RetroCommissioning Program Impact Evaluation Report

Energy Efficiency Plan: Program Year 2023 (1/1/2023-12/31/2023)

Prepared for:

Nicor Gas Company

FINAL

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1. Introduction

This report presents the results of the impact evaluation of the Nicor Gas 2023 RetroCommissioning program and a summary of the energy impacts for the total program as well as relevant measure and program structure details. The appendices present the impact analysis methodology, detailed engineering desk review results, and Illinois total resource cost (TRC) inputs. Program year 2023 covers January 1, 2023, through December 31, 2023.

The 2023 RetroCommissioning program is offered jointly to customers served by ComEd, Nicor Gas, Peoples Gas, and North Shore Gas. This report presents results of the impact evaluation for Nicor Gas.

2. Program Description

The RetroCommissioning program has been part of ComEd's Energy Efficiency program portfolio since 2007. In 2010, ComEd began coordinating the program with the gas utilities that also serve ComEd customers. ComEd manages and funds the program, and the gas utilities have the option to share the program costs and savings with ComEd on a project-by-project basis. The overlapping gas territories include Nicor Gas, PGL, and NSG.

The RetroCommissioning program helps commercial and industrial customers improve the energy performance of their facilities through systematic analysis of existing building systems. Program-qualified energy efficiency service providers (EESPs) recruit participants, conduct energy studies, and recommend energy-saving measures to implement. EESPs are required to verify implemented projects and measures before the project is considered complete. As the implementation contractor, Resource Innovations verifies, tracks, and reports savings for the coordinating utilities.

Generally, the program pays 100% for a detailed study, contingent on a participant's commitment to spend a defined amount of its own funds implementing study recommendations with a simple payback of 18 months or less. In CY2023, this component consisted of two tracks: Monitoring-Based Commissioning (MBCx), and RetroCommissioning Flex (RCx).

- **MBCx** projects are supported by a multiyear agreement between the building owner and the EESP. This approach identifies, analyses, implements, and verifies multiple bundles of measures on a rolling basis with the EESP monitoring building automation system (BAS) data periodically using integrated, program-installed software to document ongoing savings. Measure savings are counted toward program goals in the calendar year they are submitted based on EESP monitoring since the prior submitted savings.
- **RCx** projects generally last 6-15 months and include a fully funded RCx Flex study covering the costs of engineering services and additional performance-based incentives. To receive the study, participants must agree to implement mutually agreed upon energy conservation measures (ECMs) with a simple payback of 1.5 years or less.

The program had 15 participants in 2023 and completed 16 projects[1] as Table 2-1 shows.

Table 2-1. 2023 Volumetric Findings Detail

Participation	Total
Participants*	15
Installed Projects †	16

* Participants are defined as unique Business Name
† Installed Projects are defined as unique Vendor Project ID

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

3. Program Savings Detail

Table 3-1 summarizes the energy savings the RetroCommissioning program achieved in 2023. Guidehouse implemented the addition to the Illinois Energy Efficiency Policy Manual related to the Net-to-Gross (NTG) ratio to be used for "economically disadvantaged areas" (hereafter "DAC") for eligible business customers.

Table 3-1. 2023 Annual Energy Savings Summary

Program Path	Ex Ante Gross Savings (therms)	Verified Gross RR*	Verified Gross Savings (therms)	NTG†	Verified Net Savings (therms)
All Tracks	168,480	89%	149,187	0.98	146,204
All Tracks – DAC	41,014	103%	42,278	1.00	42,278
Total or Weighted Average	**209,494**	**91%**	**191,465**		**188,482**

* Realization Rate (RR) is the ratio of verified gross savings to ex ante gross savings, based on evaluation research findings.
† Net-to-Gross (NTG): A deemed value. Available on the Stakeholders Advisory Group (SAG) website: **https://www.ilsag.info/evaluator-ntg-recommendations-for-2023/.** The NTG ratio for eligible business customers in disadvantaged neighborhoods is set to 1.00 as per the "NTG Ratio for Disadvantaged Areas" policy.[2]

Source: Guidehouse evaluation team analysis.

4. Program Savings by Measure

The RetroCommissioning program does not claim savings by measure, so this report does not present measure-level savings. Evaluation-verified savings for the program are based on a random sample of projects and reported at the project level. 5.1Appendix A provides more information about sampled project-level (bundle-level for MBCx) savings.

[1] Program participants can submit multiple bundles at different times during the year. Each project bundle submitted in CY2022 is counted as one project for impact evaluation sampling purposes.
[2] Illinois Energy Efficiency Policy Manual Version 3.0, Section 7.4, available at **https://www.ilsag.info/policy/**

5. Impact Analysis Findings and Recommendations

5.1 Findings and Recommendations

Finding 1. The evaluation team noted that input parameters in some ex ante custom calculators (e.g., 19-0151, 20-0036) were based on setpoint values even when those parameters were monitored and trended and actual values were available. The team also identified one project (22-0027) where hard-coded input parameters in the calculators did not match the trend data and investigation phase data was not updated with additional pre- and post-implementation data collected during the verification phase.

> **Recommendation 1**. Emphasize the priority of measured data for measure verification when available. Hard-coded values, if used, should indicate the source and include the corresponding source document as part of the project files. If additional/more recent trend data is collected, it should be used to update the estimated savings.

Finding 2. The evaluation team noticed multiple input errors in the project calculators (e.g., 20-0061, 21-0054, 22-0010, 20-0037, 20-0049, 19-0151, 22-0045). Some examples of the errors include incorrect motor horsepower, incorrect air handler schedule, incorrect fan power calculations, and incorrect/inconsistent boiler efficiency.

> **Recommendation 2**. Enhance quality control procedures to reduce these errors.

Finding 3. For project 20-0036, the implemented mixed air temperature (MAT) setpoint and discharge air temperature (DAT) setpoint sequencing measures save cooling energy but also result in increased natural gas usage for certain air handling units. Through this project, the optimization sequence was implemented as a permanent change rather than a reset measure. As a result, although the implemented change reduced cooling load in the summer, it also resulted in increased heating loads in the winter as the change was not reset back to winter setpoints.

> **Recommendation 3.** Provide training to highlight the difference between a reset and a change to ensure the appropriate optimization sequence is applied through the program.

Finding 4. For multiple projects (e.g., 19-0151, 22-0006, 22-0010), the evaluation team through verification activities found that the equipment that was modified for program measures is no longer in service. Program requirements under the RetroCommissioning program offerings stipulate that equipment must be installed and operational. The evaluation team did not verify any savings associated with the equipment that is no longer in service.

> **Recommendation 4.** If the program is aware than equipment within the scope of the project is scheduled for near-term replacement, any savings resulting from operational modifications on that equipment should not be claimed as they will not persist following replacement. No-cost changes/measures are still encouraged because they provide immediate benefit to the participant, even though they may not qualify as eligible savings through the program.

Finding 5. For project ID 21-0054, the calculator did not use the most appropriate weather station based on proximity. The evaluation team updated the reference weather station selected in the calculator.

> **Recommendation 5.** Increase training on the availability of weather stations in the standard calculator template and ensure uniform use of proximal datasets. In CY2024, additional weather stations will be included in the calculator, which will increase the alternatives available as "best reference" and the possibility of erroneous selections, making the increased training more valuable.

Finding 6. Through onsite inspections and phone interviews with building operators, the evaluation team noticed that some retrocommissioning measures (e.g., 20-0037, 20-0036) were deemed too aggressive by the operating engineers and undone to meet occupant comfort or other system setpoints. Examples of these measures include rooftop unit scheduling, and MAT and DAT setpoint resets and optimization.

> **Recommendation 6.** Time should be allowed post implementation for facility operators to adjust to the measures for continued feasibility before the program finalizes the estimated project savings. If the recommended changes are identified to be too aggressive and compromise system operation or occupant comfort, the EESPs should readjust the measures before finalizing project savings. The additional time post implementation will allow the EESPs to find compromised solutions for implemented measures rather than the facility operators undoing the measure entirely.

Appendix A. Impact Analysis Methodology

A.1 Ex Ante Estimates

EESPs estimated ex ante energy savings with custom algorithms, frequently using hourly weather data and time-series trend data applied in engineering relationships of energy, temperature, and mass transfer. Alternatively, when data supported the method, EESPs determined savings by regressions of utility-metered energy use versus outdoor temperature and other independent variables. When energy efficiency measures had a climate-related component, service providers used standard weather datasets (typical meteorological year 3, or TMY3)[3] for proximal locations to estimate weather-normalized savings.

A.2 Evaluation Methods

The evaluation team used a stratified random sampling approach to select the gross impact sample. In 2023, the evaluation team reviewed 28 projects[4] (38% of the total) and 499,866 therms (77% of the total claimed). The team sorted projects based on the level of ex ante kWh electricity savings and presence or absence of therms gas savings, and then placed the projects into six strata. Within each stratum, the team selected a random sample of projects for analysis.

The evaluation team reviewed each sampled project and its measures individually to validate the savings, usually using the same methods as the ex ante estimate. Savings calculation reviews ensured the savings estimates were accurately modelled, used consistent inputs, and included reasonable assumptions, as required. In some cases, the team acquired additional trend data or interval meter data to verify savings with more data and data concurrent with expected savings (e.g., winter data for winter measures). In most cases, the impact evaluation involved analysis of time-series trend and measured data both pre- and post-implementation. In all cases, the evaluation team normalized savings estimates to TMY weather data to minimize the effects of atypical weather variation.

For a nested sample of projects (selected from projects sampled for engineering review), Guidehouse performed onsite inspections to determine whether implemented measures were still operating as described in project documentation (set points, affected equipment, hours of operation, etc.). For projects not selected for an onsite inspection, evaluators supplemented desk reviews with phone interviews with building operators and reviewed some BAS via remote connection or teleconferencing.

In cases where the evaluation team's verified inputs were inconsistent with EESP reported data, such as setpoints or operational hours, the team re-estimated savings with available data, additional data requested from the participant or EESP, or program guideline inputs.

[3] TMY3 were produced by the National Renewable Energy Laboratory's Electric and Systems Center under the Solar Resource Characterization Project, which is funded and monitored by the US Department of Energy's Energy Efficiency and Renewable Energy Office. Source data for all 239 TMY3 locations draw on data from 1991 through 2005.

[4] The evaluation team reviewed 34 individual sample points because the team randomly selected multiple bundles for four projects in CY2023.

Table A-1. 2023 Profile of Gross Impact Sample (All Projects)

Population Summary				Sample Summary		
Program	Sampling Strata	Number of Projects (N)	Ex Ante Gross Savings (therms)	n	Ex Ante Gross Savings (therms)	Sampled % of Population (% therms)
RetroCommissioning	Large	7	0	6	0	N/A
	Large – Gas	2	228,167	2	228,167	100%
	Medium	14	0	6	0	N/A
	Medium – Gas	8	146,814	6	130,911	89%
	Small	38	0	6	0	N/A
	Small – Gas	30	277,280	8	140,788	51%
Total or Weighted Average		**99**	**652,261**	**34**	**499,866**	**77%**

Note: The population and the sample summary represent all projects completed in CY2023 as per the ComEd tracking data, collaborated with the Nicor Gas data. Here we shown the gas sample disposition.

Source: Guidehouse evaluation team analysis.

A.2.1 Savings Rollup

There are two basic statistical methods for combining individual gross RRs from the sample projects into an estimate of verified gross therms savings for the population when using stratified random sampling: separate and combined ratio estimation.[5] In the case of a separate ratio estimator, a separate gross therms savings RR is calculated for each stratum and then combined. In the case of a combined ratio estimator, the evaluation completes a single gross therms savings RR calculation without first calculating separate gross RRs by stratum.

The evaluation team used the separate ratio estimation technique to estimate verified gross impacts for the program. The separate ratio estimation technique follows the steps outlined in the California Evaluation Framework,[6] which identifies best practices in program evaluation. The team matched these steps to the stratified random sampling method it used to create the sample for the component.

[5] A full discussion and comparison of separate vs. combined ratio estimation can be found in *Sampling Techniques* (Cochran, 1977), pp. 164-169.

[6] Tec Market Works, *The California Evaluation Framework*, prepared for the California Energy Commission, June 2004, available at **http://www.calmac.org**.

Appendix B. Impact Analysis Detailed Results

Table B-1 provides the ex ante and verified gas savings for each stratum.

Table B-1. 2023 Gas Savings by Strata (All Projects)

Strata	Sample Size	Ex Ante Gross Savings (therms)	Verified Gross RR*	Verified Gross Savings (therms)	NTG†	Verified Net Savings (therms)
Large	6	0	N/A	0	0.98	0
Large – Gas	2	228,167	107%	243,015	0.98	238,154
Medium	6	0	N/A	0	0.98	0
Medium – Gas	6	130,911	111%	145,784	0.99	143,601
Small	6	0	N/A	1,156	0.98	1,133
Small – Gas	8	140,788	84%	118,030	0.98	115,669
Total or Weighted Average	**34**	**499,866**	**102%**	**507,984**	**0.98**	**498,557**

* RR is the ratio of verified gross savings to ex ante gross savings, based on evaluation research findings.
† NTG: A deemed value. Available on the SAG web site: **https://www.ilsag.info/evaluator-ntg-recommendations-for-2023/.** The NTG ratio for eligible business customers in disadvantaged neighborhoods is set to 1.00 as per the "NTG Ratio for Disadvantaged Areas" policy.

Source: Guidehouse evaluation team analysis.

Table B-2 shows the strata classification and ex ante and verified gas savings for all projects claimed by Nicor Gas in 2023.

Table B-2. 2023 Gas Savings by Project (Nicor Gas Projects Only)

Project ID	Bundle #	Strata	Ex Ante Gross Savings (therms)	Verified Gross RR*	Verified Gross Savings (therms)	NTG†	Verified Net Savings (therms)
19-0151	Bundle #1	Small - Gas	54,283	84%	45,508	0.98	44,598
20-0065	Bundle #4	Small - Gas	49,670	84%	41,641	0.98	40,808
22-0025	Bundle #1	Medium - Ga	22,425	111%	24,973	0.98	24,473
21-0052	Bundle #1	Medium - Ga	20,339	111%	22,650	1.00	22,650
20-0036	Bundle #8	Small - Gas	18,831	84%	15,787	0.98	15,471
21-0036	Bundle #2	Small - Gas	11,983	84%	10,046	1.00	10,046
22-0045	Bundle #1	Medium - Ga	8,338	111%	9,285	1.00	9,285
23-0011	Bundle #1	Small - Gas	6,566	84%	5,505	0.98	5,395
20-0061	Bundle #2	Large - Gas	5,981	107%	6,370	0.98	6,243
20-0036	Bundle #9	Small - Gas	3,800	84%	3,186	0.98	3,122
22-0067	Bundle #1	Small - Gas	2,018	84%	1,692	0.98	1,658
22-0044	Bundle #1	Small - Gas	1,757	84%	1,473	0.98	1,444
22-0040	Bundle #1	Small - Gas	1,290	84%	1,081	0.98	1,060
22-0013	Bundle #1	Small - Gas	823	84%	690	0.98	676
22-0013	Bundle #2	Small - Gas	728	84%	610	0.98	598
22-0025	Bundle #2	Small - Gas	0	84%	413	0.98	405
22-0062	Bundle #1	Small - Gas	354	84%	297	1.00	297
23-0022	Bundle #1	Small - Gas	308	84%	258	0.98	253
Total or Weighted Average			**209,494**	**91%**	**191,465**		**188,482**

* RR is the ratio of verified gross savings to ex ante gross savings, based on evaluation research findings.
† NTG: A deemed value. Available on the SAG website: **https://www.ilsag.info/evaluator-ntg-recommendations-for-2023/.** The NTG ratio for eligible business customers in disadvantaged neighborhoods is set to 1.00 as per the "NTG Ratio for Disadvantaged Areas" policy.

Source: Guidehouse evaluation team analysis.

Table B-3 details the verified gas savings and RRs of all sampled gas projects.

Table B-3. 2023 Gas Savings by Project (All Sampled Projects)

Project ID	Bundle #	Strata	Ex Ante Gross Savings (therms)	Verified Gross RR*	Verified Gross Savings (therms)	NTG†	Verified Net Savings (therms)
22-0010	Bundle #12	Large - Gas	169,694	111%	188,549	0.98	184,778
20-0061	Bundle #2	Large - Gas	58,473	93%	54,466	0.98	53,377
19-0151	Bundle #1	Small - Gas	54,283	86%	46,414	0.98	45,486
22-0010	Bundle #10	Medium - Gas	34,422	111%	38,247	0.98	37,482
22-0010	Bundle #11	Medium - Gas	27,641	111%	30,757	0.98	30,142
22-0010	Bundle #8	Small - Gas	25,124	89%	22,332	0.98	21,886
22-0025	Bundle #1	Medium - Gas	22,425	100%	22,425	0.98	21,977
21-0052	Bundle #1	Medium - Gas	20,339	100%	20,339	1.00	20,339
21-0047	Bundle #1	Small - Gas	20,124	100%	20,124	0.98	19,722
20-0036	Bundle #8	Small - Gas	18,831	42%	7,963	0.98	7,804
22-0014	Bundle #1	Medium - Gas	17,746	100%	17,746	0.98	17,391
22-0027	Bundle #1	Small - Gas	14,730	88%	12,902	0.98	12,644
22-0045	Bundle #1	Medium - Gas	8,338	195%	16,270	1.00	16,270
21-0054	Bundle #1	Small - Gas	4,558	113%	5,156	0.98	5,053
17-119	Bundle #5	Small - Gas	2,410	100%	2,410	0.98	2,362
22-0013	Bundle #2	Small - Gas	728	100%	728	0.98	713
22-0001	Bundle #2	Small	0	N/A	1,156		1,133

Note: Participants can submit multiple bundles at different times during the year. Each project bundle submitted in CY2023 was counted as one project for impact evaluation sampling purposes.

* RR is the ratio of verified gross savings to ex ante gross savings, based on evaluation research findings.

† NTG: A deemed value. Available on the SAG website: **https://www.ilsag.info/evaluator-ntg-recommendations-for-2023/.** The NTG ratio for eligible business customers in disadvantaged neighborhoods is set to 1.00 as per the "NTG Ratio for Disadvantaged Areas" policy.

Source: Guidehouse evaluation team analysis.

Appendix C. Program-Specific Inputs for the Illinois TRC

Table C-1 shows the TRC cost-effectiveness analysis inputs available at the time of producing this impact evaluation report. Currently, additional required cost data (e.g., measure costs, program-level incentive and non-incentive costs) are not included in Table C-1 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 C-1. 2023 Verified Cost-Effectiveness Inputs

Program Path	Savings Category	Units	Quantity	Effective Useful Life	Ex Ante Gross Savings (therms)	Verified Gross Savings (therms)	Verified Net Savings (therms)
All Other Tracks	All Tracks	Projects	14	8.6	168,480	149,187	146,204
All Other Tracks	All Tracks – DAC	Projects	4	8.6	41,014	42,278	42,278
Total or Weighted Average			**17**	**8.6**	**209,494**	**191,465**	**188,482**

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