Home Energy Savings 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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1. Introduction

This report presents the results of the impact evaluation of the Nicor Gas 2019 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. Program year 2019 covers January 1, 2019 through December 31, 2019.

2. Program Description

The HES Program includes an assessment and direct install component jointly implemented by Nicor Gas and 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 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 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. For participants to receive the instant discount for attic insulation, they must have air sealing and attic insulation installed at the same time.

The program had 10,870 participants in 2019 and completed 11,046 projects as shown in the following table.

Installed measures were categorized as air sealing and insulation (ASI) or direct install (DI). ASI measures include air sealing, attic insulation, basement sidewall insulation, duct insulation and sealing, and wall insulation measures. Direct install measures include advanced thermostat, hot water (HW) pipe insulation, low flow faucet aerator, low flow showerhead, programmable thermostat, and thermostat education measures.

Table 2-1. 2019 Volumetric Summary

Participation	ASI	DI	Total
Participants *	1,168	9,759	10,870
Installed Projects †	1,172	9,874	11,046

* Participants are defined as the number of distinct building premise IDs.
† Installed Projects are defined as the number of distinct project IDs.
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
ASI	Air Sealing (installed without attic insulation)	Projects	255
ASI	Air Sealing (installed with attic insulation)	Projects	902
ASI	Attic Insulation	Square Feet	1,112,978
ASI	Basement Sidewall Insulation	Square Feet	7,430
ASI	Duct Insulation and Sealing	Projects	202
ASI	Wall Insulation	Square Feet	63,047
DI	Advanced Thermostat	Each	1,696
DI	HW Pipe Insulation	Linear Feet	16,702
DI	Low Flow Faucet Aerator	Each	10,850
DI	Low Flow Showerhead	Each	11,149
DI	Programmable Thermostat	Each	1,381
DI	Thermostat Education	Each	1,659

Source: Nicor Gas tracking data and Guidehouse team analysis.

3. Savings Summary

Table 3-1 summarizes the energy savings the Home Energy Savings (HES) 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)
ASI – Air Sealing, Insulation (Basement, Duct, Wall)	77,408	100%	77,408	0.82	63,474
ASI – Air Sealing and Attic Insulation	109,248	100%	109,248	1.00	109,248
DI - Programmable Thermostats	88,202	100%	87,769	0.81	71,093
DI - Thermostat Education	104,835	99%	104,018	0.85	88,415
DI - HW Pipe Insulation	8,276	100%	8,287	0.99	8,204
DI - Advanced Thermostats	117,560	100%	117,361	NA	117,361
DI - Aerators, Showerheads	111,171	100%	111,156	1.07	118,937
Program Total	**616,701**	**100%**	**615,246**	**NA**	**576,732**

* 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 on the Illinois Energy Efficiency Stakeholder Advisory Group (SAG) web site: http://ilsag.info/net-to-gross-framework.html.
Source: Nicor Gas tracking data and Guidehouse team analysis.

4. Program Savings by Measure

The program includes 11 measures as shown in the following table. The thermostat and showerhead measures contributed the most savings.

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

Program Path	Measure	Ex Ante Gross Savings (Therms)	Verified Gross RR*	Verified Gross Savings (Therms)	NTG†	Verified Net Savings (Therms)
ASI	Air Sealing (installed without attic insulation)	23,637	100%	23,637	0.82	19,382
	Air Sealing (installed with attic insulation)	57,069	100%	57,069	NA	57,069
	Attic Insulation	52,179	100%	52,179	NA	52,179
	Basement Sidewall Insulation	897	100%	897	0.82	736
	Duct Insulation and Sealing	45,809	100%	45,809	0.82	37,563
	Wall Insulation	7,065	100%	7,065	0.82	5,793
DI	Advanced Thermostat	117,560	100%	117,361	NA	117,361
	HW Pipe Insulation	8,276	100%	8,287	0.99	8,204
	Low Flow Faucet Aerator	12,171	100%	12,172	1.07	13,024
	Low Flow Showerhead	99,001	100%	98,985	1.07	105,913
	Programmable Thermostat	88,202	100%	87,769	0.81	71,093
	Thermostat Education	104,835	99%	104,018	0.85	88,415
Program Total		**616,701**	**100%**	**615,246**	**NA**	**576,732**

* 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 on the Illinois SAG web site: http://ilsag.info/net-to-gross-framework.html.
Source: Nicor Gas tracking data and Guidehouse team analysis.

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 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)
Advanced Thermostat	Each	Varies	Varies	100%	TRM v7.0 - 5.3.16* and Program Tracking Data (PTD†)
Air Sealing (installed without attic insulation)	Project	Varies	Varies	100%	TRM v7.0 - 5.6.01 and PTD
Air Sealing (installed with attic insulation)	Project	Varies	Varies	100%	TRM v7.0 - 5.6.01 and PTD
Attic Insulation	Square Feet	Varies	Varies	100%	TRM v7.0 - 5.6.05 and PTD
Basement Sidewall Insulation	Square Feet	Varies	Varies	100%	TRM v7.0 - 5.6.02 and PTD
Duct Insulation and Sealing	Project	Varies	Varies	100%	TRM v7.0 - 5.3.04 and PTD
HW Pipe Insulation	Linear Feet	Varies	Varies	100%	TRM v7.0 - 5.4.01 and PTD
Low Flow Faucet Aerator	Each	Varies	Varies	100%	TRM v7.0 - 5.4.04 and PTD
Low Flow Showerhead	Each	Varies	Varies	100%	TRM v7.0 - 5.4.05 and PTD
Programmable Thermostat	Each	Varies	Varies	100%	TRM v7.0 - 5.3.11 and PTD
Thermostat Education	Each	Varies	Varies	99%	TRM v7.0 - 5.3.11 and PTD
Wall Insulation	Square Feet	Varies	Varies	100%	TRM v7.0 - 5.6.04 and PTD

* State of Illinois Technical Reference Manual version 7.0 from http://www.ilsag.info/technical-reference-manual.html.
† Program Tracking Data (PTD) provided by Nicor Gas, extract dated January 31, 2020.

5.2 Other Findings and Recommendations

5.2.1 Tracking Data Changes

Changing Fuel or Building Type from Mid-Year to Final Tracking Data

Guidehouse pointed out during the 2019 mid-year impact review that 1.7% of ex ante therm savings claimed for water measures had an Electric DHW fuel and 0.7% of ex ante therm savings claimed for HVAC measures had an electric heating fuel. In the final tracking data there were no hot water projects with an Electric DHW fuel. Projects which had previously had an Electric DHW fuel had their DHW fuel

type switched to natural gas. Similarly, no HVAC projects in the final tracking data had an electric heating fuel, including the Wave 1 projects which had previously listed an electric heating fuel.

Guidehouse pointed out during the 2019 mid-year impact review that projects with a "Multi-Family" residential building type had not used multi-family inputs. Guidehouse found that 118 unique building account numbers which were tracked as multi-family during the mid-year review had switched to a single-family building type in the final tracking data. Example projects include PID-2019.02.28-36166, PID-2019.02.28-36198, and PID-2019.02.28-36258. Guidehouse deemed these changes reasonable after reviewing a small sample of the addresses and verified these buildings were single-family buildings.

Recommendation 1. Guidehouse did not apply changes to the revised therms savings. However, we recommend that Nicor Gas ensure consistency in their data tracking process on documenting facility fuel use type or building type between mid-year and final tracking data.

5.2.2 Household Type

Guidehouse used the building type mappings in Table 5-2 to inform the inputs for the verification savings calculation. The Illinois TRM v7.0 includes new guidance on the building type definition for smaller multi-family buildings when selecting TRM input values: "Use multi-family if building meets utility's definition for multi-family".

Table 5-2. Building Type Mapping Used by Guidehouse

Tracking Data Building Type (ResidentialBuildingType)	TRM Household Type Assigned by Guidehouse
Multi Family	MF
Single Family	SF
Townhouse, Inside Unit	SF
Duplex, Single Unit	SF
N/A	SF
Single-family detached	SF
Townhouse, end unit	SF

Source: Guidehouse analysis of tracking data

Guidehouse found one advanced thermostat measure with a multi-family building type that used single-family inputs (PID-2019-09.12-49199). Specifically, the ex ante savings used a SF household factor (100%), rather than an MF household factor (65%).

Recommendation 2. Ensure that when SF and MF building types are appropriately recorded in the tracking system, the correct TRM inputs are used.

5.2.3 Climate Zone Mapping

Guidehouse found that certain zip codes in the tracking database had the incorrect climate zone.[1]

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

Table 5-3. Climate Zone Mapping by Zip Code

IL Zip Code	Tracking Climate Zone	TRM Climate Zone
61103	2	1
60473	3	2
60035	1	2
60460	1	2

Source: Nicor Gas tracking data and Guidehouse team analysis.

Recommendation 3. Guidehouse recommends the implementer correct the climate zones of projects installed in the zip codes identified in Table 5-3 to match the Illinois TRM.

5.2.4 HVAC: Thermostats

The gross savings realization rate was 100% for programmable thermostats, 99% for thermostat education, and 100% for advanced thermostats.

Guidehouse found that the final tracking data did not specify which households had boiler heating in the "MeasureNotes" data field. In order to account for which households had boiler heating, Guidehouse used the "HeatingSystemType" field. This did not produce the same 100% realization rate for such projects as when the "MeasureNotes" field was used during the early impact review.

Guidehouse found that the heating system in the MeasureNotes field during the mid-year review were often inconsistent with the heating system in the HeatingSystemType field used in this final evaluation (Table 5-4).

Table 5-4. Discrepancies between Wave 1 and Final Heating Systems

Wave 1 Evaluation MeasureNotes Heating System	Final Evaluation HeatingSystemType Heating System	Example Vendor Project IDs	Number of Unique Projects
Boiler	Boiler	PID-2019.02.28-36228, PID-2019.02.28-36259	52
Boiler	Furnace	PID-2019.03.27-38633, PID-2019.04.10-40157	95

Source: Nicor Gas tracking data and Guidehouse team analysis.

Recommendation 4. Nicor Gas should align the tracking data "HeatingSystemType" and "MeasureNotes" fields to consistently label boiler heating systems. Those fields should then be used to inform the annual gas heating consumption used in ex ante therms savings calculations.

To determine Gas Heating Consumption for the programmable thermostat measure, IL TRM v7.0 requires an estimate of annual household heating consumption for gas heated single-family homes. Guidehouse estimated an annual household heating load and boiler gas heating consumption for projects with boiler heating (Table 5-5) to serve as a guide for the program use.

Table 5-5. Annual Household Load and Consumption for Gas-Boiler-Heated Single Family Homes by Climate Zone

Climate Zone	Annual Household Heating Load For Gas Boiler Heated Single Family Homes (therms)	Annual Gas Boiler Heating Consumption (therms)
1	1,275	1,555
2	1,218	1,485
3	1,043	1,272
4	805	982
5	819	999

Source: TRM version 6.0, gas heating consumption assumes boiler efficiency of 0.82.

Guidehouse found instances where some "VendorProjectID" claimed savings for more than one thermostat. The claiming of more than one thermostat measure per household is prohibited by the Illinois Technical Reference Manual (TRM).[2] This occurred in about 0.85% of projects and examples of this finding are PID-2019-05.23-42100 and PID-2019.05.31-43648.

Recommendation 5. Guidehouse recommends the program claim savings for only one thermostat measure per household.

5.2.5 Hot Water: All Measures

The gross savings realization rate was 100% for HW pipe insulation, 100% for low flow faucet aerators, and 100% for low flow showerheads.

Guidehouse found that 0.34% of projects did not have a DHW fuel type provided in the tracking data (all other projects had a natural gas DHW fuel type). For these projects, Guidehouse used a %FossilDHW input of 84%, the %FossilDHW for an "Unknown" DHW fuel (TRM v7.0 5.4.4). Nicor Gas used 100% for all projects.

Recommendation 6. Guidehouse recommends the program use 84% for %FossilDHW input when the DHW fuel type is unknown.

5.2.6 Air Sealing, Duct Sealing, and Insulation Measures

The gross savings realization rate was 100% for all air sealing, duct sealing, and insulation measures. However, Nicor Gas used a NTG value of 0.82 for all measures in the tracking data when calculating net savings. The correct NTG for duct sealing, basement/sidewall and wall insulation is 0.82 for 2019, but when air sealing is combined with attic insulation and the IL TRM v7.0 algorithm is applied with the 72% savings adjustment factor, no further NTG adjustment is required (NTG = 1.00 for calculation purposes). Attic insulation is always installed with air sealing, but when air sealing is installed without attic insulation in the same project, the 72% savings adjustment factor is not applied and a NTG of 0.82 is used.

[2] The TRM v7.0 thermostat measures assign "household energy savings." To determine the appropriate savings, Guidehouse 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 7. Guidehouse recommends that Nicor Gas check and correct as needed the 2019 and 2020 NTG tracked values for all air sealing, duct sealing, and insulation measures. The correct NTG values for 2019 and 2020 are found in the 2020 SAG NTG recommendations in *Nicor_Gas_NTG_History_and_2020_Values 2019-10-01 Final.*xlsx on the SAG web site.

6. Appendix 1. Impact Analysis Methodology

Guidehouse calculated gross savings by using the methodologies prescribed in TRM v7.0 and the inputs provided in the program tracking data (PTD), when available.

Guidehouse calculated verified net energy savings by multiplying the verified gross savings estimates by a net-to-gross (NTG) ratio. In 2019, the NTG estimates used to calculate the net verified savings were based on past evaluation research and defined by a consensus process through SAG

7. Appendix 2. Program-Specific Inputs for the Illinois TRC

Table 7-1, the Total Resource Cost (TRC) variable table. 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. Detail in this table (e.g., EULs), other than final 2019 savings and program data, are subject to change and are not final.

Table 7-1. Total Resource Cost Savings Summary

Research Category	Units	Quantity	Effective Useful Life	Ex Ante Gross Savings (Therms)	Verified Gross Savings (Therms)	Verified Net Savings (Therms)
Advanced Thermostat	Each	1,696	11	117,560	117,361	117,361
Air Sealing (installed without attic insulation)	Projects	255	20	23,637	23,637	19,382
Air Sealing (installed with attic insulation)	Projects	902	20	57,069	57,069	57,069
Attic Insulation	Square Feet	1,112,978	20	52,179	52,179	52,179
Basement Sidewall Insulation	Square Feet	7,430	20	897	897	736
Duct Insulation and Sealing	Projects	202	20	45,809	45,809	37,563
HW Pipe Insulation	Linear Feet	16,702	15	8,276	8,287	8,204
Low Flow Faucet Aerator	Each	10,850	10	12,171	12,172	13,024
Low Flow Showerhead	Each	11,149	10	99,001	98,985	105,913
Programmable Thermostat	Each	1,381	8	88,202	87,769	71,093
Thermostat Education	Each	1,659	2	104,835	104,018	88,415
Wall Insulation	Square Feet	63,047	20	7,065	7,065	5,793
Total			**11.7**	**616,701**	**615,246**	**576,732**

Source: Nicor Gas tracking data and Guidehouse team analysis.