Residential New Construction Impact Evaluation Report

Energy Efficiency Plan Year 2020 (1/1/2020-12/31/2020)

Prepared for:

Nicor Gas

Final

July 7, 2021

Prepared by:

Sophie Gunderson
Guidehouse

Charles Ampong
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

Table of Contents

List of Tables

1. Introduction

This report presents the results of the impact evaluation of the Nicor Gas 2020 Residential New Construction (RNC) Program. It presents a summary of the program structure as well as program total and measure-level energy and demand impacts. Program year 2020 covers January 1, 2020 through December 31, 2020.

2. Program Description

The RNC Program is offered by Nicor Gas and implemented by Residential Science Resources (RSR). The program had 769 participants in 2020 as shown in Table 2-1.

Table 2-1. 2020 Volumetric Findings Detail

Participation	Unit	Quantity
Participants	Unique VendorProjectIDs	769
Advanced Thermostat	Installed	729
Gas High Efficiency Furnace*	Installed	771
Duct Insulation and Sealing	Projects	549
Gas Water Heater	Installed	744
Air Sealing	Projects	549

* Larger homes may install two furnaces for more efficient air distribution.
Source: Nicor Gas tracking data and Guidehouse evaluation team analysis.

3. Program Savings Detail

Table 3-1 summarizes the energy savings the RNC Program achieved in 2020.

Table 3-1. 2020 Annual Energy Savings Summary

Program Path	Ex Ante Gross Savings (Therms)	Verified Gross RR*	Verified Gross Savings (Therms)	NTG†	Verified Net Savings (Therms)
Residential New Construction	243,248	108%	261,917	0.83	217,737
Total or Weighted Average	**243,248**	**108%**	**261,917**	**0.83**	**217,737**

* Realization Rate (RR) is the ratio of verified gross savings to ex ante gross savings, based on evaluation research findings.
† A deemed value. Available on the SAG web site: https://www.ilsag.info/ntg_2020.
Source: Guidehouse evaluation team analysis.

4. Program Savings by Measure

The program includes five measures as shown in Table 4-1. The Gas High Efficiency Furnace and Air Sealing measures contributed the most savings.

Table 4-1. 2020 Annual Energy Savings by Measure

End-use	Research Category	Ex Ante Gross Savings (Therms)	Verified Gross RR*	Verified Gross Savings (Therms)	NTG†	Verified Net Savings (Therms)
HVAC	Duct Insulation and Sealing - Blower Door	38,683	100%	38,667	0.80	30,933
HVAC	Gas High Efficiency Furnace	95,955	100%	95,722	0.80	76,578
HVAC	Advanced Thermostat‡	40,824	100%	41,020	NA	41,020
Hot Water	Gas Water Heater	25,120	101%	25,379	0.80	20,303
Shell	Air Sealing	42,666	143%	61,129	0.80	48,903
Total or Weighted Average		**243,248**	**108%**	**261,917**	**0.83**	**217,737**

* Realization Rate (RR) is the ratio of verified gross savings to ex ante gross savings, based on evaluation research findings.
† Deemed values. The TRM v8.0 algorithm for advanced thermostat savings is deemed to calculate net savings, so no NTG adjustment is applicable (NA). Available on the SAG web site: https://www.ilsag.info/ntg_2020.
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 Guidehouse's 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 other than 100%. Appendix A provides a description of the impact analysis methodology. 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 Average (therms/unit)	Verified Gross Average (therms/unit)	Realization Rate	Data Source(s)*
Duct Insulation and Sealing - Blower Door	Project	70.46	70.43	100%	Illinois TRM v8.0 (TRM)† – Section 5.3.4; Illinois Energy Code‡
Gas High Efficiency Furnace	Each	128.97	128.66	100%	TRM v8.0 – Section 5.3.7
Advanced Thermostat	Each	56.00	56.27	100%	TRM v8.0 – Section 5.3.16
Gas Water Heater	Each	33.76	34.11	101%	TRM v8.0 – Section 5.4.2 and Section 4.3.1.
Air Sealing	Project	77.72	111.35	143%	TRM v8.0 – Section 5.6.1; Illinois Energy Code

* Program Tracking Data (PTD) provided by Nicor Gas, extract dated January 28, 2021.
† State of Illinois Technical Reference Manual version 8.0 from http://www.ilsag.info/technical-reference-manual.html.
‡ Illinois Energy Conservation Code, July 1, 2018.
https://www2.illinois.gov/cdb/business/codes/IllinoisAccessibilityCode/Documents/2018%20Illinois%20Specific%20Amendments%20with%20Modifications%20Shown.pdf

5.1.1 Duct Insulation and Sealing

The evaluation team found 31 measures with realization rates other than 100% in the end of year impact analysis. We conducted an interim impact review on the RNC program in August and September 2020, and were unable to reproduce the ex ante savings or the CFM reduction required for the TRM algorithm at that time. On November 24, 2020, Guidehouse and the implementers had a meeting to discuss the interim review findings. During this meeting, the implementer described assumptions and methodology used to calculate the ex ante savings reported for this measure. Guidehouse took note of these assumptions and used them to verify savings, as shown in Table 5-2.

Table 5-2. Duct Sealing Calculation Assumptions

Project Square Footage (SF) of Conditioned Floor Area	CFM Before Installation (CFM per 100 SF of Conditioned Floor Area)	CFM After Installation	ΔCFM25 Calculation
3,750 SF (Fixed assumption, not provided in tracking data)	4 (Fixed assumption based on IL residential energy code)	Provided in the PostInstallValue column of the tracking data	(4-PostInstallValue) * 3,750 /100

Source: Nicor Gas tracking data and implementation contractor assumptions.

These assumptions yielded 100% realization rates for 518 measures, but did not do so for the remaining 31, as shown in Table 5-3. The evaluation team was not able to determine the cause of this discrepancy.

Table 5-3. Duct Sealing Measures with Savings Discrepancies

VendorProjectID	Verified Realization Rate	VendorProjectID	Verified Realization Rate
149596	69%	150276	87%
149602	102%	150277	118%
149603	121%	150278	77%
149606	87%	150279	96%
149760	123%	150280	112%
149835	104%	150354	77%
149837	77%	150358	79%
149839	125%	150359	128%
149842	114%	150445	143%
150010	110%	152586	95%
150012	121%	157158	95%
150014	58%	157320	95%
150018	104%	157327	95%
150134	90%	158569	95%
150135	178%	159373	95%
150275	79%		

Source: Guidehouse evaluation team analysis.

Additionally, the evaluation team found that there were 25 measures which did not report input capacities in the System tab of the tracking data. Although this variable is canceled out in the duct insulation calculation, these values are needed to accurately verify furnace savings. The evaluation team used the reported installed furnace model numbers to collect the input capacities for these measures and verify savings. The realization rate for these measures is 100%.

Recommendation 1. For duct sealing measures, report the conditioned floor area square footage of each project instead of using an average value from a previous evaluation year.

Recommendation 2. Confirm the input values used in ex ante savings calculations are provided as input values in the tracking data.

5.1.2 Gas High Efficiency Furnace

The evaluation team found 9 gas furnace measures with realization rates other than 100%. Six of these measures (Project IDs 152586, 157158, 157320, 157327, 158569, 159373) have realization rates of 85%. The ex ante calculations for these measures used an EFLH (Equivalent Full Load Hours) value associated with climate zone 2 instead of climate zone 3, as reported for these measures in the tracking data. Climate zone 2 uses an EFLH value of 976, whereas climate zone 3 is an EFLH of 836, leading to the 85% realization rate. The evaluation team was unable to identify a cause for the discrepancies in the realization rates for the remaining three measures. The values used in the calculation are shown in Table 5-4.

Table 5-4. Gas High Efficiency Furnace Savings Discrepancies

VendorProjectID	EFLH	Input Capacity*	AFUE_eff	AFUE_base	Verified Realization Rate
149515	976	60000	0.961	0.80	60%
152995	976	40000 40000	0.950	0.80	73%
155673	976	80000 80000	0.921	0.80	114%

* Larger homes may install two furnaces for more efficient air distribution.
Source: Nicor Gas tracking data and Guidehouse evaluation team

Additionally, the evaluation team found that there were 25 measures which did not report input capacities in the System tab of the tracking data. The evaluation team used the reported installed furnace model numbers to collect the input capacities for these measures and verify savings. The realization rate for these measures is 100%.

Recommendation 3. Confirm the input values used in ex ante savings calculations are consistent and provided as input values in the tracking data.

Recommendation 4. Use project zip codes to best align with the TRM Climate Zones when calculating savings.

5.1.3 Advanced Thermostats

The evaluation team verified one measure, Project #159373, to have an 86% realization rate. The ex ante savings for this measure used a Gas_Heating_Consumption value of 1005, aligning to Climate Zone 2 (Chicago). Guidehouse mapped the zip code of this project to Climate Zone 3 (Springfield) and verified savings using a value of 861.

Recommendation 5. Use project zip codes to best align with the TRM climate zones when calculating savings.

5.1.4 Gas Water Heaters with 75 Gallon Storage

The evaluation team found 26 projects that had installed 75 gallon storage water heaters. The Btu per hour (Btu/hr) input rating for these water heaters is more than 75,000 Btu/hr (typically 76,000 Btu/hr) and these are covered under the non-residential TRM measure 4.3.1 as a high-input residential-duty commercial equipment type. All of the measures reported a UEFefficient value of 0.69 in the tracking data, except one that reported 0.70. The evaluation team reviewed manufacturers' literature to identify the UEF efficiency rating for the 26 installed models and found 21 water heaters with a UEF of 0.69, one project with a UEF of 0.59 (Project ID 149602), and four projects with a model number not found (Project IDs 153294, 161500, 164930, 165037).

To calculate verified therms for 75 gallon tanks, the evaluation used the algorithm for TRM measure 4.3.1. Using this tank size and residential-duty commercial equipment type classification, the UEFbaseline value is calculated to be 0.5177, as deemed by the TRM v8.0 UEFbaseline equation. The verified savings calculation uses the residential input assumptions from TRM measure 5.4.2 for water temperatures and annual hot water use. Table 5-5 shows ex ante and verified gross therm savings by manufacturer and model number. Of the four model numbers not found, Nicor Gas provided specification sheets for two of the models, and two model numbers were verified to be typos for model RG2PV75H6N, and were corrected.

The verified savings for the 75 gallon water heaters was 1,197 gross therms versus 608 ex ante therms, a realization rate of 197% for these larger units.

Table 5-5. Gas Water Heater Savings Discrepancies

Manufacturer	Model Number	Unit Quantity	Ex Ante Therms per unit	UEFefficient Verified	Verified Therms per unit	Verified Realization Rate
AO Smith	GPVX-75L-310	1	23.4	0.69	46.9	200%
State	GS6-75-YRVHTL 210	1	23.4	0.69	46.9	200%
State	GS6-75-YRVHTL 210	1	23.4	0.69	46.9	200%
State	GS6-75-YRVHTL 310	1	23.4	0.69	46.9	200%
Bradford White	RG1PV75H6N (typo)	1	23.4	0.69	46.9	200%
Bradford White	RG275H6N	1	23.4	0.59	23.0	98%
Bradford White	RG2PV75H6N	19	23.4	0.69	46.9	200%
Bradford White	RH2PV75H6N (typo)	1	23.4	0.69	46.9	200%

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

Recommendation 6. Determine and track the UEFefficient values for 75 gallon storage water heaters using manufacturer and model numbers, and use tracked values in the ex ante savings calculation.

5.1.5 Air Sealing

The existing TRM v8.0 air sealing algorithm assumes nHeat is the same value for the base case and new scenario. The evaluation team verified savings by calculating the delta therms for each measure, subtracting new home therm usage from baseline therms. The baseline therms usage was calculated using a baseline AFUE value of 80% and distribution efficiency of 85%, resulting in an nHeat value of 68%. The efficient new home therms usage for each measure was subtracted from this baseline, using an nHeat value calculated with the AFUE value provided in the tracking data, multiplied by the distribution efficiency of 85%. This approach ensured that the baseline therms usage was not underestimated by using only the efficient AFUE value. Additionally, the evaluation team used the assumed Nicor Gas conditioned area volume of 31,875 cubic feet to convert the ACH50 values provided in the tracking data to CFM50 values used in the TRM v8.0 savings algorithm. The calculation variables are summarized in Table 5-6.

Table 5-6. Air Sealing Calculation Variables

CFM50 Existing*	CFM50 New*	nHeat†	N_heat
2,125	(PostInstallValue ACH50 * 31,875) / 60	Equipment Efficiency * 85%	19.4

* The TRM v8.0 algorithm refers to "CFM50_existing" as the base case and "CFM50_new" as the efficient case. For New Construction, "CFM50_existing" refers to the Illinois residential energy code baseline, and "CFM50_new" refers to the as-built home.
† Equipment Efficiency for "existing" uses the TRM v8.0 Time of Sale furnace efficiency baseline of 80% AFUE which is based on federal standard. Equipment Efficiency for new (as-built) home is from Nicor Gas tracking data.
Source: Nicor Gas tracking data and Guidehouse evaluation team.

Additionally, there are 26 projects which have realization rates above 100%, not related to the nHeat adjustment described above, shown in Table 5-7. Guidehouse was unable to pinpoint a cause for the higher realization rates.

Table 5-7. Air Sealing Measures with Savings Discrepancies

VendorProjectID	VendorProjectID
148833	149120
148835	149121
148964	149152
148965	149154
148966	149159
148967	149161
148969	149163
148971	149165
148972	149261
148973	149280
148974	149281
148975	149502
149115	149514

Source: Guidehouse evaluation team analysis.

The evaluation team found 6 projects which used the Heating Degree Days (HDD) value associated with climate zone 2, when these projects were located in climate zone 3. This discrepancy caused varying realization rates for these measures, as shown in Table 5-8.

Table 5-8. Air Sealing Calculation HDD Discrepancy

VendorProjectID	HDD used in Ex Ante Savings	HDD used in Verified Savings	Verified Realization Rate
152586	5113	4379	118%
157158	5113	4379	129%
157320	5113	4379	117%
157327	5113	4379	124%
158569	5113	4379	120%
159373	5113	4379	114%

Source: Nicor Gas tracking data and Guidehouse evaluation team.

Recommendation 7. Estimate air sealing energy savings using a baseline nHeat value derived from energy code to calculate the baseline therm usage and the new nHeat derived from tracking data to calculate the new home therm usage.

Recommendation 8. For air sealing measures, base conditioned volume on a reported conditioned floor area square footage of each project instead of using an average value from a previous evaluation year.

Recommendation 9. Use project zip codes to best align with the TRM climate zones when calculating savings.

Recommendation 10. Confirm the input values used in ex ante savings calculations are consistent and provided as input values in the tracking data.

Appendix A. Impact Analysis Methodology

Guidehouse followed algorithms outlined in the Illinois Technical Reference Manual (TRM) v8.0 to calculate verified gross savings for residential programs. The evaluation team verified that these algorithms and appropriate deemed input parameters were correctly applied and validated custom parameters that were used. Baseline assumptions were derived from Illinois energy code[1] or the TRM.

Guidehouse calculated verified net savings by multiplying verified gross savings by a net-to-gross (NTG) of 0.80, except for advanced thermostats where no NTG adjustment was applied. The 2020 NTG value of 0.65 for Residential New Construction was deemed for the comprehensive RNC program implemented jointly with ComEd. The 2020 pilot delivery and incentive structure of the Nicor Gas Prescriptive RNC Program is significantly different from the joint RNC program. Guidehouse conducted secondary research, but did not find a comparable program with a researched NTG value to use for the RNC Prescriptive offering. We recommend the TRM default value of 0.80 for this pilot program in 2020, and the value was accepted by the Illinois Stakeholder Advisory Group (SAG) for 2021, as well.

[1] Illinois Energy Conservation Code, July 1, 2018. https://www2.illinois.gov/cdb/business/codes/IllinoisAccessibilityCode/Documents/2018%20Illinois%20Specific%20Amendments%20with%20Modifications%20Shown.pdf

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

End Use	Research Category	Units	Quantity	Effective Useful Life	Ex Ante Gross Savings (Therms)	Verified Gross Savings (Therms)	Verified Net Savings (Therms)
HVAC	Duct Insulation and Sealing - Blower Door	Each	549	20.0	38,683	38,667	30,933
HVAC	Gas High Efficiency Furnace - TOS	Each	771	20.0	95,955	95,722	76,578
HVAC	Advanced Thermostat - Programmable	Each	729	11.0	40,824	41,020	41,020
Hot Water	Gas Water Heater - TOS	Each	744	13.0	25,120	25,379	20,303
Shell	Air Sealing	Each	549	20.0	42,666	61,129	48,903
Total or Weighted Average				**17.9**	**243,248**	**261,917**	**217,737**

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