Multi-Family Impact Evaluation Report

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

Prepared for:

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1. Introduction

This report presents the results of the impact evaluation of the Nicor Gas 2021 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 2021 covers January 1, 2021 through December 31, 2021.

2. Program Description

The Multi-Family Program is delivered through three channels:

- The Direct Installation path offered jointly with ComEd, which provides free assessment and no-cost direct installation (DI) in-unit (IU) of measures in residential multi-family buildings with five or more living units.
- The Prescriptive path 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 315 participants in 2021 and completed 4,064 projects as shown in Table 2-1.

Table 2-1. 2021 Volumetric Findings Detail

Participation	Direct Install	Prescriptive	CPOP	Total
Participants*	53	27	235	315
Installed Projects†	3,758	54	252	4,064
Measure Types‡	15	7	14	36

* 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.

Error! Reference source not found. summarizes the installed measure quantities that are the basis for verified energy savings.

Table 2-2. 2021 Installed Measure Quantities

Program Path	Measure	Quantity Unit	Installed Quantity	Customers	Projects
CPOP	Boiler Tune Up	Unit	238	196	197
	Domestic Hot Water (DHW) Controller	Apartment (Apt) Unit	1,197	36	36
	Pipe Insulation (DI) CA	Linear Feet	17,500	116	117
	Boiler Reset Controls	Project	46	45	45
	DHW Tank Insulation	Square Feet	335	5	5
	Steam Traps	Unit	3	1	1
Direct Install	Programmable Thermostat (DI) IU	Unit	896	17	896
	Low Flow Showerhead (DI) IU	Unit	1,958	42	1,689
	Pipe Insulation (DI) CA	Linear Feet	6,105	23	24
	Reprogram Thermostat (DI) IU	Unit	225	7	225
	Shower Timer	Unit	1,609	20	1,483
	Faucet Aerator - Bathroom (DI) IU	Unit	1,572	30	1,192
	Faucet Aerator - Kitchen (DI) IU	Unit	915	31	905
	Low Flow Showerhead (DI) CA	Unit	21	5	5
	Advanced Thermostat	Unit	23	1	23
	Faucet Aerator - Bathroom (DI) CA	Unit	36	11	11
	Faucet Aerator - Kitchen (DI) CA	Unit	9	4	4
Prescriptive	Condensing Boilers	Unit	25	13	25
	Pipe Insulation Indoor Hot Water (HW) Space Heat	Linear Feet	7,453	3	3
	Ozone Laundry	Unit	3	3	3
	Hydronic Boilers	Unit	4	1	4
	Boiler Tune Up	Unit	9	2	8
	Furnace	Unit	10	4	10
	Boiler Reset Controls	Unit	1	1	1

* 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 2021.

Table 3-1. 2021 Annual Energy Savings Summary

Program Path	Ex Ante Gross Savings (Therms)	Verified Gross RR*	Verified Gross Savings (Therms)	NTG†	Verified Net Savings (Therms)
CPOP	221,027	128%	282,902	0.93	263,099
Direct Install	96,179	100%	96,230	Varies	93,668
Prescriptive	101,038	102%	103,513	0.93	96,267
Total or Weighted Average	**418,244**	**115%**	**482,646**	**0.94**	**453,034**

* 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/evaluator-ntg-recommendations-for-2021/.
Source: Nicor Gas tracking data and Guidehouse evaluation team analysis.

4. Program Savings by Measure

The program includes 24 measures as shown in **Error! Reference source not found.**. The boiler tune-up and on-demand domestic hot water (DHW) controller measures in the CPOP program path contributed the most savings.

Table 4-1. 2021 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)
CPOP	Boiler Tune Up	120,406	101%	122,086	0.93	113,540
	DHW Controller	28,453	264%	75,052	0.93	69,798
	Pipe Insulation (DI) CA	40,472	130%	52,529	0.93	48,852
	Boiler Reset Controls	29,542	103%	30,291	0.93	28,171
	DHW Tank Insulation	1,526	100%	1,524	0.93	1,418
	Steam Traps	627	226%	1,420	0.93	1,320
Direct Install	Programmable Thermostat (DI) IU	36,289	100%	36,289	0.96	34,838
	Low Flow Showerhead (DI) IU	22,159	100%	22,159	1.01	22,381
	Pipe Insulation (DI) CA	15,448	100%	15,503	0.96	14,883
	Reprogram Thermostat (DI) IU	9,113	100%	9,113	0.96	8,748
	Shower Timer	5,695	100%	5,694	0.96	5,466
	Faucet Aerator - Bathroom (DI) IU	2,471	100%	2,473	1.01	2,498
	Faucet Aerator - Kitchen (DI) IU	2,388	100%	2,390	1.01	2,414
	Low Flow Showerhead (DI) CA	1,257	100%	1,255	0.96	1,205
	Advanced Thermostat	1,067	100%	1,067	0.90	960
	Faucet Aerator - Bathroom (DI) CA	226	97%	220	0.96	211
	Faucet Aerator - Kitchen (DI) CA	67	100%	67	0.96	64
Prescriptive	Condensing Boilers	38,226	107%	41,036	0.93	38,164
	Pipe Insulation Indoor HW Space Heat	25,463	99%	25,128	0.93	23,369
	Ozone Laundry	23,446	100%	23,446	0.93	21,804
	Hydronic Boilers	8,108	100%	8,108	0.93	7,541
	Boiler Tune Up	3,341	100%	3,341	0.93	3,107
	Furnace	1,799	100%	1,799	0.93	1,673
	Boiler Reset Controls	656	100%	656	0.93	610
	Total or Weighted Average	**418,244**	**115%**	**482,646**	**0.94**	**453,034**

† A deemed value. Available on the SAG web site:https://www.ilsag.info/evaluator-ntg-recommendations-for-2021/.
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)
Advanced Thermostat	Unit	46.38	46.38	100%	TRM, v9.0† Errata, Section 5.3.16
Boiler Reset Controls	Unit	Varies	Varies	103%	TRM, v9.0, Section 4.4.4
Boiler Tune Up	Unit	Varies	Varies	101%	TRM, v9.0, Section 4.4.2
Condensing Boilers	Unit	Varies	Varies	107%	TRM, v9.0, Section 4.4.10
DHW Controller	Unit	Varies	62.70	264%	TRM, v9.0, Section 4.3.8
DHW Tank Insulation	Square Feet	4.56	4.55	100%	TRM, v9.0, Section 4.4.14
Faucet Aerator - Bathroom (DI) CA	Unit	Varies	6.10	97%	TRM, v9.0, Section 4.3.2
Faucet Aerator - Bathroom (DI) IU	Unit	1.57	1.57	100%	TRM, v9.0, Section 5.4.4
Faucet Aerator - Kitchen (DI) CA	Unit	7.44	7.44	100%	TRM, v9.0, Section 4.3.2
Faucet Aerator - Kitchen (DI) IU	Unit	2.61	2.61	100%	TRM, v9.0, Section 5.4.4
Furnace	Unit	Varies	179.75	100%	TRM, v9.0, Section 5.3.7
Hydronic Boilers	Unit	2,027.03	2,027.03	100%	TRM, v9.0, Section 4.4.10
Low Flow Showerhead (DI) CA	Unit	Varies	59.75	100%	TRM, v9.0, Section 4.3.3
Low Flow Showerhead (DI) IU	Unit	11.32	11.32	100%	TRM, v9.0, Section 5.4.5
Ozone Laundry	Unit	7,815.23	7,815.23	100%	TRM, v9.0, Section 4.3.6

Measure	Unit Basis	Ex Ante Gross (therms/unit)	Verified Gross (therms/unit)	Realization Rate	Data Source(s)
Pipe Insulation (DI) CA	Linear Feet	Varies	Varies	130%	TRM, v9.0, Section 4.4.14
Pipe Insulation Indoor HW Space Heat	Linear Feet	3.42	3.37	99%	TRM, v9.0, Section 4.4.14
Programmable Thermostat (DI) IU	Unit	40.50	40.50	100%	TRM, v9.0, Section 5.3.11
Reprogram Thermostat (DI) IU	Unit	40.50	40.50	100%	TRM, v9.0, Section 5.3.11
Shower Timer	Unit	3.54	3.54	100%	TRM, v9.0, Section 5.4.9
Steam Traps	Unit	208.99	473.29	229%	TRM, v9.0 Errata, Section 4.4.16

* Program tracking data 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.

5.2 Findings and Recommendations

5.2.1 Boiler Reset Controls

The evaluation team could not reproduce the ex ante therm savings for projects PID-2021.09.15-93732 and PID-2021.09.15-93733, resulting in a realization rate of 127% for these projects. As the other 45 boiler reset control projects had realization rates of 100%, the issue is likely a database error and not a savings calculation issue.

Recommendation 1. Review the database entries for these two projects and ensure that future calculations for this measure include additional quality assurance checks in the tracking system.

5.2.2 Boiler Tune Up

The evaluation team could not reproduce the ex ante therm savings for projects PID-2021.09.15-93732 and PID-2021.09.15-93733, resulting in realization rates of 330% and 141%, respectively. As the other 245 boiler tune-up projects had realization rates of 100%, the issue is likely a database error and not a savings calculation issue.

Recommendation 2. Review the database entries for these two projects and ensure that future calculations for this measure include additional quality assurance checks in the tracking system.

5.2.3 Condensing Boilers

Ex ante calculations for condensing boilers with capacity greater than 300 MBH and less than 2,500 MBH use a baseline boiler efficiency of 82%.

Recommendation 3. Use a baseline boiler efficiency of 80% for condensing boilers with capacity greater than 300 MBH and less than 2,500 MBH per the IL TRM v9.0 Section 4.4.10.

5.2.4 Furnace

The building type code for the efficient furnace project PID-2021.10.05-94476 is listed as a garage. As this is an in-unit measure and the building type is listed as multi-family, the evaluation team assumed the project was implemented in a multi-family unit.

Recommendation 4. Review the building type code for this project.

5.2.5 Hot Water Insulation – 1" (CA)

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

5.2.6 Low Flow Aerator – Bath (CA)

The evaluation team could not reproduce the ex ante therm savings for project PID-2021.11.17-96595, resulting in a savings realization rate of 88% for this project. As the other 10 common area bathroom aerator projects had realization rates of 100%, the issue is likely a database error and not a savings calculation issue.

Recommendation 6. Review the database entries for this project and ensure quality assurance of data tracking.

5.2.7 On-Demand DHW Controller

For 25 of the 42 on-demand DHW controller projects, the ex ante gross per unit savings differs from the verified gross per unit savings by a factor of 1,000. We could not identify the underlying cause for the ex ante discrepancy, but it may be due to typing/human error while entering tracking values.

Recommendation 7. Cross verification of entered tracking values is recommended.

As the savings for this measure are calculated on a per apartment unit basis, the evaluation team compared the quantity for each project with number of apartment units at the property provided in the program tracking data. The evaluation team updated the quantity for each project to correspond with the number of apartment units at the properties installing the DHW controllers. The ex ante total quantity for this measure was 3,390, compared with a verified quantity of 1,197.

Recommendation 8. Ensure that the quantity for each on-demand DHW controller project corresponds to the number of apartment units at the property. If the claimed controller quantity and number of apartment units differ, collect additional information to support the use of claimed quantities and provide to the evaluation team.

5.2.8 Steam Trap

The evaluation team could not reproduce the ex ante savings for the steam trap measure. The updated algorithm in Section 4.4.6 of TRM v9.0 requires the calculation of T_1 representing the temperature of saturated steam. T_1 relies on the average steam trap inlet absolute pressure in psia (P_1). The evaluation team calculated verified savings for this project assuming an average steam trap inlet pressure of 2 psig for a multifamily space heating steam system.

Recommendation 9. Track the assumptions used for average steam trap inlet and outlet pressures in psia to calculate the temperature of saturated steam (T_1) per Section 4.4.16 of the TRM. If the values are unknown, use a value of 16.696 for P_1 which results in a T_1 value of 665.86.

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 v9.0[1].
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.

[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)
CPOP	Boiler Tune Up	Unit	238	3.0	120,406	122,086	113,540
	DHW Controller	Apt Unit	1,197	15.0	28,453	75,052	69,798
	Pipe Insulation (DI) CA	Varies	17,500	15.0	40,472	52,529	48,852
	Boiler Reset Controls	Unit	46	16.0	29,542	30,291	28,171
	DHW Tank Insulation	Square Feet	335	15.0	1,526	1,524	1,418
	Steam Traps	Unit	3	6.0	627	1,420	1,320
Direct Install	Programmable Thermostat (DI) IU	Unit	896	16.0	36,289	36,289	34,838
	Low Flow Showerhead (DI) IU	Unit	1,958	10.0	22,159	22,159	22,381
	Pipe Insulation (DI) CA	Linear Feet	6,105	15.0	15,448	15,503	14,883
	Reprogram Thermostat (DI) IU	Unit	225	2.0	9,113	9,113	8,748
	Shower Timer	Unit	1,609	2.0	5,695	5,694	5,466
	Faucet Aerator – Bath. (DI) IU	Unit	1,572	10.0	2,471	2,473	2,498
	Faucet Aerator - Kitchen (DI) IU	Unit	915	10.0	2,388	2,390	2,414
	Low Flow Showerhead (DI) CA	Unit	21	10.0	1,257	1,255	1,205
	Advanced Thermostat	Unit	23	11.0	1,067	1,067	960
	Faucet Aerator – Bath. (DI) CA	Unit	36	10.0	226	220	211
	Faucet Aerator - Kitchen (DI) CA	Unit	9	10.0	67	67	64
Prescriptive	Condensing Boilers	Unit	25	25.0	38,226	41,036	38,164
	Pipe Insulation Indoor HW Space Heat	Linear Feet	7,453	15.0	25,463	25,128	23,369
	Ozone Laundry	Unit	3	10.0	23,446	23,446	21,804
	Hydronic Boilers	Unit	4	25.0	8,108	8,108	7,541
	Boiler Tune Up	Unit	9	3.0	3,341	3,341	3,107
	Furnace	Unit	10	20.0	1,799	1,799	1,673
	Boiler Reset Controls	Unit	1	16.0	656	656	610
Total or Weighted Average				**12.1**	**418,244**	**482,646**	**453,034**

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