Home Energy Savings Impact Evaluation Report

Energy Efficiency Plan: Plan Year 2021 (1/1/2021-12/31/2021)

Prepared for:

Nicor Gas

Final

May 17, 2022

Prepared by:

Charles Ampong
Guidehouse

Marisa Rudolph
Guidehouse

Submitted to:

Nicor Gas Company
1844 Ferry Road
Naperville, IL 60563

Submitted by:

Guidehouse
150 N. Riverside Plaza, Suite 2100
Chicago, IL 60606

Contact:

Ed Balbis
Partner
561.644.9407
ebalbis@guidehouse.com

Stu Slote
Director
802.526.5113
stu.slote@guidehouse.com

Kevin Grabner
Associate Director
608.616.5805
kevin.grabner@guidehouse.com

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1. Introduction

This report presents the results of the impact evaluation of the Nicor Gas 2021 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. Appendix A presents the impact analysis methodology. Program year 2021 covers January 1, 2021 through December 31, 2021.

2. Program Description

The HES Program includes an assessment and direct install component jointly implemented by Nicor Gas and ComEd 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. A Virtual Home Assessment (VHA) option was added in 2020 to adapt to COVID restrictions.

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 prescriptive building shell insulation (ASI) measures for eligible homes installed by an approved contractor. Measures include air sealing, attic insulation, duct sealing, basement sidewall insulation, 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 11,017 participants in 2021 and completed 11,195 projects, as shown Table 2-1. Installed measures were categorized as prescriptive duct and air sealing and insulation (ASI), direct installation (DI) and virtual home assessments (VHA). Prescriptive 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. Measures delivered through virtual home assessments include advanced thermostat, hot water (HW) pipe insulation, low flow faucet aerator, low flow showerhead, programmable thermostat, and thermostat education measures. The DI and VHA paths also distributed leave-behind Home Energy Assessment (HEA) Kits, which are comprised of weather stripping, door sweep, and shower timer measures.

Table 2-1. 2021 Volumetric Findings Detail

Participation	ASI	DI	VHA	Total
Participants *	1,281	9,145	655	11,017
Installed Projects †	1,284	9,227	687	11,195

* 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 evaluation team analysis.

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

Table 2-2. 2021 Measure Quantities

Program Path	Measure	Quantity Unit	Installed or Distributed Quantity*
ASI	Air Sealing (installed with attic insulation)	Projects	1,007
ASI	Air Sealing (installed without attic insulation)	Projects	241
ASI	Attic Insulation	Square Feet	1,207,405
ASI	Basement Sidewall Insulation	Square Feet	12,713
ASI	Duct Insulation and Sealing	Projects	39
ASI	Wall Insulation	Square Feet	83,537
DI	Advanced Thermostat	Each	1,126
DI	HEA Kit	Each	8,726
DI	HW Pipe Insulation	Linear Feet	15,502
DI	Low-Flow Faucet Bathroom Aerator	Each	5,036
DI	Low-Flow Faucet Kitchen Aerator	Each	812
DI	Low-Flow Showerhead	Each	5,271
DI	Programmable Thermostat	Each	790
DI	Thermostat Education	Each	1,754
VHA	Advanced Thermostat	Each	38
VHA	HEA Kit	Each	619
VHA	HW Pipe Insulation	Linear Feet	3,303
VHA	Low-Flow Faucet Bathroom Aerator	Each	1,030
VHA	Low-Flow Faucet Kitchen Aerator	Each	138
VHA	Low-Flow Showerhead	Each	882
VHA	Programmable Thermostat	Each	12
VHA	Thermostat Education	Each	4

* The ASI path shows installed quantities. The DI and VHA paths show distributed quantities.
Source: Nicor Gas tracking data and Guidehouse evaluation team analysis.

3. Program Savings Detail

Table 3-1 summarizes the energy savings the Home Energy Savings Program achieved by path in 2021.

Table 3-1. 2021 Annual Energy Savings Summary

Program Management	Ex Ante Gross Savings (Therms)	Verified Gross RR*	Verified Gross Savings (Therms)	NTG†	Verified Net Savings (Therms)
Prescriptive Air Sealing and Insulation (ASI)	211,733	121%	255,546	0.88	225,453
Direct Install (DI)	443,239	98%	435,076	0.93	405,043
Virtual Home Assessments (VHA)	20,779	110%	22,945	1.00	22,872
Total or Weighted Average	**675,751**	**106%**	**713,567**	**0.92**	**653,368**

* Realization Rate (RR) is the ratio of verified gross savings to ex ante gross savings, based on evaluation research findings.
† Deemed NTG values vary by measure. Details provided in Section 4. Deemed values available on the SAG web site: https://www.ilsag.info/evaluator-ntg-recommendations-for-2021/.
Source: Nicor Gas data and Guidehouse evaluation team analysis.

4. Program Savings by Measure

The program includes 13 measures as shown Table 4-1. The HEA Kits, thermostats, showerheads, insulation, and air sealing measures contributed the most savings.

Table 4-1. 2021 Annual Energy Savings by Measure

Program Path	Measure	Ex Ante Gross Savings (Therms)	Verified Gross RR	Verified Gross Savings (Therms)	NTG	Verified Net Savings (Therms)
ASI	Air Sealing (installed with attic insulation)	70,183	100%	70,183	0.88	61,761
ASI	Air Sealing (installed without attic insulation)	21,959	100%	21,959	0.83	18,226
ASI	Attic Insulation	104,260	138%	143,384	0.89	127,612
ASI	Basement Sidewall Insulation	1,873	100%	1,873	0.85	1,592
ASI	Duct Insulation and Sealing	10,480	100%	10,480	0.93	9,746
ASI	Wall Insulation	2,979	257%	7,666	0.85	6,516
ASI Subtotal or Weighted Average		***211,733***	***121%***	***255,546***	***0.88***	***225,453***
DI	Advanced Thermostat	83,586	100%	83,586	0.90	75,227
DI	HEA Kit	146,951	99%	145,021	0.99	143,570
DI	HW Pipe Insulation	7,644	80%	6,093	0.99	6,032
DI	Bathroom Faucet Aerator	4,606	100%	4,606	1.07	4,928
DI	Kitchen Faucet Aerator	2,269	100%	2,269	1.07	2,428
DI	Low-Flow Showerhead	46,453	100%	46,432	1.07	49,682
DI	Programmable Thermostat	47,821	96%	45,870	0.81	37,155
DI	Thermostat Education	103,910	97%	101,199	0.85	86,019
DI Subtotal or Weighted Average		***443,239***	***98%***	***435,076***	***0.93***	***405,043***
VHA	Advanced Thermostat	3,342	100%	3,342	0.90	3,008
VHA	HEA Kit	7,908	131%	10,346	0.99	10,242
VHA	HW Pipe Insulation	1,263	81%	1,024	0.99	1,014
VHA	Bathroom Faucet Aerator	743	100%	743	1.07	795
VHA	Kitchen Faucet Aerator	310	100%	310	1.07	332
VHA	Low-Flow Showerhead	6,373	100%	6,370	1.07	6,816
VHA	Programmable Thermostat	591	95%	561	0.81	454
VHA	Thermostat Education	249	100%	249	0.85	212
VHA Subtotal or Weighted Average		***20,779***	***110%***	***22,945***	***1.00***	***22,872***
Total or Weighted Average		**675,751**	**106%**	**713,567**	**0.92**	**653,368**

Source: Nicor Gas tracking data and Guidehouse evaluation 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 Guidehouses's review. The realization rate is the ratio of the verified savings to the ex ante savings. Following Table 5-1, we provide findings and recommendations, including discussion of all measures with realization rates above or below 100%. Appendix A provides a description of the impact analysis methodology. Table B-1 in Appendix B shows the Total Resource Cost (TRC) cost-effectiveness analysis inputs available at the time of producing this impact evaluation report.

Table 5-1. Verified Gross Savings Parameters

Measure	Unit Basis	Ex Ante Gross (therms/unit)	Verified Gross (therms/unit)	Realization Rate	Data Source(s)
Air Sealing (installed with attic insulation)	Project	Varies	Varies	100%	TRM v9.0 - 5.6.1† and PTD*
Air Sealing (installed without attic insulation)	Project	Varies	Varies	100%	TRM v9.0 - 5.6.1 and PTD
Attic Insulation	Square Feet	Varies	Varies	138%	TRM v9.0 - 5.6.5 and PTD
Basement Sidewall Insulation	Square Feet	Varies	Varies	100%	TRM v9.0 - 5.6.2 and PTD
Duct Insulation and Sealing	Project	Varies	Varies	100%	TRM v9.0 - 5.3.4 and PTD
Wall Insulation	Square Feet	Varies	Varies	257%	TRM v9.0 - 5.6.4 and PTD
Advanced Thermostat	Each	Varies	Varies	100%	TRM v9.0 - 5.3.16 and PTD
HEA Kit	Each	Varies	Varies	100%	Evaluation Research and PTD
HW Pipe Insulation	Linear Feet	Varies	Varies	80%	TRM v9.0 - 5.4.1 and PTD
Bathroom Faucet Aerator	Each	Varies	Varies	100%	TRM v9.0 - 5.4.4 and PTD
Kitchen Faucet Aerator	Each	Varies	Varies	100%	TRM v9.0 - 5.4.4 and PTD
Low-Flow Showerhead	Each	Varies	Varies	99%	TRM v9.0 - 5.4.5 and PTD
Programmable Thermostat	Each	Varies	Varies	96%	TRM v9.0 - 5.3.11 and PTD
Thermostat Education	Each	Varies	Varies	97%	TRM v9.0 - 5.3.11 and PTD

* Program Tracking Data (PTD) provided by Nicor Gas; extract dated January 28, 2022.
† State of Illinois Technical Reference Manual version 9.0 from http://www.ilsag.info/technical-reference-manual.html.

COVID-19 lockdowns in 2020 prompted ComEd, Nicor Gas, Peoples Gas, and North Shore Gas to pursue virtual assessment and guided self-installation options for their assessment and direct install programs. The TRM does not prescribe in-service rates (ISRs) for measures installed as part of a virtual assessment channel. In order to estimate program savings for 2020 and 2021, Guidehouse developed custom ISRs for virtual assessment/self-install measures[1]. These measures include showerheads, kitchen and bathroom aerators, and omnidirectional and specialty LEDs. Guidehouse used a weighted average approach to create the custom virtual assessment ISRs by weighting the efficiency kit ISR (as specified in the TRM) by fifty percent and the direct-install ISR by fifty percent.

Table 5-2. Virtual Home Assessment In-Service Rates

Measure Category	Prospective Custom ISR for 2021 Single Family Virtual Assessment Measures
Showerheads	0.795
Aerators – Bathroom	0.780
Aerators – Kitchen	0.765
DHW Pipe Insulation	0.780
Omnidirectional LEDs	0.803
Specialty LEDs	0.803

Source: Guidehouse analysis, IL TRM v8.0

5.2 Findings and Recommendations

5.2.1 Advanced Thermostats

The verified gross realization rate for the advanced thermostats projects was 100%. The evaluation team found instances of advanced thermostat measures in the tracking data that did not include the correct heating reduction factor, even though the ex ante savings reflect the deemed values in the TRM.

Recommendation 1. Ensure claimed savings and tracked assumptions are consistent with the baseline description for thermostats. Ensure the tracking data reflects inputs from the most recent TRM, including the errata memo.

5.2.2 Programmable Thermostats and Thermostat Education

The evaluation team found 65 programmable thermostats and 91 instances of thermostat education where the realization rate varied from 33% to 105%, resulting in an overall realization of 97% for the programmable thermostats and thermostat education. The evaluation team noticed that tracking data listed household factors for multi-family thermostats as 1.00, while they should be 0.65 according to the TRM v9.0. Guidehouse found 63 projects where the *MeasureName* field indicated the measure was a programmable thermostat, but the ex ante savings were improperly based on advanced thermostats. Affected projects include PID-2021.02.26-80684, PID-2021.03.12-82407, PID-2021.03.12-82635, and others. There are other

[1] Guidehouse, *In-Service Rates for CY2020 Single Family Virtual Assessment Measures*, August 20, 2020.

projects in the tracking data for single-family projects where the inputs matched TRM v9.0, but Guidehouse was not able to replicate ex ante savings.

Recommendation 2. Ensure household factors and subsequent ex ante savings values are consistent with the reported residential building type for single-family and multi-family.

Recommendation 3. Ensure thermostat claimed savings and assumptions are consistent with the MeasureName field or baseline description in the *MeasureNotes* field.

Recommendation 4. Ensure all thermostats are categorized correctly and include all of the proper inputs in the tracking data per the TRM v9.0 to produce ex ante savings.

5.2.3 Multifamily Low-Flow Showerhead

Low-flow showerheads had a verified gross savings realization rate of 99% overall. The evaluation team determined that multifamily low flow showerheads had a verified unit savings value of 11.31 therms for Direct Install measures (ex ante was 12.68 therms) and 9.47 therms for Virtual Assessment measures (ex ante was 9.92 therms), resulting in a realization rate of 95% for all multifamily showerheads. Guidehouse adjusted the virtual ISR rounded values of 0.80 to the recommended default value of 0.795. Guidehouse also adjusted the faucets per household input to 1.3 and household factor to 2.1 for all multifamily measures. The single family showerheads had a 100% gross realization rate.

Recommendation 5. Use the TRM deemed inputs to calculate ex ante savings, which would produce 11.31 therms per showerhead for multifamily direct install measures and 9.47 for multifamily virtual assessment measures.

Recommendation 6. Ensure VHA ISR values match the recommended default values.

5.2.4 HW Pipe Insulation (1 ft.)

The pipe insulation measure had a verified gross realization rate of 80%. The measure description in the tracking data produces savings for two types of pipe insulation systems: (1) domestic hot water pipe insulation (DHW) with 8,766 hours of use, and (2) hot water space heating pipe insulation (HW) with climate zone 2 equivalent full load hours (EFLH). The tracking values of the circumference of existing pipe (Cexist = 0.1635 ft) and the new pipe (Cnew = 0.425) do not produce the ex ante savings.

Recommendation 7. Produce separate measure descriptions for the DHW and HW space heating pipe insulation measures.

Recommendation 8. Track Cexist and Cnew assumptions that are consistent with the ex ante savings for each measure.

5.2.5 Wall Insulation

Guidehouse could not determine a cause to explain the realization rate deviating from 100%. Guidehouse identified clusters of realization rates, varying from 224% to 277%. Examples include projects PID-2021.03.02-81098, PID-2021.03.02-81101, and PID-2021.03.02-81107. A

potential input variable that may be causing the savings to deviate from 100% could be R_new, and is driven by the insulation material parameters.

Recommendation 9. Review the R_new input and other tracking input assumptions for the wall insulation measure to reflect the savings claimed.

5.2.6 Attic Insulation

Realization rates for the attic insulation measures varied from 88% to 212%, resulting in an overall realization rate of 138%. The evaluation team changed the adjustment factor for all attic insulation measures to 72% per the TRM v9.0 as all attic insulation measures were installed with air sealing. Guidehouse could not replicate ex-ante savings for the other attic insulation projects or isolate a cause for the variations in realization rate. It is possible the R_exist and R_new values listed in the tracking data do not reflect those used in the ex-ante savings.

Recommendation 10. Ensure tracking data includes R_exist and R_new assumptions that are consistent with values used in the ex-ante calculations.

5.2.7 HEA Kits Savings Estimates

The HEA Kit measures included weather stripping, a door sweep, and a shower timer. The evaluation team identified several instances where the ex ante per unit savings did not match the verified savings based on TRM v9.0. The verified savings per kit are based on several configurations of project information in the tracking data (DHW fuel, space heating system type, household type, and climate zone). Two types of discrepancies resulted in savings adjustments:

- Households with electric DHW and electric space heating systems are not expected to produce gas savings for the kit measures that affect those end uses.
- Many of the ex ante estimates in the tracking data differ from the reported climate zones or household types.

The total ex ante savings is 154,859 therms, and the verified savings is 155,366 therms, producing 100% verified gross realization rate (99% for DI and 131% for VHA). Table 5-3 shows the verified per unit savings by measure location and system configuration.

Table 5-3. Single-Family HEA Kits Configurations and Savings

Household, Climate Zone, and Systems Configuration	Ex Ante Savings Per Kit	Verified Savings Per Kit	Household Type	HDD Zone	DHW Fuel	Space Heating Fuel
MF, HDD - 1, DHW - Natural Gas, Space Heating - Natural Gas	17.31 or 16.31	16.99	MF	1	Natural Gas	Natural Gas
MF, HDD - 1, DHW - Electric, Space Heating – Electric	17.307	-	MF	1	Natural Gas	Natural Gas
MF, HDD - 2, DHW - Electric, Space Heating - Natural Gas	16.85 or 15.85	13.01	MF	2	Electric	Natural Gas
MF, HDD - 2, DHW - Electric, Space Heating – Electric	vary from 9.44 to 16.86	-	MF	2	Electric	Electric
MF, HDD - 2, DHW - Natural Gas, Space Heating – Electric	16.85	3.54	MF	2	Natural Gas	Electric
MF, HDD - 2, DHW - Natural Gas, Space Heating - Natural Gas	15.85 or 16.85	16.54	MF	2	Natural Gas	Natural Gas
MF, HDD - 3, DHW - Natural Gas, Space Heating - Natural Gas	15.1	15.00	MF	3	Natural Gas	Natural Gas
SF, HDD - 1, DHW - Electric, Space Heating – Electric	17.31	-	SF	1	Electric	Electric
SF, HDD - 1, DHW - Electric, Space Heating - Natural Gas	17.31	13.45	SF	1	Electric	Natural Gas
SF, HDD - 1, DHW - Natural Gas, Space Heating - Natural Gas	17.31 or 16.31	17.16	SF	1	Natural Gas	Natural Gas
SF, HDD - 2, DHW - Electric, Space Heating – Unknown	9.44	12.16	SF	2	Electric	Unknown
SF, HDD - 2, DHW - Electric, Space Heating – Electric	vary from 9.44 to 15.85	-	SF	2	Electric	Electric
SF, HDD - 2, DHW - Electric, Space Heating - Natural Gas	vary from 9.44 to 16.86	13.01	SF	2	Electric	Natural Gas
SF, HDD - 2, DHW - Natural Gas, Space Heating – Electric	15.85 or 16.85	3.71	SF	2	Natural Gas	Electric
SF, HDD - 2, DHW - Natural Gas, Space Heating - Natural Gas	vary from 9.44 to 17.31	16.71	SF	2	Natural Gas	Natural Gas
SF, HDD - 2, DHW - Unknown, Space Heating – Unknown	15.85	15.27	SF	2	Unknown	Unknown
SF, HDD - 3, DHW - Natural Gas, Space Heating - Natural Gas	14.10 or 15.12	15.00	SF	3	Natural Gas	Natural Gas
SF, HDD - 3, DHW - Unknown, Space Heating – Unknown	15.1	13.67	SF	3	Unknown	Unknown

Source: Guidehouse analysis

Recommendation 11. Review the tracking system inputs and the ex ante savings methodology to align ex ante savings with the configurations of inputs in the tracking

data (DHW fuel, space heating system type, household type, climate zone). Refer to the verified savings per unit for combinations of measure configurations that are shown in Table 5-3.

Appendix A. Impact Analysis Methodology

Guidehouse calculated gross savings by using the methodologies prescribed in Illinois Technical Reference Manual (TRM) v9.0[2] and the inputs provided in the program tracking data when available.

Guidehouse calculated verified net energy savings by multiplying the verified gross savings estimates by a net-to-gross (NTG) ratio. In 2021, the NTG values used to calculate the net verified savings were based on past evaluation research and defined by a consensus process through the Illinois Stakeholder Advisory Group (SAG).

The NTG for the leave-behind HEA Kit was not specifically identified in the deemed 2021 NTG values. Instead of the TRM default NTG of 0.80, we assigned a NTG of 0.99 to those measures, which is the NTG used for other self-installable equipment measures in the program, including boiler pipe insulation and DHW pipe insulation.

[2] State of Illinois Technical Reference Manual version 9.0 from http://www.ilsag.info/technical-reference-manual.html

Appendix B. Program Specific Inputs for the Illinois TRC

Table B-1 shows the Total Resource Cost (TRC) cost-effectiveness analysis inputs available at the time of producing 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. Guidehouse will include annual and lifetime water savings and greenhouse gas reductions in the end of year summary report.

Table B-1. Verified Cost Effectiveness Inputs

Program Path	Research Category	Units	Quantity	Effective Useful Life	Ex Ante Gross Savings (Therms)	Verified Gross Savings (Therms)	Verified Net Savings (Therms)
ASI	Air Sealing (installed without attic insulation)	Project	241	20.0	21,959	21,959	18,226
ASI	Air Sealing (installed with attic insulation)	Project	1,007	20.0	70,183	70,183	61,761
ASI	Attic Insulation	Sq. Ft	1,207,405	20.0	104,260	143,385	127,613
ASI	Basement Sidewall Insulation	Sq. Ft	12,713	20.0	1,873	1,873	1,592
ASI	Duct Insulation and Sealing	Sq. Ft	39	20.0	10,480	10,480	9,746
ASI	Wall Insulation	Sq. Ft	83,537	20.0	2,979	7,666	6,516
DI & VHA	Advanced Thermostat	Each	1,164	11.0	86,928	86,928	78,235
DI & VHA	HEA Kit	Each	9,345	16.6	154,859	155,366	153,813
DI & VHA	HW Pipe Insulation	Linear Feet	18,805	15.0	8,906	7,117	7,046
DI & VHA	Bathroom Faucet Aerator	Each	6,066	10.0	5,349	5,349	5,723
DI & VHA	Kitchen Faucet Aerator	Each	950	10.0	2,579	2,579	2,760
DI & VHA	Low Flow Showerhead	Each	6,153	10.0	52,826	52,801	56,497
DI & VHA	Programmable Thermostat	Each	802	8.0	48,412	46,431	37,609
DI & VHA	Thermostat Education	Each	1,758	2.0	104,159	101,449	86,232
Total or Weighted Average				**13.9**	**675,751**	**713,567**	**653,368**

Source: Nicor Gas tracking data and Guidehouse evaluation team analysis.