Business Custom Incentive Program Impact Evaluation Report

Energy Efficiency Plan: Plan Year 2019 (1/1/2019-12/31/2019)

Presented to
Nicor Gas Company

Final

August 27, 2020

Prepared by:

Rick Berry
Guidehouse

Charles Ampong
Guidehouse

Tatjana Gasic
Guidehouse

Roger Hill
InCA Energy

www.guidehouse.com

Business Custom Incentive Program Impact Evaluation Report

Submitted to:

Nicor Gas Company
1844 Ferry Road
Naperville, IL 60563

Submitted by:

Guidehouse (which acquired Navigant in 2019)
150 N. Riverside Plaza, Suite 2100
Chicago, IL 60606

Contact:

Randy Gunn
Partner
312.583.5714
randy.gunn@guidehouse.com

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

Laura Agapay-Read
Managing Consultant
312.583.4178
laura.agapay.read@guidehouse.com

TABLE OF CONTENTS

1. Introduction 1
2. Program Description 1
3. Savings Summary 2
4. Program Savings by Measure 2
5. Impact Analysis Findings and Recommendations 3

5.1 Impact Parameter Estimates 3
5.2 Findings and Recommendations 4
5.2.1 Custom Program 4
5.2.2 Nicor Gas Retro-Commissioning Program 7

6. Appendix 1. Impact Analysis Methodology 8

6.1 Verified Gross Program Savings Analysis Approach 8
6.2 Verified Net Program Savings Analysis Approach 9

7. Appendix 2. Impact Analysis Supplemental Information 10
8. Appendix 3. Program-Specific Inputs for the Illinois TRC 13

LIST OF TABLES AND FIGURES

Table 2-1. 2019 Volumetric Summary 1
Table 3-1. 2019 Annual Energy Savings Summary – Custom 2
Table 3-2. 2019 Annual Energy Savings Summary – NG RCx 2
Table 4-1. 2019 Annual Energy Savings by Measure – Custom Program Total 2
Table 4-2. 2019 Annual Energy Savings by Measure – NG RCx Program Total 3
Table 5-1. Verified Gross Savings Parameters 4
Table 6-1. Profile of Gross Impact Sample for Custom Projects 8
Table 6-2. Gross Therm Realization Rates and Relative Precision at 90% Confidence Level 9
Table 7-1. Profile of 2019 Custom Program Gross Impact Sample 10
Table 7-2. 2019 Summary of Custom Program Sample M&V Results 11
Table 7-3. 2019 Summary of Custom Program Sample M&V Results by Sector 12
Table 7-4. 2019 Summary of NG RCx M&V Results 12
Table 8-1. TRC Inputs for Nicor Gas 13

1. Introduction

This report presents the results of the impact evaluation of the Nicor Gas 2019 Business Custom Incentive (Custom) Program, and includes two Retro-Commissioning projects that Nicor Gas completed as non-joint (stand-alone) projects in 2019. 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 2019 covers January 1, 2019 through December 31, 2019.

2. Program Description

The Custom Program is targeted to the public sector and private sector commercial and industrial (C&I) customers of Nicor Gas. It provides customers with rebate incentives for the installation of cost-effective natural gas-related energy efficiency improvements that are not eligible for a prescriptive rebate under the Nicor Gas Business Energy Efficiency Rebate Program. The Custom Program provides audits and engineering studies to assist customers in understanding their efficiency opportunities by quantifying the estimated project costs, energy savings, and forecasted incentives. The program targets large public sector and C&I customers with more complex facilities that will benefit most from a custom offering during new equipment purchases, facility modernization and industrial process improvements. The Custom Program was implemented in 2019 by CLEAResult.

The program staff work with both trade allies and decision-makers at facilities with natural gas use over 60,000 therms to identify and quantify efficiency opportunities at their facilities. Interested customers must first submit a letter of interest and a pre-approval application to the program. The initial application includes usage history and detailed calculations and specifications for the project. Program staff review the customer's initial reported savings and screen projects using an internal cost-benefit test. The Custom Program requires that a project's initial application be pre-approved prior to the start of the project. Prior to issuing an approval notice, pre-installation inspections are performed on almost all projects, especially for complex and high impact measures.

Additionally, Nicor Gas launched a Nicor Gas only Retro-Commissioning (NG-RCx) offering in 2019, assisting participants with low-cost and no cost tune-ups and adjustments to the operating systems, building controls, energy management systems and HVAC systems of existing buildings. In 2019, the Nicor Gas Retro-Commissioning projects were implemented by CLEAResult, and included with Custom tracking data.

The Custom program had 32 participants in 2019 and completed 36 projects as shown in the following table. The NG-RCx Program completed projects with two customers.

Table 2-1. 2019 Volumetric Summary

Participation	Private	Public	Total
Custom – Participants	24	8	32
Custom – Completed Projects	28	8	36
Projects, 2,500 - 7,500 therms	20	7	27
Projects, > 7,500 therms	8	1	9
Nicor Gas Retro-Commissioning	2	0	2

Source: Nicor Gas tracking data and Guidehouse team analysis.

3. Savings Summary

Table 3-1 summarizes the energy savings the Custom Program achieved by path in 2019.

Table 3-1. 2019 Annual Energy Savings Summary – Custom

Program Path	Ex Ante Gross Savings (Therms)	Verified Gross RR*	Verified Gross Savings (Therms)	NTG†	Verified Net Savings (Therms)
Private	15,157,154	100%	15,224,579	0.79	12,027,418
Public	428,789	100%	430,697	0.79	340,250
Total	**15,585,943**	**100%**	**15,655,276**	**0.79**	**12,367,668**

* Realization Rate (RR) is the ratio of verified gross savings to ex ante gross savings, based on evaluation research findings. The RR values in this table reflect the weighted program-level RR. For sector-level information, see Table 7-3.
† Net-to-Gross (NTG) is the ratio of verified net savings to verified gross savings. The NTG is a deemed value. Source: Nicor_Gas_NTG_History_and_2019_Recommendations_2018-10-01_Final Aerator Showerhead Correction 2019-04-12.xlsx, which is to be found on the Illinois SAG web site: http://ilsag.info/net-to-gross-framework.html.
Source: Nicor Gas tracking data and Guidehouse team analysis

Table 3-2 summarizes the energy savings the NG-RCx Program achieved in 2019.

Table 3-2. 2019 Annual Energy Savings Summary – NG RCx

Program Path	Ex Ante Gross Savings (Therms)	Verified Gross RR	Verified Gross Savings (Therms)	NTG*	Verified Net Savings (Therms)
Nicor Gas RCx	291,639	90%	263,085	0.94	247,300
Total	**291,639**	**90%**	**263,085**	**0.94**	**247,300**

* The NTG is a deemed value. Source: Nicor_Gas_NTG_History_and_2019_Recommendations_2018-10-01_Final Aerator Showerhead Correction 2019-04-12.xlsx, which is to be found on the Illinois SAG web site: http://ilsag.info/net-to-gross-framework.html.
Source: Nicor Gas tracking data and Guidehouse team analysis

4. Program Savings by Measure

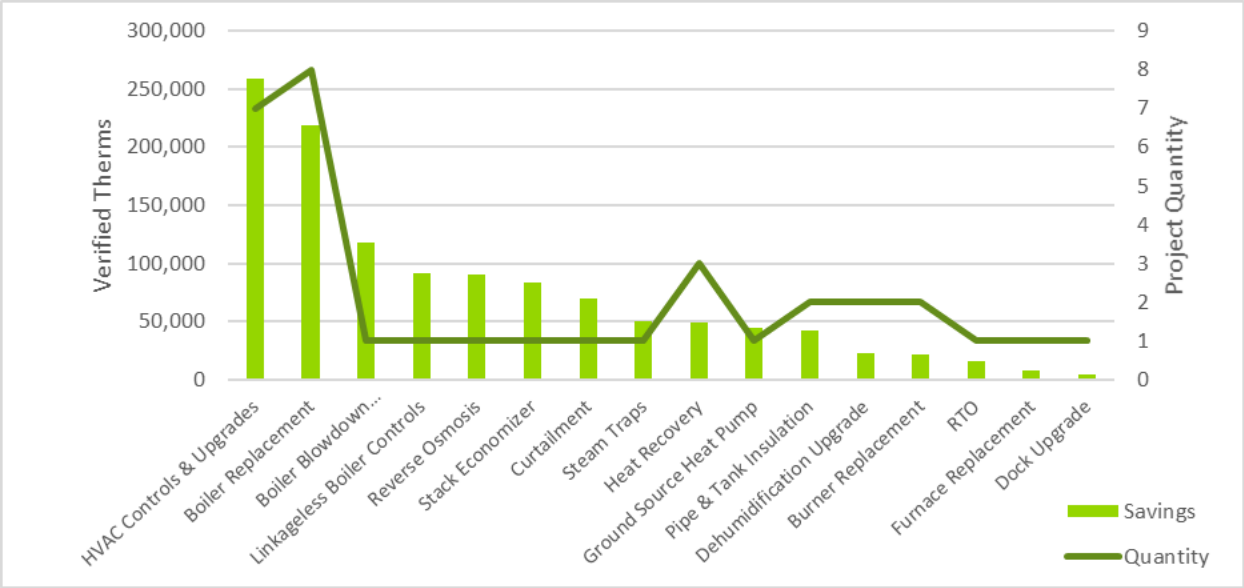
The Custom Program identifies measures as less than or equal to or greater than 7,500 therms, as shown in Table 4-1. These projects (minus the two Certainty strata projects, to show detail) are further broken down by project type (i.e., technology) in Figure 4-1.

Table 4-1. 2019 Annual Energy Savings by Measure – Custom Program Total

Program Path	Ex Ante Gross Savings (Therms)	Verified Gross RR	Verified Gross Savings (Therms)	NTG†	Verified Net Savings (Therms)
Custom 2,500-7,500 therms	52,215	100%	52,447	0.79	41,433
Custom > 7,500 therms	15,533,728	100%	15,602,829	0.79	12,326,235
Total	**15,585,943**	**100%**	**15,655,276**	**0.79**	**12,367,668**

† Net-to-Gross (NTG) is the ratio of verified net savings to verified gross savings. The NTG is a deemed value. Source: Nicor_Gas_NTG_History_and_2019_Recommendations_2018-10-01_Final Aerator Showerhead Correction 2019-04-12.xlsx, which is to be found on the Illinois SAG web site: http://ilsag.info/net-to-gross-framework.html.
Source: Nicor Gas tracking data and Guidehouse team analysis.

Figure 4-1. Verified Savings by Custom Project Type



Note: Totals may not sum exactly due to rounding. Does not include two process improvement projects accounting for 14,151,553therms.
Source: Nicor Gas tracking data and Navigant team analysis.

The NG RCx Program identifies low-cost and no cost tune-ups and adjustments to the operating systems, building controls, energy management systems and HVAC systems of existing buildings. Two projects were completed in 2019, as shown in Table 4-2.

Table 4-2. 2019 Annual Energy Savings by Measure – NG RCx Program Total

Project – Measures	Ex Ante Gross Savings (Therms)	Verified Gross RR	Verified Gross Savings (Therms)	NTG†	Verified Net Savings (Therms)
NG RCx 19-01 – Reduced Humidification and Optimize Snow Melt	88,697	86%	76,098	0.94	71,532
NG RCx 19-03 – Fan Scheduling and Temperature Setback	202,942	92%	186,987	0.94	175,768
Total	**291,639**	**90%**	**263,085**	**0.94**	**247,300**

† Net-to-Gross (NTG) is the ratio of verified net savings to verified gross savings. The NTG is a deemed value. Source: Nicor_Gas_NTG_History_and_2019_Recommendations_2018-10-01_Final Aerator Showerhead Correction 2019-04-12.xlsx, which is to be found on the Illinois SAG web site: http://ilsag.info/net-to-gross-framework.html.
Source: Nicor Gas tracking data and Guidehouse team analysis.

5. Impact Analysis Findings and Recommendations

5.1 Impact Parameter Estimates

Table 5-1 shows that the unit therm savings for custom measures vary, and the overall realization rate for custom measures was 100%, and 90% for NG RCx measures. The realization rate (RR) is the ratio of verified savings to ex ante savings. Following the table, we provide findings and recommendations, including a discussion of sampled projects with realization rates above or below 100%. Appendix 1

provides a description of the impact analysis methodology. Appendix 2 provides project-level realization rates and a summary of adjustments to the verified savings.

Table 5-1. Verified Gross Savings Parameters

Measure	Unit Basis	Ex Ante Gross (therms/unit)	Verified Gross (therms/unit)	Realization Rate	Data Source(s)
Custom Measures	Vary	Vary	Vary	100%	Project File Review, Monthly Billing Data, Measurement and Verification*
NG RCx Measures	Vary	Vary	Vary	90%	Project File Review, Monthly Billing Data, Measurement and Verification*

* Project files and monthly billing data provided by Nicor Gas.
Source: Nicor Gas tracking data and Navigant team analysis.

5.2 Findings and Recommendations

5.2.1 Custom Program

The following section provides insight into key program findings and recommendations.

Project NG-18-035 involved installing boiler controls and the calculation used the specific heat capacity (Btu/lb-°F) of boiler exhaust gases. The ex ante calculation assumed a value 0.30 Btu/lb-°F but provided no supporting reference for the value. The verified savings are based on a stoichiometric calculation of the specific heat capacity (0.27 Btu/lb-°F) using the Shomate Equation.[1] Relatively small adjustments to the specific heat capacity resulted in large changes to the realization rate (i.e., a 20% reduction in specific heat reduced the realization rate to 40%). The adjustment in this project reduced the realization rate to 70%.

Recommendation 1. If a hard-coded value is found in a calculation, Guidehouse recommends providing the supporting reference for that value. This aids in the evaluation of the projects as well as internal quality control processes.

Recommendation 2. If the Shomate Equation is used to calculate the specific heat capacity of exhaust gases, Guidehouse recommends confirming that the coefficients reflect the appropriate temperature ranges. The National Institute of Standards and Technology (NIST)[2] provides coefficient values for various temperature ranges. The coefficient values used in the calculation should reflect the temperatures involved in the project. This is a common source of error based on evaluation experience.

Recommendation 3. Guidehouse recommends that the implementer review the sensitivity of calculation inputs and confirm that the strength of the supporting references reflect the effect that it has on the calculation. For example, if an assumption such as heat capacity in Project NG-18-035, has a significant impact on the savings of the project, the supporting reference for that assumption should be strong.

[1] The Shomate Equation is a polynomial equation ($C_p° = A + B*t + C*t^2 + D*t^3 + E/t^2$) that allows for the calculation of specific heat capacity values. The coefficient values can be found on the NIST Chemistry WebBook, SRD 69. https://webbook.nist.gov/chemistry/

[2] For example NIST provides coefficients for Nitrogen in three temperature ranges: 100 – 500 K, 500 – 2,000 K, and 2,000 – 6,000 K. The temperature ranges differ for individual substances. https://webbook.nist.gov/cgi/cbook.cgi?ID=C7727379&Mask=1

Project NG-18-034 involved the installation of boiler replacement and tank insulation. The convective and radiation losses of the existing boilers were calculated by treating all the boilers as one larger boiler, despite the losses being a function of boiler size (capacity). The verified savings calculation treats the boilers as separate units and significantly reduces the losses. This adjustment reduced the realization rate to 78%. The ex ante calculation assumed that the individual boiler capacities could be combined with negligible impact. However, the heat losses of those individual boilers calculated to a significantly different value than if they were treated as one combined boiler capacity.

Recommendation 4. Guidehouse recommends that the implementer not treat multiple heating units (i.e., boilers or furnaces) as one unit. There are a number of properties that can vary based on unit capacity: efficiency, losses, load, and modulation capability, among others.

Project NG-19-36 involved a series of infrastructure improvements that reduced the load on an auxiliary boiler in cold weather conditions and allowed the boiler to be shut down in warm weather conditions. The evaluation team required additional post-installation usage data to confirm that the boiler could be shut down in warm weather conditions. The additional post-installation usage data and communication with the customer allowed the data to be analyzed in context. The adjustments based on the additional information increased the realization rate to 106%. There are no recommendations related to this project since the details of the post-installation usage were unpredictable to the customer and implementation contractor.

Project NG-19-19 involved adding a mechanism for direct heat exchange on an industrial process. This would allow the customer to recover and reuse heated material to increase process efficiency. The one month of post-installation data used in the ex ante calculation showed an increase in material flow rate above typical values. This was determined to be due a pumping improvement, however, the evaluation team requested additional post-installation data to confirm the sustainability of the increased flow rate. The verified savings calculation incorporates an additional three and a half months of data,[3] which showed several periods of low production in an otherwise consistent production level. The project realization rate was 94%.

Recommendation 5. Guidehouse recommends that the implementer provide explanations for anomalous or outlier values found in pre- or post-installation usage data.

Project NG06-PS-001 involved a comprehensive upgrade of HVAC systems and controls. Due to the interaction of the individual measures, a regression analysis was used to calculate savings. The ex ante savings calculation used 150 days of post-installation data. The verified savings calculation incorporated additional usage data, totaling 304 days, which greater energy usage than the ex ante calculation anticipated. This adjustment reduced the realization rate to 90%.

Project NG-19-13 involved reverse osmosis boiler feedwater treatment and tank insulation. The verified savings calculation corrected the thermal conductivity of water from 2 Btu/h-ft-°F to 0.3408 Btu/h-ft-°F in the tank insulation calculation. This adjustment reduced the realization rate to 99%.

Recommendation 6. Guidehouse recommends that the implementer provide supporting references for thermodynamic and physical properties of materials. Effective references for physical properties include, but are not limited to thermodynamic textbooks, online engineering tables, or ASHRAE handbooks.

[3] The data used in the calculation had to be limited to March 15th, 2020 to remove the effects of the COVID-19 virus on production.

Project PRJ-1786626 involved a boiler replacement. The ex ante calculation assumes a heating balance point temperature (HBPT) of 69°F, but provides no supporting reference for the value. If this was a calculated value, no supporting calculation was provided. The verified savings is based on a calculated HBPT value of 62°F. This adjustment increased the realization rate to 101%.

Recommendation 7. Guidehouse recommends that the implementer calculate and provide the supporting calculations for heating balance point temperatures used in the savings calculations.

Project NG06-PS-004 involved the installation of HVAC upgrades and controls. Due to the interaction of the individual measures, a regression analysis was used to calculate savings. The ex ante savings calculation used 182 days of post-installation data. The verified savings calculation incorporated additional usage data, totaling 365 days, that showed less than expected savings during non-heating season conditions. This adjustment reduced the realization rate to 97%.

Project NG-19-02 involved a boiler replacement. The verified savings updated the installed boiler efficiency from 83.7% to 83.65% based on an average of the two screen shots provided in the project file. Another update was to base the average material volume received and processed on all of the historic gas data provided, not just a portion of the historic gas data. This adjustment reduced the realization rate to 92%.

Recommendation 8. Guidehouse recommends that the implementer provide supporting references that provide context regarding the omission of any usage or process data points from the calculation.

Project PRJ-1584026 involved the installation of HVAC upgrades and controls. Due to the interaction of the individual measures, a regression analysis was used to calculate savings. The ex ante calculation utilized a polynomial trendline with several data points removed from the analysis. The verified savings calculation used a linear trendline, consistent with past analyses of building automation systems. While linear, multilinear, and advanced (i.e., polynomial) regressions are specified in the Department of Energy's Uniform Methods Protocols[4], recommends linear regressions when there is one routinely varying significant parameter. In this project, that parameter was outside air temperature This update reduced the realization rate to 99%.

Recommendation 9. Guidehouse recommends that if a calculation method deviates from standard practice, such as using a polynomial regression in a building automation system project, that the implementer provide an explanation for that decision (e.g., cell comment or text box is sufficient).

Project NGPS-18-003 involved a boiler replacement. The verified savings calculation corrects a pivot table aggregation of TMY3 temperature data which was off by one row. This adjustment reduced the realization rate to 98%.

Project PRJ-2310136 involved a boiler burner replacement. The ex ante savings calculation used 354 days of post-installation data. The verified savings calculation incorporated additional usage data, totaling 365 days. This adjustment increased the realization rate to 101%.

[4] Romberger, Jeff. "HVAC Controls (DDC/EMS/BAS) Evalaution Protocol," SBW Consulting, Inc. https://www.nrel.gov/ump/assets/pdfs/2014-10-01_ump_hvac-controls.pdf

Recommendation 10. Guidehouse recommends that the implementer utilize post-installation data for a full year, if available.

Project NGPS-19-04 involved an upgrade to a dehumidification system. The verified savings calculation updated the square footage of the pool based on the pool dimensions provided in the project file. Additionally, the verified savings calculation updated the return air moist air density and mass flow rate fields using return air characteristics, not outside air characteristics. These adjustments reduced the realization rate to 99%.

Recommendation 11. Guidehouse recommends that the implementer provide supporting references for calculation inputs in the calculation file. This aids in the evaluation of the projects as well as internal quality control processes.

5.2.2 Nicor Gas Retro-Commissioning Program

In many cases, savings estimates are based on regressions between consumption and outdoor temperatures. Since heat transfer and thermal loads are proportional to temperature differences, linear regressions of empirical data are good practice. In several cases, though, the reported correlations were second or higher order polynomials. At the extremes or when there is a need to extrapolate beyond observed data, these high-order correlations diverge from reality and introduce large errors.
In other cases, linear correlations included data that were out of the operating range of the affected systems, thus distorting the correlations between temperature and consumption. For example, including points of (near) zero consumption over an extended temperature range will cause a poor correlation.

Recommendation 12. Use linear regressions to model linear systems. When equipment operates in different modes, use piece-wise linear regressions for each mode. For example, a building with gas heat, domestic hot water and absorption cooling will have a linear correlation for consumption with a negative slope at low temperatures, a linear correlation with a positive slope during the cooling season and a linear (horizontal) section for domestic hot water only when indoor comfort can be maintained with the ventilation system alone. Linear extrapolation beyond measured data is acceptable, if consistent with the expected operating mode.

In most estimates of savings, a number of assumptions are inevitable. Several similar estimates for the same building or similar system used different assumptions for the same parameter. While each independent assumption was reasonable, the applications of different values was not adequately explained. As this program evolves, different service providers will introduce their own assumptions

Recommendation 13. In the short-term ensure that the current service provider applies consistent assumptions for similar situations or explain differences. In the long-term, the program implementer should establish consistent assumptions for the program. For example, standardize assumed efficiency for different types of boilers, distribution losses (good, medium and poor), design over-sizing practices, factors for different pumped solutions and others. Parameter estimates and assumptions should follow a hierarchy: 1) measured values, 2) submittal values, 3) design values and 4) rules-of-thumb. These assumptions should be vetted by an independent authority (Illinois TRM, professional society references, Illinois evaluator).

6. Appendix 1. Impact Analysis Methodology

6.1 Verified Gross Program Savings Analysis Approach

The 2019 evaluation involved retrospective adjustments to ex ante gross savings on custom measure variables of all projects installed in 2019. CLEAResult provided documentation of project applications and savings. Guidehouse verified project eligibility and savings based on engineering review, billing data review, and on-site measurement and verification (M&V) of a sample of program measures. Guidehouse designed the sample sizes to provide a 90/10 confidence and relative precision level for program-level gross savings verification.

The evaluation team conducted site-specific research on a sample of projects to verify project savings. Two very large private sector projects which constituted 90% of the 2019 total savings were designated as a Certainty Stratum – projects whose size required that they be sampled. The remaining 17 sampled projects were randomly selected through a stratified sample design at the tracking record level using the population gross therm savings determined from program tracking data. A combined sample of private and public sector projects were drawn, which included 6 out of 8 public sector projects and 13 out of 28 private sector projects. Strata were defined by project size, and the details of strata boundaries are provided in Table 6-1. Two of the four 2019 "parallel path" projects that received early feedback from the evaluation team at the implementer's request were included in the sample of 19 projects selected.

Table 6-1. Profile of Gross Impact Sample for Custom 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)
C&I Custom	C	2	14,088,880	2	14,088,880	100%
	1	6	753,008	5	604,763	80%
	2	5	355,002	3	204,263	58%
	3	23	389,053	9	218,154	56%
TOTAL		**36**	**15,585,943**	**19**	**15,116,060**	**97%**

Source: Guidehouse analysis

Since there were only two NG RCx projects in 2019, we conducted M&V on both as a census verification.

Engineering Review of Project Files

For each selected 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 sampled 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 and post inspection reports and photos, and calculation spreadsheets.

Table 6-2 gives the strata-level verified gross realization rates and statistical precision values at 90% confidence for the Custom Program.

Table 6-2. Gross Therm Realization Rates and Relative Precision at 90% Confidence Level

Program	Strata	Relative Precision +or-%	Mean RR	Standard Error
C&I Custom	C	0.0%	101%	0.00
	1	4.6%	91%	0.02
	2	2.9%	97%	0.01
	3	3.2%	97%	0.02
Custom Total RR (90/10)		**0.2%**	**100%**	**0.00**

Source: Guidehouse analysis

6.2 Verified Net Program Savings Analysis Approach

Guidehouse calculated verified net energy savings by multiplying the verified gross savings estimates by a 0.79 net-to-gross (NTG) ratio for the Custom Program, and 0.94 for the NG RCx Program. In 2019, the NTG ratio estimate used to calculate the net verified savings were based on past evaluation research and defined by a consensus process through Illinois Stakeholder Advisory Group (SAG), as documented in a spreadsheet.[5]

[5] Net-to-Gross (NTG) is the ratio of verified net savings to verified gross savings. The NTG is a deemed value. Source: Nicor_Gas_NTG_History_and_2019_Recommendations_2018-10-01_Final Aerator Showerhead Correction 2019-04-12.xlsx, which is to be found on the Illinois SAG web site: http://ilsag.info/net-to-gross-framework.html.

7. Appendix 2. Impact Analysis Supplemental Information

Table 7-1 provides a summary of the Custom Program sample selection and M&V approach. Table 7-2 provides a summary of M&V results for the Custom Program sample.

Table 7-1. Profile of 2019 Custom Program Gross Impact Sample

Project ID	Program Path	Ex Ante Gross Savings (therms)	Strata	M&V Approach	Measure
NG-19-36	Private	8,079,076	C	File Review	Process Improvement
NG-19-19	Private	6,009,804	C	File Review	Process Improvement
NG06-PS-001	Public	170,526	1	File Review	HVAC Controls & Upgrades
NG-18-035	Private	114,703	1	File Review	Linkageless Boiler Controls
NG-19-13	Private	113,381	1	File Review	Reverse Osmosis
NG-19-01	Private	105,715	1	File Review	Stack Economizer
PRJ-1786626	Private	100,438	1	File Review	Boiler Replacement
NG06-PS-004	Public	91,415	2	File Review	HVAC Controls & Upgrades
NGPS-18-008	Public	56,787	2	File Review	Ground Source Heat Pump
NG-19-02	Private	56,061	2	File Review	Boiler Replacement
NG06-PS-012	Public	46,065	3	File Review	Pipe & Tank Insulation
PRJ-1619034	Private	31,382	3	File Review	Boiler Replacement
PRJ-1584026	Private	30,699	3	File Review	HVAC Controls & Upgrades
NGPS-18-003	Public	30,299	3	File Review	Boiler Replacement
NG-18-034	Private	21,953	3	File Review	Boiler Replacement
PRJ-2310136	Private	21,927	3	File Review	Burner Replacement
PRJ-985992	Private	17,340	3	File Review	Dehumidification Upgrade
NGPS-19-04	Public	11,302	3	File Review	Dehumidification Upgrade
PRJ-1869499	Private	7,187	3	File Review	HVAC Controls & Upgrades

Source: Nicor Gas tracking data and Guidehouse team analysis.

Table 7-2. 2019 Summary of Custom Program Sample M&V Results

Project ID	Program Path	Measure Description	Gross Realization Rate	Summary of Adjustment
NG-19-36	Private	Process Improvement	106%	Updated project with additional metered data
NG-19-19	Private	Process Improvement	94%	Updated project with additional metered data that confirmed the persistence of increased pumping capacity
NG06-PS-001	Public	HVAC Controls & Upgrades	90%	Updated project with additional metered data
NG-18-035	Private	Linkageless Boiler Controls	70%	Corrected heat capacity of exhaust gases
NG-19-13	Private	Reverse Osmosis	99%	Minor adjustments to insulation thickness values
NG-19-01	Private	Stack Economizer	100%	Ok
PRJ-1786626	Private	Boiler Replacement	101%	Calculated heating balance temperature and updated baseline efficiency value
NG06-PS-004	Public	HVAC Controls & Upgrades	97%	Updated project with additional metered data
NGPS-18-008	Public	Ground Source Heat Pump	100%	Ok
NG-19-02	Private	Boiler Replacement	92%	Updated project with additional metered data and minor adjustments to efficiency
NG06-PS-012	Public	Pipe & Tank Insulation	100%	Ok
PRJ-1619034	Private	Boiler Replacement	100%	Ok
PRJ-1584026	Private	HVAC Controls & Upgrades	99%	Update regression trendline fit from polynomial to linear
NGPS-18-003	Public	Boiler Replacement	98%	Corrected pivot table in calculation
NG-18-034	Private	Boiler Replacement	78%	Re-calculated radiation and convection efficiency by treating boilers and steam generators
PRJ-2310136	Private	Burner Replacement	101%	Updated project with additional metered data
PRJ-985992	Private	Dehumidification Upgrade	100%	Ok
NGPS-19-04	Public	Dehumidification Upgrade	99%	Updated square footage and return air properties
PRJ-1869499	Private	HVAC Controls & Upgrades	100%	Ok

Source: Nicor Gas tracking data and Guidehouse team analysis.

Table 7-3. 2019 Summary of Custom Program Sample M&V Results by Sector

Sector	Quantity of Projects Sampled	Ex Ante Gross Savings (Therms)	Verified Gross Realization Rate*	Verified Gross Savings (Therms)
Private	13	14,709,666	101%	14,822,572
Public	6	406,394	95%	385,257
Total	**19**	**15,116,060**	**101%**	**15,207,829**

* This realization rate is unweighted and represents only the sample.
Source: Nicor Gas tracking data and Guidehouse team analysis.

Table 7-4 provides a summary of M&V results for the NG RCx Program verification.

Table 7-4. 2019 Summary of NG RCx M&V Results

Project ID	Program Path	Measure Description	Gross Realization Rate	Summary of Adjustment
NGRCx-19-01	NG RCx	Reduce Humidification, Optimize Snow Melt System	86%	Post-implementation humidity relationships with outdoor air were revised based on trend data and operating modes. Evaluation used our own psychrometric calculators as these data were fixed and un-traceable in the submitted form. Zeroed savings from one air handler without post-installation verification. Recalculated system steam efficiency allowing that some distribution losses probably are useful in the winter when the measure is effective. Sequential efficiency calculation corrected.
NGRCx-19-03	NG RCx	Fan House Scheduling, Temperature Setbacks	92%	Multiple adjustments to regression models and inputs.

Source: Nicor Gas tracking data and Guidehouse team analysis.

8. Appendix 3. Program-Specific Inputs for the Illinois TRC

Table 8-1 shows the Total Resource Cost (TRC) cost-effectiveness analysis inputs available at the time of drafting 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.

Table 8-1. TRC Inputs for Nicor Gas

Research Category (e.g., Measure)	Units	Quantity	Effective Useful Life (years)	Ex Ante Gross Savings (Therms)	Verified Gross Savings (Therms)	Verified Net Savings (Therms)
Process Improvement*	Project	2	21.4*	14,088,880	14,151,553	11,179,727
HVAC Controls & Upgrades	Project	7	15	325,359	326,807	258,178
Boiler Replacement	Project	8	25	275,293	276,519	218,449
Boiler Blowdown Economizer	Project	1	15	148,245	148,904	117,635
Linkageless Boiler Controls	Project	1	16	114,703	115,213	91,018
Reverse Osmosis	Project	1	15	113,381	113,885	89,969
Stack Economizer	Project	1	15	105,715	106,185	83,886
Curtailment	Project	1	13	87,445	87,834	69,389
Steam Traps	Project	1	6	63,294	63,576	50,225
Heat Recovery	Project	3	19	61,881	62,156	49,103
Ground Source Heat Pump	Project	1	25	56,787	57,040	45,061
Pipe & Tank Insulation	Project	2	15	53,471	53,709	42,430
Dehumidification Upgrade	Project	2	13	28,642	28,769	22,728
Burner Replacement	Project	2	21	27,581	27,704	21,886
RTO	Project	1	20	19,399	19,485	15,393
Furnace Replacement	Project	1	25	10,194	10,239	8,089
Dock Upgrade	Project	1	7.5	5,673	5,698	4,502
Total – Custom Program	**Project**	**36**	**21.0**	**15,585,943**	**15,655,276**	**12,367,668**
NG RCx (traditional RCx)	Project	2	8.6	291,639	263,085	247,300
Total – NG RCx	**Project**	**2**	**8.6**	**291,639**	**263,085**	**247,300**

* This is a custom value that reflects a weighted average of 19 years for NG-19-36 and 25 years for NG-19-19.

Source: Nicor Gas tracking data and Guidehouse team analysis.