------|--------------------------------|------------------------|---------------------------------|---|
| PID-2019.11.20-57384 | Boiler Replacement | 20,724 | 120% | 24,888 | Updated billing analysis data period, HDD base temperature, and installed boiler efficiency |

Source: Guidehouse analysis

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

Table 7-1 shows the Total Resource Cost (TRC) cost-effectiveness analysis inputs available at the time of drafting this impact evaluation report. Additional required cost data (e.g., measure costs, program level incentive and non-incentive costs) are not included in this table and will be provided to the evaluation team later.

Table 7-1. Verified Gross Savings Parameters

| Program Path | Research Category | Units | Quantity | Effective Useful Life* | Ex Ante Gross Savings (Therms) | Verified Gross Savings (Therms) | Verified Net Savings (Therms) |
|----------------|-------------------------------------|-------|----------|------------------------|--------------------------------|---------------------------------|-------------------------------|
| Direct Install | Programmable Thermostat (IU) | Unit | 2,004 | 8 | 92,215 | 92,256 | 87,643 |
| | HW Pipe Insulation | LN FT | 18,241 | 15 | 55,784 | 55,802 | 53,012 |
| | Showerhead (IU) | Unit | 3,569 | 10 | 40,432 | 40,391 | 41,199 |
| | Advanced Thermostat | Unit | 345 | 11 | 19,833 | 19,833 | 19,833 |
| | Kitchen Aerator (IU) | Unit | 1,896 | 10 | 4,958 | 4,958 | 4,710 |
| | Bath Aerator (IU) | Unit | 2,818 | 10 | 4,624 | 4,624 | 4,393 |
| | Showerhead (CA) | Unit | 19 | 10 | 1,233 | 1,233 | 1,258 |
| | Reprogram Thermostat (IU) | Unit | 12 | 2 | 486 | 486 | 462 |
| | Bath Aerator (CA) | Unit | 50 | 10 | 305 | 305 | 311 |
| | Programmable Thermostat (CA) | Unit | 13 | 8 | 302 | 302 | 287 |
| | Kitchen Aerator (CA) | Unit | 20 | 10 | 149 | 149 | 152 |
| Prescriptive | Condensing Boilers | Unit | 30 | 20 | 81,795 | 87,836 | 82,566 |
| | Boiler Tune Up | Unit | 132 | 3 | 43,225 | 43,225 | 40,631 |
| | Boiler Reset Controls | Unit | 17 | 20 | 9,453 | 9,453 | 8,886 |
| | Outdoor Pool Covers | SQ FT | 5,455 | 6 | 5,510 | 5,510 | 5,179 |
| | Steam Traps | Unit | 34 | 6 | 5,020 | 5,020 | 4,719 |
| | Furnace | Unit | 39 | 20 | 4,056 | 4,056 | 3,812 |
| | Pipe Insulation – Indoor DHW | LN FT | 1,299 | 15 | 3,771 | 3,771 | 3,545 |
| | Pipe Insulation – Indoor Space Heat | LN FT | 2,353 | 15 | 4,262 | 4,262 | 4,006 |
| | Programmable Thermostats (CA) | Unit | 26 | 8 | 605 | 605 | 568 |
| | Hydronic Boilers | Unit | 1 | 20 | 532 | 532 | 501 |
| Custom | Custom | Unit | 1 | 20 | 20,724 | 24,888 | 23,394 |
| Total | | | | 12.6 | 399,272 | 409,495 | 391,066 |

Source: Nicor Gas tracking data and Guidehouse team analysis.