NAVIGANT

Business Custom Incentive Program Impact Evaluation Report

Energy Efficiency Plan: Plan Year 2018 (1/1/2018-12/31/2018)

Presented to
Nicor Gas Company

Final

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1. INTRODUCTION

This report presents the results of the impact evaluation of the Nicor Gas 2018 Business Custom Incentive Program.[1] It presents a summary of the energy impacts for the custom measures and broken out by relevant measure and program structure details. The appendix presents the impact analysis methodology. The 2018 program covers January 1, 2018 through December 31, 2018.

2. PROGRAM DESCRIPTION

The Business Custom Incentive 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 2018 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 submit a pre-approval application to the program. The initial application includes baseline equipment operation and history, estimated savings, and specifications for the project. Program staff review the customer's initial reported savings, performing independent metering and analysis as needed, 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.

The program had 37 participants in 2018 and completed 39 projects as shown in Table 2-1.

Table 2-1. 2018 Volumetric Summary

Participation	Private Sector	Public Sector	Total
Participants*	33	4	37
Installed Projects†	35	4	39

* Participants are defined as unique company name-address combinations
† Installed Projects are defined as unique Vendor Project IDs
Source: Nicor Gas tracking data and Navigant team analysis.

[1] The Business Custom Incentive Program is part of the broader Custom Program that also includes Combined Heating and Power (CHP) track and the Retro-Commissioning (RCx) track. Evaluation results for the RCx is provided in separate reports. This report presents the evaluation of the program savings realized from the public sector and C&I custom measure component of the Custom Program.

3. Program Savings Summary

Table 3-1 summarizes the energy savings the Custom Program achieved by sector in 2018.

Table 3-1. 2018 Annual Energy Savings Summary

Sector	Ex Ante Gross Savings (therms)	Verified Gross RR†	Verified Gross Savings (therms)	NTG†	Verified Net Savings (therms)
Private	1,580,626	100%	1,576,639	0.79	1,245,545
Public	29,093	99%	28,860	0.79	22,799
Total 2018	1,609,719	100%	1,605,498	0.79	1,268,344

Note: Totals may not sum exactly due to rounding.
* Realization Rate (RR) is the ratio of verified gross savings to ex ante gross savings, based on evaluation research findings.
† Net-to-Gross (NTG) is the ratio of verified net savings to verified gross savings. The NTG is a deemed value. Source: Nicor Gas GPY7 NTG Values 2017-03-01 Final Faucet Aerator Correction 2019-03-20.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 Navigant team analysis.

4. Program Savings by Measure

The Custom Program was divided into four strata for sampling and savings verification. The evaluation sampled 24 out of the 39 projects in 2018 for engineering desk review and onsite verifications. Details on strata boundaries are discussed in Appendix 1 in Section 6.

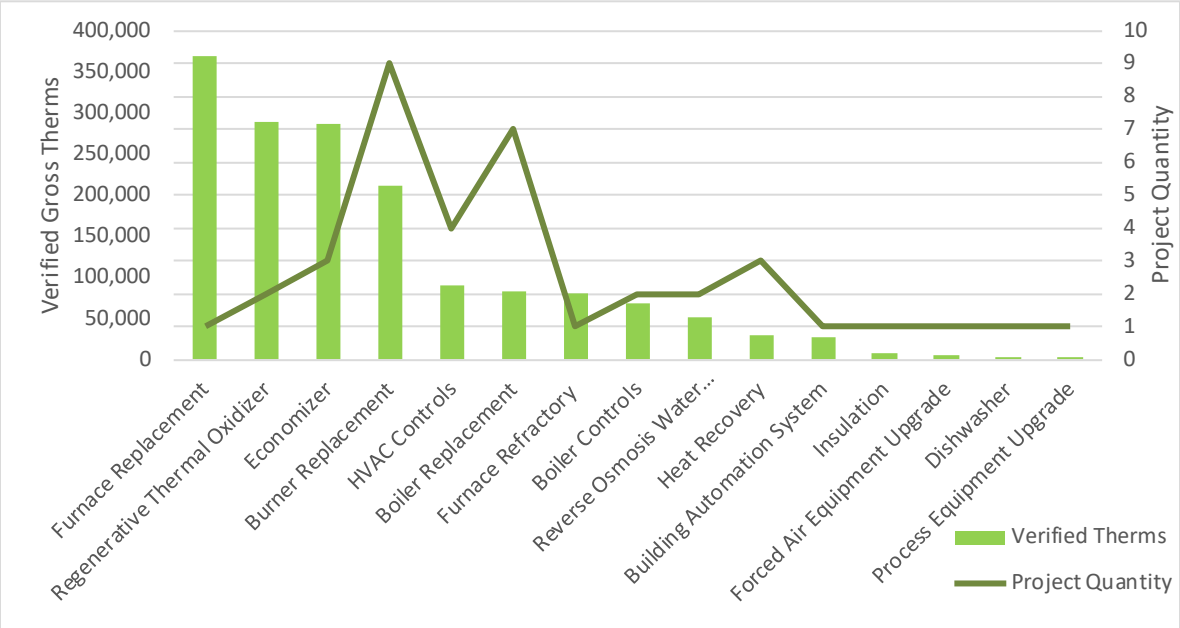
Table 4-1. 2018 Annual Energy Savings by Strata

Research Category	Ex Ante Gross Savings (therms)	Verified Gross RR	Verified Gross Savings (therms)	NTG	Verified Net Savings (therms)
Certainty	632,302	99%	625,204	0.79	493,911
Strata 1	499,920	100%	500,253	0.79	395,200
Strata 2	448,404	101%	451,181	0.79	356,433
Public Strata	29,093	99%	28,860	0.79	22,799
Total 2018	1,609,719	100%	1,605,498	0.79	1,268,344

Note: Totals may not sum exactly due to rounding.
Source: Nicor Gas tracking data and Navigant team analysis.

Figure 4-1 shows the verified savings by the various project types received by the Custom Program.

Figure 4-1. Verified Savings by Project Type



Source: Nicor Gas tracking data and Navigant 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 percent. 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 percent. 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, On-Site Measurement and Verification*

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

5.2 Other Findings and Recommendations

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

Project 1547976 (RR = 128%) calculated energy savings of a regenerative thermal oxidizer (RTO) based on average process and combustion flow rates during operating and non-operating conditions. However, the time component was multiplied by a load factor. If a calculation uses full-load hours, then the other inputs (flows, temperatures, etc.) should also reflect full-load conditions.

> **Recommendation 1.** Navigant recommends that corresponding process variables such as temperature and flow rates reflect full-load conditions when full-load hours are used.

Project 1860160 (RR = 94%) involved the installation of a boiler replacement in a hospital. The heating degree-day base temperature was estimated to be 65°F in the ex ante calculation. Navigant analyzed the facility's gas usage and heating degree-days of various base temperatures, to calculate the base temperature with the highest coefficient of correlation (R^2). This analysis produced a base temperature estimate of 48°F.

> **Recommendation 2.** In projects that utilize heating degree-days, Navigant recommends calculating site-specific heating degree-day base temperatures if the usage data is available and of sufficient quality. This will more accurately account for unknown factors (e.g., internal heat loads, temperature setpoints) unique to that facility.

Project 1584019 (RR = 90%) involved a burner replacement in a hospital. The implementer's calculation workbook used in this project did not provide clear explanations for the data entry fields, leading to some adjustments of calculation inputs. Navigant updated the boiler sizes (BTU/hour) from the boilers' rated input to their rated outputs based on provided nameplate data. In addition, Navigant updated the number of turndown steps in the energy savings calculation. The original savings reported the turndown ratio which is the ratio of the maximum input to the minimum input and is not the same as turn down steps.

Recommendation 3. Navigant recommends the implementer update the boiler burner replacement workbook with additional instruction for the user. Specifically, the boiler size should be clarified as input or output values and turndown should be clarified to refer explicitly to turndown steps or turndown ratios, to avoid confusion.

Project 833759 (RR = 115%) involved the installation of air compressor heat recovery. The implementer used a heat recovery efficiency of 75% which accounted for 10% reduction from heat losses and 15% reduction from air compressor losses. Navigant increased heat recovery efficiency to 80%, based on information from the Compressed Air Challenge and the US Department of Energy.[2] In addition, Navigant used logged data for the hours of use and specification sheets for the maximum power rather than default values or algorithms.

Recommendation 4. Navigant recommends the implementer support assumptions and input values with references.

Recommendation 5. Navigant recommends the implementer use actual hours of use if metered data is of sufficient quality to do so.

Project 1596805 (RR = 98%) used a default value of 8,760 for hours of use at a hospital and efficiency of 80% for a steam boiler. Navigant updated the values to 8,766 hours and 80.7%, respectively, per the IL TRM v6.0.

Recommendation 6. Navigant recommends using default values from the effective version of the IL TRM.

Project 1034763 (RR = 44%) involved air compressor heat recovery. The implementer based the ex ante calculation on full-load compressor operation, but inspection of this site showed the compressors to be very lightly loaded (28-35%). Navigant updated the calculation to reflect the compressor operating at a reduced load.

Recommendation 7. Navigant recommends accounting for equipment loading when heat is being recovered from said equipment.

Project 917633 (RR = 97%) involved the installation of a regenerative thermal oxidizer (RTO). The implementer used a value of 0.2404 Btu/lb-°F for the specific heat of air in the ex ante savings calculation. This value is relatively accurate for temperatures up to 200°F, but the RTO operated at 1,545°F. Navigant updated the specific heat capacity of air value in the ex post calculation to reflect the project conditions.

Recommendation 8. Navigant recommends adjusting thermodynamic and physical properties (e.g., density, heat capacity, etc.) to reflect the installed conditions.

Table 7-2 in Appendix 2 provides a summary of adjustments made to other sampled projects.

[2] Improving Compressed Air System Performance – A Sourcebook for Industry, Third Edition. https://www.energy.gov/sites/prod/files/2016/03/f30/Improving%20Compressed%20Air%20Sourcebook%20version%203.pdf

6. APPENDIX 1. IMPACT ANALYSIS METHODOLOGY

6.1 Verified Gross Program Savings Analysis Approach

The 2018 evaluation involved retrospective adjustments to ex ante gross savings on custom measure variables of all projects installed in 2018. CLEAResult provided documentation of project applications and savings. Navigant 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. Navigant 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 were designated as a Certainty Stratum – projects whose size required that they be sampled. Additionally, all four public sector projects were assigned to a dedicated public stratum. The remaining private 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. Strata were defined by project size, based on gross energy savings boundaries that placed about one-third of program-level savings into each stratum. The details of strata boundaries are provided in Table 6-1. Both 2018 "parallel path" projects that received early feedback from evaluation at the implementer's request were included in the sample of 24 projects selected, including all four public sector projects.

Table 6-1. Strata Boundary Detail for 2018 Custom Sample

Strata	Description of Strata Boundary	Values of Strata Boundary (therms)
Certainty	Projects saving > 200,000 therms	≥ 260,335
1	Projects comprising the 45th percentile (minus Certainty strata)	114,393 > x ≥ 61,235
2	Projects below 45th percentile (minus Certainty strata)	61,235 > x
Public	Public sector projects	NA

Source: Navigant analysis

Table 6-2 shows a profile of the sample selection.

Table 6-2. 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)
Custom	Certainty	2	632,302	2	632,302	100%
	1	6	499,920	5	418,285	84%
	2	27	448,404	13	200,029	45%
	Public	4	29,093	4	29,093	100%
TOTAL		39	1,609,719	24	1,279,709	79%

Source: Nicor Gas tracking data and Navigant team analysis.

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.

On-Site Data Collection

On-site monitoring and verification (M&V) were completed for a subset of 6 of the 24 customer applications sampled. Table 6-3 gives the strata-level verified gross realization rates and statistical precision values at 90 percent confidence.

Table 6-3. Gross Therm Realization Rates and Relative Precision at 90% Confidence Level

Program	Strata	Relative Precision +or-%	Mean RR	Standard Error
Business Custom	Certainty	0.00%	99%	0.00
	1	1.13%	100%	0.01
	2	7.05%	101%	0.04
	Public	0.00%	99%	0.00
Customer Total RR (90/10)		1.84%	100%	0.01

Source: Navigant analysis

6.2 Verified Net Program Savings Analysis Approach

Navigant calculated verified net energy savings by multiplying the verified gross savings estimates by a 0.79 net-to-gross (NTG) ratio. In 2018, the NTG ratio estimates used to calculate the net verified savings were based on past evaluation research and defined by a consensus process through SAG, as documented in a spreadsheet.[3]

[3] Source: Nicor Gas GPY7 NTG Values 2017-03-01 Final Faucet Aerator Correction 2019-03-20.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 sample selection and M&V approach. Table 7-2 provides a summary of M&V results for the sample.

Table 7-1. Profile of PY6 Custom Gross Impact Sample

Project ID	Ex Ante Gross Savings (therms)	Strata	M&V Approach	Measure
PRJ-532160	371,967	Certainty	File Review	Furnace Replacement
PRJ-917633	260,335	Certainty	File Review	Regenerative Thermal Oxidizer
PRJ-1623450	114,393	1	File Review	Burner Replacement & Economizer
PRJ-254833	89,491	1	File Review	Stack Economizer
PRJ-1348945	79,998	1	On-Site	Furnace Rebuild
PRJ-1508138	73,168	1	On-Site	Burner Replacement
PRJ-710983	61,235	1	File Review	Control Upgrade
PRJ-1547976	31,345	2	File Review	Regenerative Thermal Oxidizer
PRJ-1271774	31,257	2	File Review	RO System for Process Water Reclamation
PRJ-1527083	24,132	2	File Review	Boiler Replacement
PRJ-786666	18,887	2	On-Site	Reverse Osmosis System
PRJ-1901586	17,499	2	On-Site	Burner Replacement
PRJ-833759	17,004	2	File Review	Heat Recovery
PRJ-1584019	15,440	2	File Review	Burner Replacement
PRJ-1860160	14,859	2	File Review	Boiler Replacement
PRJ-1755493	10,120	2	On-Site	Vent Condenser
PRJ-1596805	7,310	2	File Review	Boiler Insulation
PRJ-1089501	6,101	2	File Review	Burner Replacement
PRJ-1518305	3,445	2	File Review	Process Heaters
PRJ-1034763	2,630	2	On-Site	Heat Recovery
NGPS-18-006	10,273	Public	File Review	Boiler Plant Upgrade
NGPS-18-004	9,642	Public	File Review	Boiler Replacement
NGPS-18-010	6,978	Public	File Review	Boiler Replacement
PRJ-1871314	2,200	Public	File Review	Unit Ventilators Scheduling

Source: Nicor Gas tracking data and Navigant team analysis.

Table 7-2. 2018 Summary of Sample M&V Results

Project ID	Measure Description	Gross Realization Rate	Summary of Adjustment
PRJ-532160*	Furnace Replacement	100%	OK
PRJ-917633	Regenerative Thermal Oxidizer	97%	Updated the heat capacity value to cover the range of applicable temperatures
PRJ-1623450	Burner Replacement & Economizer	100%	OK
PRJ-254833	Stack Economizer	100%	OK
PRJ-1348945	Furnace Rebuild	105%	Updated annual production and process efficiency based on data received at site visit
PRJ-1508138	Burner Replacement	99%	Updated air intake equation based on metered data and updated baseline usage data to reflect past 24 months
PRJ-710983	Control Upgrade	95%	Updated TMY3 data
PRJ-1547976	Regenerative Thermal Oxidizer	128%	Updated process inputs to reflect full load conditions
PRJ-1271774	RO System for Process Water Reclamation	101%	Updated RO water inlet temperature
PRJ-1527083	Boiler Replacement	100%	OK
PRJ-786666*	Reverse Osmosis System	100%	OK
PRJ-1901586	Burner Replacement	100%	OK
PRJ-833759	Heat Recovery	115%	Updated recovery efficiency, compressor power, and hours
PRJ-1584019	Burner Replacement	90%	Updated input horsepower and number of turndown steps
PRJ-1860160	Boiler Replacement	94%	Updated base temperature
PRJ-1755493	Vent Condenser	100%	OK
PRJ-1596805	Boiler Insulation	98%	Updated default steam boiler efficiency and hours
PRJ-1089501	Burner Replacement	100%	OK
PRJ-1518305	Process Heaters	100%	OK
PRJ-1034763	Heat Recovery	44%	Updated HOU and applied a load factor
NGPS-18-006	Boiler Plant Upgrade	96%	Updated square footage
NGPS-18-004	Boiler Replacement	102%	Updated average annual usage
NGPS-18-010	Boiler Replacement	100%	OK
PRJ-1871314	Unit Ventilators Scheduling	99%	Removed gas savings from heating during the summer

* Parallel path project

Source: Navigant analysis of tracking data.

8. Appendix 2. Program-Specific Inputs for the Illinois TRC

The Total Resource Cost (TRC) variable table only includes cost-effectiveness analysis inputs available at the time of finalizing this 2018 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. Detail in this table (e.g., EULs) other than final 2018 savings and program data are subject to change and are not final.

Table 8-1. Total Resource Cost Savings Summary

Research Category	Units	Quantity	Effective Useful Life (years)	Ex Ante Gross Savings (therms)	Verified Gross Savings (therms)	Verified Net Savings (therms)
Boiler Controls	Project	2	17	67,836	68,256	53,922
Boiler Replacement	Project	7	20	83,505	83,786	66,191
Building Automation System	Project	1	15	27,987	28,160	22,247
Burner Replacement	Project	9	21	211,230	211,988	167,470
Dishwasher	Project	1	16	3,734	3,757	2,968
Economizer	Project	3	15	285,519	285,709	225,710
Forced Air Equipment Upgrade	Project	1	15	5,982	6,019	4,755
Furnace Refractory	Project	1	13	79,998	80,051	63,241
Furnace Replacement	Project	1	13	371,967	367,792	290,555
Heat Recovery	Project	3	13	29,754	29,938	23,651
HVAC Controls	Project	4	15	89,628	89,813	70,953
Insulation	Project	1	20	7,310	7,355	5,811
Process Equipment Upgrade	Project	1	13	3,445	3,466	2,738
Regenerative Thermal Oxidizer	Project	2	20	291,680	288,952	228,272
Reverse Osmosis Water Treatment	Project	2	13	50,144	50,455	39,859
Total		39	16	1,609,719	1,605,498	1,268,344

Source: Navigant analysis of tracking data.