Multi-Family Program Impact Evaluation Report

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

Prepared for:

Nicor Gas

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Table of Contents

List of Tables, Figures, and Equations

1. Introduction

This report presents the results of the impact evaluation of the Nicor Gas 2020 Multi-Family 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 2020 covers January 1, 2020 through December 31, 2020.

2. Program Description

The Multi-Family Program is delivered through four channels:

- The Direct Installation 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.
- The Prescriptive and Custom paths offers incentives to multi-family decision-makers to install energy saving measures in common areas (CA) of multi-family buildings.
- In 2020, Nicor Gas launched the Centralized Plant Optimization Program (CPOP) path where program-approved contractors provide free central plant upgrades, including boiler tune-ups, boiler controls, pipe and tank insulation, and steam trap testing and repair.

The program had 212 participants in 2020 and completed 3,632 projects as shown in Table 2-1.

Table 2-1. 2020 Volumetric Findings Detail

Participation	Direct Install	Prescriptive	CPOP	Custom	Total
Participants*	89	38	83	2	212
Installed Projects†	3,253	54	323	2	3,632
Measure Types‡	14	7	18	2	41

* Participants are defined as unique site addresses in the tracking data.
† Installed Projects are defined as unique project IDs in the tracking data.
‡ Measure Types are defined as unique measure types in the tracking data, including assessments.
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. 2020 Installed Measure Quantities

Program Path	Measure	Quantity Unit	Installed Quantity	Customers*	Projects†
Direct Install	Programmable Thermostat In-Unit (IU)	Unit	978	24	978
	Low Flow Showerhead (IU)	Unit	2,028	58	1,797
	Shower Timer	Unit	1,728	48	1,495
	Pipe Insulation Common Area (CA)	Linear Feet	1,745	35	110
	Faucet Aerator - Kitchen (IU)	Unit	1,306	49	1,306
	Reprogram Thermostat (IU)	Unit	50	2	50
	Faucet Aerator - Bathroom (IU)	Unit	1,070	43	898
	Low Flow Showerhead (CA)	Unit	28	12	12
	Advanced Thermostat	Unit	21	1	21
	Faucet Aerator - Bathroom (CA)	Unit	51	18	18
	Faucet Aerator - Kitchen (CA)	Unit	9	7	7
Prescriptive	Condensing Boilers	Unit	22	12	22
	Boiler Tune Up	Unit	7	5	7
	Boiler Reset Controls	Unit	10	9	10
	Hydronic Boilers	Unit	2	2	2
	Outdoor Pool Covers	Square Feet	1,856	1	1
	Furnace	Unit	10	8	10
	Pipe Insulation Indoor Hot Water (HW) Space Heat	Linear Feet	330	2	2
CPOP	Domestic Hot Water (DHW) Controller	Unit	4,721	41	159
	Boiler Tune Up	Unit	241	44	217
	Steam Boiler Averaging Controls	Unit	102	4	4
	Steam Traps	Unit	264	7	22
	Pipe Insulation (CA)	Linear Feet	18,569	36	255
	Boiler Reset Controls	Unit	37	17	37
	DHW Tank Insulation	Square Feet	261	2	2
Custom	Custom	Measure	4	2	2

* Customers are defined as unique site addresses in the tracking data.
† Installed Projects are defined as unique project IDs in the tracking data.
Source: Nicor Gas tracking data and Guidehouse evaluation team analysis.

3. Program Savings Detail

Table 3-1 summarizes the energy savings the Multi-Family Program achieved by path in 2020. The CPOP program path achieved more than 81% of the total program verified net savings 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)
Direct Install	96,669	99%	96,042	Aerators = 1.01 Showerheads = 1.01 Advanced Thermostat = NA‡ All Other Measures = 0.96	93,651
Prescriptive	71,225	99%	70,675	0.93	65,728
CPOP	861,405	100%	861,364	0.93	801,069
Custom	22,816	107%	24,359	0.93	22,654
Total or Weighted Average	**1,052,114**	**100%**	**1,052,441**	**0.93**	**983,102**

* 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.
‡ The Illinois TRM V8.0 algorithm for advanced thermostat savings is deemed to calculate net savings, so no NTG adjustment is applicable.
Source: Nicor Gas tracking data and Guidehouse evaluation team analysis.

4. Program Savings by Measure

The program includes 26 measures as shown in Table 4-1. The DHW controller and boiler tune up measures in the CPOP program path contributed the most savings.

Table 4-1. 2020 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	Programmable Thermostat (IU)	51,179	100%	51,221	0.96	49,173
	Low Flow Showerhead (IU)	23,719	97%	22,951	1.01	23,181
	Shower Timer	6,116	100%	6,115	0.96	5,871
	Pipe Insulation (CA)	4,174	106%	4,404	0.96	4,228
	Faucet Aerator - Kitchen (IU)	3,409	100%	3,411	1.01	3,446
	Reprogram Thermostat (IU)	2,993	100%	2,997	0.96	2,877
	Faucet Aerator - Bathroom (IU)	1,682	100%	1,683	1.01	1,700
	Low Flow Showerhead (CA)	1,812	92%	1,673	0.96	1,606
	Advanced Thermostat	1,207	100%	1,207	NA‡	1,207
	Faucet Aerator - Bathroom (CA)	311	100%	311	0.96	299
	Faucet Aerator - Kitchen (CA)	67	100%	67	0.96	64
Prescriptive	Condensing Boilers	44,730	99%	44,181	0.93	41,088
	Boiler Tune Up	9,421	100%	9,421	0.93	8,761
	Boiler Reset Controls	8,402	100%	8,402	0.93	7,814
	Hydronic Boilers	4,084	100%	4,084	0.93	3,798
	Outdoor Pool Covers	1,875	100%	1,875	0.93	1,743
	Furnace	1,739	100%	1,739	0.93	1,618
	Pipe Insulation Indoor HW Space Heat	974	100%	974	0.93	906
CPOP	DHW Controller	296,007	100%	296,007	0.93	275,286
	Boiler Tune Up	190,412	100%	190,412	0.93	177,083
	Steam Boiler Averaging Controls	172,649	100%	172,649	0.93	160,564
	Steam Traps	107,710	100%	107,710	0.93	100,170
	Pipe Insulation (CA)	63,425	100%	63,386	0.93	58,949
	Boiler Reset Controls	30,013	100%	30,013	0.93	27,912
	DHW Tank Insulation	1,189	100%	1,188	0.93	1,105
Custom	Custom	22,816	107%	24,359	0.93	22,654
	Total or Weighted Average	**1,052,114**	**100%**	**1,052,441**	**0.93**	**983,102**

† A deemed value. Available on the SAG web site: https://www.ilsag.info/ntg_2020.
‡ The Illinois TRM v8.0 algorithm for advanced thermostat savings is deemed to calculate net savings, so no NTG adjustment is applicable.
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 our review. The realization rate is the ratio of the verified savings to the ex ante savings. Following the table, the evaluation team 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)*
Programmable Thermostat (IU)	Unit	Varies	Varies	100%	TRM, v8.0†, Section 5.3.11
Low Flow Showerhead (IU)	Unit	Varies	11.32	97%	TRM, v8.0, Section 5.4.5
Shower Timer	Unit	3.54	3.54	100%	TRM, v8.0, Section 5.4.9
Pipe Insulation (CA)	Linear Ft.	Varies	Varies	100%	TRM, v8.0, Section 4.4.14
Faucet Aerator - Kitchen (IU)	Unit	2.61	2.61	100%	TRM, v8.0, Section 5.4.4
Reprogram Thermostat (IU)	Unit	Varies	Varies	100%	TRM, v8.0, Section 5.3.11
Faucet Aerator - Bathroom (IU)	Unit	1.57	1.57	100%	TRM, v8.0, Section 5.4.4
Low Flow Showerhead (CA)	Unit	64.90	59.75	92%	TRM, v8.0, Section 4.3.3
Advanced Thermostat	Unit	57.49	57.49	100%	TRM, v8.0, Section 5.3.16
Faucet Aerator - Bathroom (CA)	Unit	6.10	6.10	100%	TRM, v8.0, Section 4.3.2
Faucet Aerator - Kitchen (CA)	Unit	7.44	7.44	100%	TRM, v8.0, Section 4.3.2
Condensing Boilers	Unit	Varies	Varies	99%	TRM, v8.0, Section 4.4.10
Boiler Tune Up	Unit	Varies	Varies	100%	TRM, v8.0, Section 4.4.2
Boiler Reset Controls	Unit	Varies	Varies	100%	TRM, v8.0, Section 4.4.4
Hydronic Boilers	Unit	Varies	Varies	100%	TRM, v8.0, Section 4.4.10
Outdoor Pool Covers	Sq. Ft.	1.01	1.01	100%	TRM, v8.0, Section 4.3.4
Furnace	Unit	Varies	Varies	100%	TRM, v8.0, Section 5.3.7
Pipe Insul. Indoor HW Space Heat	Linear Ft.	Varies	Varies	100%	TRM, v8.0, Section 4.4.14
DHW Controller	Unit	62.70	62.70	100%	TRM, v8.0, Section 4.3.8
Steam Boiler Averaging Controls	Unit	Varies	Varies	100%	TRM, v6.0 and v8.0, Section 4.4.36
Steam Traps	Unit	407.99	407.99	100%	TRM, v8.0, Section 4.4.16
DHW Tank Insulation	Sq. Ft.	4.56	4.56	100%	TRM, v8.0, Section 4.4.14
Custom	Measure	Varies	Varies	107%	Project File Review, Evaluation‡

* Program tracking data 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.
‡ Project files and monthly billing data provided by Nicor Gas. Where conducted, on-site or telephone interview data collected by Guidehouse.

5.2 Findings and Recommendations

5.2.1 Boiler Reset Controls and Boiler Tune Up

Guidehouse noted that the boiler capacity did not align with the specifications of the manufacturer and model number provided in the tracking data for multiple boiler reset controls and boiler tune up projects. Common boiler capacity reporting errors and corresponding example project IDs are summarized in Table 5-2. Boiler capacity is a crucial parameter for accurately estimating the savings for these measures.

Table 5-2. Boiler Capacity Reporting Errors

Error	Project ID
No boiler manufacturer or model provided	PID-2020.07.31-69665, PID-2020.07.31-69647
Manufacturer and model of control system provided instead of boiler	PID-2020.09.15-70285, PID-2020.09.15-70297
Same manufacturer and model number provided uses different capacity values in the calculations	PID-2020.03.03-64805, PID-2020.04.14-69250
Capacity used for calculations does not match specifications for boiler model provided	PID-2020.07.31-69631

Source: Guidehouse evaluation team analysis.

Recommendation 1. To ensure correct capacity values are used to calculate savings, conduct a thorough quality check of boiler specification information provided by the implementation contractor or trade ally.

5.2.2 Condensing Boilers

Ex ante calculations for condensing boilers with capacity less than 3,000 MBH use a baseline boiler efficiency of 80%.

Recommendation 2. Use a baseline boiler efficiency of 82% for condensing boilers with capacity less than 3,000 MBH per Illinois Technical Reference Manual (TRM) v8.0 Section 4.4.10.

5.2.3 Low Flow Showerhead (IU)

Ex ante savings for this measure for project IDs PID-2020.08.19-69897, PID-2020.09.16-71531, PID-2021.01.06-78690, and PID-2021.01.06-78681 are calculated using parameters from TRM v8.0 for common area applications.

Recommendation 3. Use parameters from TRM v8.0 Section 5.4.5 for all in-unit showerhead measures.

Ex ante savings for 234 low flow showerhead measures are calculated using an energy per gallon (EPG_{Gas}) value of 0.005800, while savings for 1,784 measures are calculated using an EPG_{Gas} value of 0.005831.

Recommendation 4. Use an EPG_Gas value of 0.005831 from the TRM v8.0 Section 5.4.5 for low flow showerheads to avoid rounding adjustments.

5.2.4 Low Flow Showerhead (CA)

Ex ante savings for this measure are calculated using an EPG_{Gas} value of 0.0063 from TRM v7.0 Section 4.3.3.

Recommendation 5. Use the EPG_{Gas} value of 0.0058 from TRM v8.0 Section 4.3.3 for all common area showerhead measures installed in 2020.

5.2.5 Programmable Thermostat (IU) and Reprogrammable Thermostat (IU)

Ex ante savings for these measures are calculated using a heating load of 1,485 therms for boiler systems, which represents the TRM boiler load of 1,218 therms divided by the efficiency of a boiler system (82.0%).

Recommendation 6. Use a Heating Load of 1,487 therms which represents the TRM boiler load of 1,218 therms divided by the TRM v8.0 default efficiency of a boiler system (81.9%).

5.2.6 Pipe Insulation (CA)

Ex ante savings for the HW Insulation (1') DI CA measure for project IDs PID-2020.11.05-73461 and PID-2021.01.08-78947 are calculated using the heating season recirculation EFLH for climate zone 1, while the tracking data indicates these measures were installed in climate zone 2.

Recommendation 7. Use the EFLH values corresponding to the climate zone in which the measures are installed.

The ex ante savings for the HW Insulation (1') DI CA measure correspond to the domestic hot water (DHW) application.

Recommendation 8. Update the measure name to indicate the correct application for the HW Insulation (1") DI CA measure.

The Heat Loss (Q) values used for this pipe insulation measure vary based on assumed pipe size. However, the measure name indicates that the pipe size for all measures is 1'.

Recommendation 9. Update pipe insulation measure names to represent the pipe size or include this information in the tracking data.

The ex ante savings for the HW Insulation (1') DI CA measure for project ID PID-2020.03.17-66931 do not correspond to the parameters provided in the tracking database.

Recommendation 10. Update the ex ante savings for this project ID to match the parameters in the tracking data.

5.2.7 Custom – PID-2020.12.28-77895

For the boiler turndown improvement measure, the ex ante savings calculated an energy loss due to cycling for both the baseline and efficient cases despite the boiler percent load exceeding the minimum turndown ratio for the boiler. In the verified savings, energy loss due to cycling is calculated for the baseline and efficient cases only when the boiler percent load is less than the minimum turndown ratio.

Recommendation 11. Update the ex ante savings to calculate energy loss for the baseline and efficient cases only when the boiler percent load is less than the minimum turndown ratio.

For the boiler efficiency upgrade measure, the ex ante savings calculated the normalized baseline usage using typical meteorological year (TMY) heating degree days (HDD) corresponding to a base temperature of 55°F. In the verified savings, the normalized baseline energy usage is calculated using TMY HDD corresponding to a base temperature of 65°F determined based on analysis of the monthly billing data for the facility.

Recommendation 12. Update the base temperature used to calculate the TMY HDD based on analysis of the monthly billing data for the facility, when available.

For the boiler efficiency upgrade measure, the ex ante savings are calculated using an efficient boiler efficiency of 85.2%. Guidehouse calculated verified savings for this measure using an efficient boiler efficiency of 85.0% based on the boiler specification sheet.

Recommendation 13. Update the efficient boiler efficiency to match the specification sheet for installed equipment.

Appendix A. 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 v8.0[1] or evaluation research for non-deemed measures.
2. Validating that the savings algorithm was applied correctly.
3. Multiplying the verified per-unit savings value by the quantity reported in the tracking data.

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 A-1 provides a summary of M&V results for the custom projects reviewed by Guidehouse.

Table A-1. Profile of Gross Impact Sample for Custom Projects

Project ID	Measure Description	Ex Ante Gross Savings (Therms)	Gross Realization Rate	Verified Gross Savings (Therms)	Summary of Adjustment
PID-2020.12.28-77895	Boiler Efficiency Upgrade	8,650	106%	9,195	Updated proposed boiler efficiency; updated billing analysis to use a base temperature of 65F
	Boiler Controls Upgrade	7,531	109%	8,196	
	Boiler Turndown Improvement	3,784	109%	4,117	Updated energy loss to be zero when Boiler Load % is greater than Turndown Ratio
PID-2021.01.06-78519	DHW Tank Insulation	2,851	100%	2,851	NA

Source: Guidehouse evaluation team analysis.

Engineering Review of Project Files

For each custom project, an in-depth application review is performed to assess the engineering methods, parameters and assumptions used to generate all ex ante impact estimates. For each measure in the project, engineers estimated ex post gross savings based on their review of documentation and engineering analysis.

To support this review, the implementation contractor provided project documentation in electronic format for each sampled project. Documentation included some or all scanned files of hardcopy application forms and supporting documentation from the applicant (invoices, measure specification sheets, and vendor proposals), pre-inspection reports and photos, post inspection reports and photos, and calculation spreadsheets.

[1] Available on the SAG web site: 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)
Direct Install	Programmable Thermostat (IU)	Unit	978	8.0	51,179	51,221	49,173
	Low Flow Showerhead (IU)	Unit	2,028	10.0	23,719	22,951	23,181
	Shower Timer	Unit	1,728	2.0	6,116	6,115	5,871
	Pipe Insulation (CA)	Linear Ft.	1,745	15.0	4,174	4,404	4,228
	Faucet Aerator - Kitchen (IU)	Unit	1,306	10.0	3,409	3,411	3,446
	Reprogram Thermostat (IU)	Unit	50	2.0	2,993	2,997	2,877
	Faucet Aerator - Bathroom (IU)	Unit	1,070	10.0	1,682	1,683	1,700
	Low Flow Showerhead (IU)	Unit	28	10.0	1,812	1,673	1,606
	Advanced Thermostat	Unit	21	11.0	1,207	1,207	1,207
	Faucet Aerator - Bath (CA)	Unit	51	10.0	311	311	299
	Faucet Aerator - Kitchen (CA)	Unit	9	10.0	67	67	64
Prescriptive	Condensing Boilers	Unit	22	20.0	44,730	44,181	41,088
	Boiler Tune Up	Unit	7	3.0	9,421	9,421	8,761
	Boiler Reset Controls	Unit	10	20.0	8,402	8,402	7,814
	Hydronic Boilers	Unit	2	20.0	4,084	4,084	3,798
	Outdoor Pool Covers	Square Ft.	1,856	6.0	1,875	1,875	1,743
	Furnace	Unit	10	20.0	1,739	1,739	1,618
	Pipe Insulation Indoor HW Space Heat	Linear Ft.	330	15.0	974	974	906
CPOP	DHW Controller	Unit	4,721	15.0	296,007	296,007	275,286
	Boiler Tune Up	Unit	241	3.0	190,412	190,412	177,083
	Steam Boiler Averaging Controls	Unit	102	15.0	172,649	172,649	160,564
	Steam Traps	Unit	1,750	6.0	107,710	107,710	100,170
	Pipe Insulation (CA)	Linear Ft.	18,569	15.0	63,425	63,386	58,949
	Boiler Reset Controls	Unit	37	20.0	30,013	30,013	27,912
	DHW Tank Insulation	Square Ft.	261	15.0	1,189	1,188	1,105
Custom	Custom	Measure	4	15.0	22,816	24,359	22,654
Total or Weighted Average				**11.6**	**1,052,114**	**1,052,441**	**983,102**

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