Multi-Family Home Energy Savings Program

GPY5 Evaluation Report

Energy Efficiency Plan: Gas Plan Year 5 (6/1/2015-5/31/2016)

FINAL

June 29, 2017

Prepared for:

Nicor Gas Company

Submitted by:
Navigant Consulting, Inc.

Charles Ampong, Managing Consultant
608.446.3172
charles.ampong@navigant.com

www.navigant.com

©2017 Navigant Consulting, Inc.

Submitted to:

Nicor Gas Company
1844 Ferry Road
Naperville, IL 60563

Submitted by:

Navigant Consulting, Inc.
30 S. Wacker Drive, Suite 3100
Chicago, IL 60606
Phone 312.583.5700
Fax 312.583.5701

Contact:

Randy Gunn, Managing Director
312.938.4242
randy.gunn@navigant.com

Kevin Grabner, Associate Director
608.497.2323
kevin.grabner@navigant.com

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

Acknowledgements
This report includes contributions from Rick Berry and Sagar Deo in addition to those individuals listed above.

Disclaimer: This report was prepared by Navigant Consulting, Inc. ("Navigant") for Nicor Gas based upon information provided by Nicor Gas and from other sources. Use of this report by any other party for whatever purpose should not, and does not, absolve such party from using due diligence in verifying the report's contents. Neither Navigant nor any of its subsidiaries or affiliates assumes any liability or duty of care to such parties, and hereby disclaims any such liability.

TABLE OF CONTENTS

LIST OF FIGURES AND TABLES

Figures

Tables

E. EXECUTIVE SUMMARY

This report presents a summary of the findings and results from the impact and process evaluation of the Nicor Gas Multi-Family Home Energy Savings Program (MFHES Program or Multi-Family Program), which is electric program year eight (EPY8) and gas program year five (GPY5).[1] The EPY8/GPY5 program year was jointly implemented with Commonwealth Edison Company (ComEd). The program achieves electric energy and demand savings for ComEd customers and natural gas energy savings for customers of Nicor Gas Company (Nicor Gas). This evaluation report includes total Nicor Gas impacts from the jointly implemented program. CLEAResult is the implementation contractor of the Multi-Family Program.

The Multi-Family Program is delivered through two channels: the direct install path which provides free assessment and no-cost direct installation of measures in residential multi-family buildings with five or more living units and the prescriptive path which offers prescriptive and custom incentives to multi-family decision-makers to install energy savings measures in common areas of multi-family buildings.

The GPY5 program was essentially the same as the GPY4 program, with the exception that incentives for certain residential measures were reduced, notably, rebates for common area programmable thermostats due to the reduction in deemed savings in the Illinois Technical Reference Manual (TRM v4.0).[2]

The GPY5 evaluation involved verifying the compliance of the Multi-Family Program savings to the Illinois TRM (v4.0) or applying necessary research adjustments to non-deemed savings in the tracking database and calculating verified net impact savings using the net-to-gross (NTG) ratio approved through the Illinois Stakeholder Advisory Group (SAG) consensus process.[3] Navigant coordinated with program staff and the implementation contractor staff to verify information about the tracking system.

E.1. Program Savings

Table E-1 and Table E-2 summarize the total program savings, and program savings by measure. Table E-1 shows the GPY5 MFHES Program achieved net energy savings of 759,655 therms.

[1] The EPY8/GPY5 program year began June 1, 2015 and ended May 31, 2016.
[2] Illinois Statewide Technical Reference Manual for Energy Efficiency Version 4.0, available at: http://www.ilsag.info/technical-reference-manual.html
[3] http://ilsagfiles.org/SAG_files/NTG/2016_NTG_Meetings/Final_Documents/Nicor_Gas_NTG_Summary_GPY1-6_2016-02-29_Final.pdf

Table E-1. GPY5 Program Results

Savings Category	Nicor Gas
Ex Ante Gross Savings[4] (Therms)	805,102
Verified Gross Realization Rate (RR)	1.00 ‡
Verified Gross Savings (Therms)	806,062
Net to Gross Ratio (NTGR)	In-Unit = 0.95; Common Area = 0.94 †
Verified Net Savings (Therms)	759,655

Source: Utility tracking data and Navigant analysis.
IU= dwelling unit, CA= common areas
‡ Based on evaluation research findings
† Source:
http://ilsagfiles.org/SAG_files/NTG/2016_NTG_Meetings/Final_Documents/Nicor_Gas_NTG_Summary_GPY1-6_2016-02-29_Final.pdf

Table E-2 summarizes the ex ante gross savings, verified gross savings, and verified net savings for the GPY5 MFHES Program by measure. The direct install residential unit measures contributed 24 percent of the GPY5 verified net savings, and the comprehensive measures contributed 76 percent of the verified net savings (74 percent from prescriptive projects and two percent from custom projects).

[4] From Program Tracking System

Table E-2. GPY5 Program Results by Measure

Research Category	Measure	Ex Ante Gross Savings (Therms)	Verified Gross Realization Rate‡	Verified Gross Savings (Therms)	NTGR †	Verified Net Savings (Therms)
Direct Install (dwelling units)	Bath Aerator	6,069	1.00	6,067	0.95	5,764
	Pipe Insulation	456	1.01	459	0.95	436
	Showerhead	83,421	1.00	83,436	0.95	79,265
	Kitchen Aerator	20,212	1.00	20,215	0.95	19,204
	Programmable Thermostat	85,415	1.00	85,418	0.95	81,147
	WH Set Back	45	1.00	45	0.95	43
DI Subtotal		*195,618*	*1.00*	*195,640*	*0.95*	*185,858*
Prescriptive/ Custom Incentives (common areas)	Boiler Reset Controls	69,414	0.99	68,819	0.94	64,690
	Storage Water Heater	119	1.00	119	0.94	112
	Boiler Tune Up	43,054	1.09	47,138	0.94	44,310
	Efficient Boiler	44,157	0.87	38,301	0.94	36,003
	Condensing Unit Heaters	532	1.00	532	0.94	500
	Pipe Insulation	431,362	1.01	434,718	0.94	408,635
	Programmable Thermostat	69	1.10	76	0.94	71
	Outdoor Pool Covers	5,058	1.00	5,058	0.94	4,755
	Efficient Furnace	2,967	1.00	2,966	0.94	2,788
	Pre-Rinse Spray Valves	236	1.00	236	0.94	222
	Custom Measures	12,516	1.00	12,458	0.94	11,711
Common Area Subtotal		*609,484*	*1.00*	*610,422*	*0.94*	*573,797*
GPY5 Total		805,102	1.00	806,062		759,655

Source: Program tracking data and Navigant analysis.
‡ Based on evaluation research findings.
† Source: http://ilsagfiles.org/SAG_files/NTG/2016_NTG_Meetings/Final_Documents/Nicor_Gas_NTG_Summary_GPY1-6_2016-02-29_Final.pdf

E.2. Impact Estimate Parameters

Table E-3 shows the key parameters used in the GPY5 impact analysis. Navigant used impact parameters as defined by the Illinois TRM (v4.0) to evaluate the savings for most program measures. We verified custom savings input parameters as provided in the tracking system or from supplemental data provided by Nicor Gas. The GPY5 evaluation did not include research on impact savings parameters for deeming in future versions of the Illinois TRM. Net-to-gross ratios for calculating GPY5 MFHES Program net savings, were deemed by the Stakeholder Advisory Group (SAG).

Table E-3. Impact Estimate Parameters

Parameter	Data Source	Deemed or Evaluated?
Net to Gross Ratio	SAG Document †	Deemed
Verified Gross Realization Rate	Program Tracking Data, Illinois TRM (v4.0) or custom evaluation	Evaluated
Space Heating Efficiency Inputs	Nicor Gas custom values	Evaluated
Custom measures inputs	Nicor Gas custom values	Evaluated
All other measures inputs, including HOU values	Program Tracking Data, Illinois TRM (v4.0)	Deemed

Source: Navigant analysis
† Deemed values.
http://ilsagfiles.org/SAG_files/NTG/2016_NTG_Meetings/Final_Documents/Nicor_Gas_NTG_Summary_GPY1-6_2016-02-29_Final.pdf

E.3. Participation Information

Table E-4 provides an overview of GPY5 participation. Navigant identified 247 assessment participants (business names)[5] in the GPY5 MFHES Program. This included 154 participants who received prescriptive or custom incentives, and 137 participants who received one or more assessments, 93 of which received no-cost direct install products.[6] A total of 601 projects[7] were completed in GPY5, involving the installation of 16,150 measures.

Table E-4. GPY5 Primary Participation Detail

Participation	Direct Install (residential units)	Prescriptive/Custom (common areas)	Program Total
Participants	93*	154***	247
Completed Projects	209**	392	601
Installed Measures[8]	15,650	500	16,150

Source: Program tracking data and Navigant analysis.
** Note: a total of 137 assessment participants were identified and 93 of them received DI measures with realized savings.*
*** Note: Includes projects described as "Assessment Direct Install" (204), and the other "Direct Install" (5).*
**** Note: Includes 16 participants identified with both Di and Prescriptive projects.*

[5] Participants refer to multi-family property owners/managers (account names or business names) that participated in the Multi-Family program in GPY5.
[6] The 137 assessment participants were identified with 261 assessment projects, and 93 of the assessment participants comprised 209 DI projects that received no-cost direct install products.
[7] Projects refer to unique applications submitted to the program by multi-family owners and managers. Projects include DI, prescriptive, and custom applications with realized savings.
[8] For evaluation reporting purpose, if a measure quantity is reported in the tracking system in linear feet, MBH, or square feet, Navigant treated each row entry of such measure as one measure quantity in this table.

E.4. Finding and Recommendations

This section summarizes the key findings and recommendations.

Program Savings Achievement

Finding 1. Navigant verified net savings of 759,655 therms for the GPY5 MFHES Program, based on the SAG approved NTG ratio of 0.95 for direct install measures and 0.94 for common area measures. The verified net savings is 89 percent of the program net savings goal of 850,876 therms.[9] The direct install path contributed 24 percent of the total net savings (up from 11 percent in GPY4), and the prescriptive and custom paths contributed 76 percent (a decrease from 89 percent in GPY4). The measures with the most savings were pipe insulation (54 percent), space heating equipment (20 percent), programmable thermostats (11 percent), showerheads (10 percent), and the remaining 5 percent from other measures.

Gross Realization Rates

Finding 2. Navigant verified the program level gross savings realization rate was 100 percent. This is based on verified gross savings of 806,062 therms, an increase of 960 therms compared with the ex ante 805,102 therms. Notable adjustments were made to ex ante savings from pipe insulation, condensing boilers, boiler tune-ups, and custom HVAC measures. Details of the measure-level adjustments are presented in Section 3.

Finding 3. Six custom projects were implemented in the GPY5 Multi-Family Program, which involved space heating boiler replacements, domestic hot water (DHW) measures and attic insulation. Using engineering and billing analysis, Navigant verified that two of the six projects had 100 percent gross savings realization rates, two had realization rates above 100 percent after engineering analysis of gas usage and efficiency improvements, and the remaining two projects had less than 100 percent gross realization rate. The overall gross savings realization rate for the custom projects is 100 percent, as the evaluation adjustments balanced across projects with higher and lower verified savings. Details of the findings on the custom projects are highlighted below and in Section 3 (Table 3-5).

Finding 4. Navigant found that a custom project consisting of a domestic hot water (DHW) boiler replacement assumed the baseload usage was exclusively for the purposes of hot water. However, there was no discussion in the project documentation of whether other potential baseload gas equipment, such as the heater for the rooftop pool, contributed to the baseload usage. Navigant's verification produced a 100 percent gross realization rate, but with a recommendation for improving data collection for such projects.

Recommendation 1. For projects that estimate baseload usage for the purposes of quantifying DHW usage, the implementation contractor should include discussion of all potential contributors to baseload usage (e.g., presence of in-unit appliances, gas pool heaters, common area fireplaces, cafeteria) in the supporting project documents. Navigant acknowledges that Nicor Gas and CLEAResult are taking steps to discuss with customers and track pertinent information mentioned during post inspection customer interviews or through other communication channels.

[9] Nicor Gas Energy Efficiency Plan, June 2014 - May 2017

Tracking System Review

Finding 5. Navigant verified that the tracking system adequately tracks the program measure savings inputs and ex ante savings but requires additional update to the hours of use (HOU) inputs for boiler tune up, boiler replacement, and pipe insulation measures. For some projects, the HOU values have not been updated from the previous version of the TRM (2,050 hours for all multi-family building types) to the current versions of the TRM (v4.0 and v5.0) which estimate savings for various multi-family building types.

Recommendation 2. Navigant acknowledges that Nicor Gas and CLEAResult are taking the necessary steps that we recommend to update the GPY6 tracking system HOU assumptions for multi-family building types, as deemed in the approved TRM version for GPY6.

Finding 6. Navigant found that there is limited description in the tracking system about certain input parameters that feed into the ex ante savings calculation for pipe insulation. These include, in addition to HOU, the pipe location, primary pipe use, and thermal regain adjustment input parameters. Other inputs are deemed heating system efficiency values, for example, low-pressure steam boilers.

Recommendation 3. Nicor Gas and CLEAResult should review the tracking system input parameters for pipe insulation. Ensure the tracking thermal regain factors are consistent with the savings claim. Ensure the description of the pipe insulation type, and clearly indicate whether the primary piping use is non-recirculation or year-round recirculation, or a seasonal period of pipe use. Also review the tracking data boiler efficiency values for the steam pipe systems to be consistent with the TRM. Navigant acknowledges that Nicor Gas and CLEAResult are taking the necessary steps that we recommend to collect all types of system configuration and recirculation approaches on applications and to use these inputs to determine GPY6 savings inputs.

Finding 7. Ex ante savings for common area programmable thermostats was 34.27 therms per thermostat. This value was a weighted average estimate from GPY4 participating building types in the Business Energy Efficiency Rebate (BEER) Program, which were different from the MFHES GPY5 participation.

Recommendation 4. If the program adopts the deemed small commercial programmable thermostats assumptions in the TRM for multi-family common areas, the implementation contractor could calculate an average savings value from the TRM building types, assuming an unknown location. Navigant acknowledges that Nicor Gas and CLEAResult are reviewing the savings calculation approach for this measure in GPY6.

Program Participation

Finding 8. The GPY5 MFHES Program has experienced a large participation increase in its direct install offering, more so than in its prescriptive offering, when compared with GPY4. The program realized participation of 247 property owners or decision makers of multi-family properties who completed an assessment. This included 154 participants that received prescriptive or custom incentives, 93 participants that received no-cost direct install products or services, and 44 participants that completed an assessment without installing a measure. A total of 601 projects were completed, representing the installation of 16,150 measures.

Recommendation 5. Navigant recommends research in 2018 to understand why some Assessment customers opt not to receive the no-cost direct install measures, if there is a trend in refusal of measures, and the graduation rate of customers from the Assessment to Rebate path within the offering. This research will include participant surveys and analyzing program data.

1. INTRODUCTION

1.1 Program Description

The Nicor Gas Multi-Family Home Energy Savings Program (MFHES Program or Multi-Family Program) is delivered through two channels: direct installation of measures in residential living units, and a comprehensive component involving the provision of prescriptive and custom incentives to commercial contractors and multi-family decision-makers to install energy savings measures in common areas of multi-family buildings. Attic air sealing and insulation also qualify for custom incentives.

During GPY5, the MFHES Program continued to offer direct installation of low-flow water-saving devices, including kitchen and bath aerators and showerheads, as well as programmable thermostats, hot water pipe wraps, and turning-down the temperature of water heaters, where applicable. The comprehensive common area measures include upgrades or improvements to central plant and heating, ventilating, and air-conditioning (HVAC) systems and controls, interior and exterior lighting systems, and building shell improvements. The implementation contractor works with installation contractors as an integral part of promoting the comprehensive component of the program.

During GPY5, program tracking data showed that 247 multi-family property owners or decision makers participated in the MFHES Program and installed 16,150 measures from 601 projects. Most of the savings from the measures installed in GPY5 are derived from deemed values contained in the Illinois Technical Reference Manual (TRM).[10]

1.2 Evaluation Objectives

The GPY5 MFHES Program evaluation primarily focused on the following key researchable questions:

Impact Questions:

1. What is the program's verified gross savings?
2. What is the program's verified net savings?
3. What updates are recommended for the Illinois Technical Reference Manual (TRM)?

Process Questions:

The GPY5 process evaluation activities for the Multi-Family Program was limited to interviews with program staff and the implementation contractor staff to verify information about the tracking system.

[10] Illinois Statewide Technical Reference Manual for Energy Efficiency Version 4.0, available at: http://www.ilsag.info/technical-reference-manual.html

2. EVALUATION APPROACH

This evaluation of the MFHES Program reflects the fifth full-scale year of program operation (June 1, 2015 through May 31, 2016). To determine verified gross savings, the evaluation team verified per unit savings for each program measure using the Illinois Technical Reference Manual (TRM v4.0) for deemed input parameters or through evaluation research to verify custom inputs applied by Nicor Gas in the ex ante calculations. Navigant multiplied measure quantities reported in the program tracking system data by the verified per unit savings values. The verified net savings was calculated using a net-to-gross ratio (NTGR) that was deemed for GPY5. Navigant interviewed program staff and the implementation contractor staff to verify information about the tracking system.

2.1 Overview of Data Collection Activities

The core data collection activities included a tracking system review and an engineering analysis as shown in the table below.

Table 2-1. Data Collection Activities

What	Who	Target Completes	Completes Achieved	When
In Depth Interviews	PM/IC	2	2	May 2016
Tracking System & Engineering Review	GPY5 projects using IL-TRM or through research	All	All	Dec 2016 –March 2017
Project File Reviews	GPY5 projects with custom inputs	All	All	Dec 2016 -March 2017

Source: Navigant analysis

2.2 Verified Savings Parameters

Table 2-2 below presents the sources for parameters that were used in verified gross savings analysis indicating which were examined through GPY5 evaluation research and which were deemed.

Table 2-2. Verified Gross and Net Savings Parameters

Measure	Input Parameter Source	Deemed or Evaluated?
NTGR	SAG Agreement†	Deemed
Gross Realization Rate	Tracking data and evaluation research	Evaluated
Bath/Kitchen Faucet Aerators	Illinois TRM, v4.0, section 5.4.4‡	Deemed
Showerhead	Illinois TRM, v4.0, section 5.4.5‡	Deemed
DHW Pipe Insulation	Illinois TRM, v4.0, section 5.4.1‡	Deemed
Boiler Tune Up, Heating	Illinois TRM, v4.0, section 4.4.2‡	Deemed
Boiler Tune Up, Process	Illinois TRM, v4.0, section 4.4.3‡	Deemed
Boiler Cutout/Reset Control	Illinois TRM, v4.0, section 4.4.4‡	Deemed
High Efficiency Boiler	Illinois TRM, v4.0, section 4.4.10‡ & custom input	Evaluated
High Efficiency Furnace	Illinois TRM, v4.0, section 4.4.11‡ & custom input	Evaluated
Commercial Pool Covers	Illinois TRM, v4.0, section 4.3.4‡	Deemed
Ozone Laundry	Illinois TRM, v4.0, section 4.3.6‡	Deemed
HW/Steam Pipe Insulation	Illinois TRM, v4.0, section 4.4.14‡	Deemed
Steam Traps	Illinois TRM, v4.0, section 4.4.16‡	Deemed
WH Temperature Setback	Illinois TRM, v4.0, section 5.4.6‡	Deemed
Programmable Thermostat	Illinois TRM, v4.0, section 5.3.11‡ & 4.4.18‡	Deemed
Custom Measures	Custom Inputs	Evaluated
Programmable Thermostat	Illinois TRM, v4.0, section 4.4.18‡	Deemed
Storage Water Heater	Illinois TRM, v4.0, section 4.3.1‡	Deemed

Source: Navigant analysis

† http://ilsagfiles.org/SAG_files/NTG/2015_NTG_Meetings/Final_2015_Documents/Nicor_Gas_NTG_Summary_GPY1-5_2015-03-01_Final.pdf

‡ Illinois Statewide Technical Reference Manual for Energy Efficiency Version 3.0, available at: http://www.ilsag.info/technical-reference-manual.html

2.3 Verified Gross Program Savings Analysis Approach

Navigant used the Illinois TRM Version 4.0 methodology to calculate verified gross savings for measures with deemed savings. The Illinois TRM allows for some custom values to be used in the algorithms as well. CLEAResult used custom input variables collected from customer applications alongside TRM deemed inputs to estimate ex ante savings for some measures. Navigant reviewed the custom assumptions in the tracking database and supplemental data provided by CLEAResult to verify the reasonableness of the custom inputs.

2.4 Verified Net Program Savings Analysis Approach

Verified net energy savings were calculated by multiplying the verified gross savings estimates by a NTGR. For GPY5, the evaluation team used NTGR values that were deemed: 0.95 for direct install residential measures and 0.94 for common area measures.

2.5 Process Evaluation

As part of the GPY5 process evaluation, Navigant performed a review of the program materials and conducted an interview with program staff and the implementation contractor staff to verify information about the tracking system.

3. GROSS IMPACT EVALUATION

Navigant performed a verification of the MFHES Program tracking database to determine the accuracy and reasonableness of the data gathered and required to calculate program savings. Navigant used measure quantities, tracking data, and supplemental data of equipment specifications supplied by Nicor Gas as inputs to Illinois TRM algorithms to determine verified gross savings. Navigant estimated that the GPY5 MFHES Program achieved verified gross savings of 806,062 therms and a verified gross realization rate of 100 percent at the program level.

3.1 Tracking System Review

The purpose of the tracking system review was to ensure the system gathers the required data to correctly calculate program savings. Nicor Gas and CLEAResult delivered tracking data in December 2016. Navigant's initial analysis of the tracking data revealed that the data fields have not changed from the previous year. Navigant relied on the TRM (v4.0) as the basis for verifying the deemed measure savings. Like GPY4, the savings input parameters in tracking data for some measures, including space and process heating equipment and pipe insulation, did not produce the claimed savings because ex ante calculations were made using inputs not provided in the tracking data. Nicor Gas provided supplemental data to back up the assumptions behind the ex ante savings for the custom inputs. Navigant's savings verification approach used custom inputs when provided in the program tracking data or the supplemental custom data provided by Nicor Gas; when not provided, we defaulted to the TRM values.[11]

Key measure specific findings from the tracking system review are provided below.

1. **Pipe Insulation: 101% RR, 54% of Program Net Savings.** For some pipe insulation projects, the ex ante savings applied an Hours of Use (HOU) value of 2,050 hours from the previous version of the TRM – a single HOU value that covered all multi-family building types (e.g. projects PRJ-505309, and PRJ-505311). The HOU value has since been updated in the approved TRM (v4.0) for GPY5 for the various types of multi-family buildings (i.e. high rise, mid-rise or low rise multi-family buildings). Navigant also found that when selecting deemed values for pipe insulation, the TRM (v4.0) had more differentiation of system configurations and recirculation approaches than Nicor Gas defined in the tracking system. There is limited description of the pipe location for certain projects, and the thermal regain adjustment values provided in the tracking system did not produce the claimed savings. In some cases, deemed heating system efficiency values are incorrectly tracked (e.g. low-pressure steam boiler efficiency should be 64.8% not 80.7%). The adjustment resulted in verified gross realization rate of 101 percent for pipe insulation measures.
2. **Space Heating Boilers and Boiler Tune-ups: 98% RR, 13% of Program Net Savings.** Navigant found that most of the space heating efficient boilers and boiler tune-up measures had 100 percent verified gross realization rates. For some projects (e.g. PRJ-505298 and PRJ-509450) the ex ante savings applied the HOU value of 2,050 hours from the previous version of the TRM that applied to all types of multi-family buildings. The HOU values in the approved TRM (v4.0) for GPY5 calculates savings for various types of multi-family buildings. After further review

[11] Navigant's retrospective verification of custom inputs was not constrained to using values provided on the application form or supplemental program tracking data provided by Nicor Gas.

of the supplemental data of heating loads of the projects, Navigant estimated 87 percent as the gross realization rate for efficient boilers. In the case for boiler tune-ups, the gross realization rate was 109 percent.

3. **Programmable Thermostats: 100% RR, 11% of Program Net Savings.** Programmable thermostats installed in residential units had a 100 percent verified gross realization rate and constituted 11 percent of the program savings. Navigant adjusted the savings for the relatively small number of programmable thermostats installed in common areas of multi-family buildings with 110 verified gross realization rate (the overall measure realization rate shows as 100 percent combined for in-unit and common areas). The common area per unit ex ante savings value for programmable thermostats was adopted from an estimate from the Business Energy Efficiency Rebate (BEER) Program. The implementation contractor used TRM assumptions to determine the therm savings value for each BEER Program building type. Then, each building type was assigned a weight using thermostat participation data by building type from GPY4 (since GPY5 participation is unknown when the program year starts). The total weighted average savings was calculated to be 34.27 therms. This was applied as a default ex ante savings value to common area thermostat participation in GPY5. Navigant calculated the GPY5 verified savings separately for each participating building type using GPY5 participation, and estimated 37.85 therms as an overall average savings value for multi-family common areas.

4. **Other Measures: 100% RR, 23% of Program Net Savings.** With exception of the adjustments to savings from pipe insulation, programmable thermostats, boiler tune-ups, and efficient boilers, the reported savings for all other program measures were consistent with the TRM deemed savings. In some cases, the evaluation team applied minor adjustments due to rounding differences.

3.2 Program Volumetric Findings

Table 3-1 provides a breakdown of the GPY5 participants by program category. Navigant identified 247 participants in the tracking system who completed an assessment. This included 154 participants who received prescriptive or custom incentives, 93 participants that received no-cost direct install products or services, and 44 participants that completed an assessment without installing a project. A total of 601 projects were completed through the GPY5 program, including the installation of 16,150 measures.

Table 3-1. GPY5 Primary Participation Detail

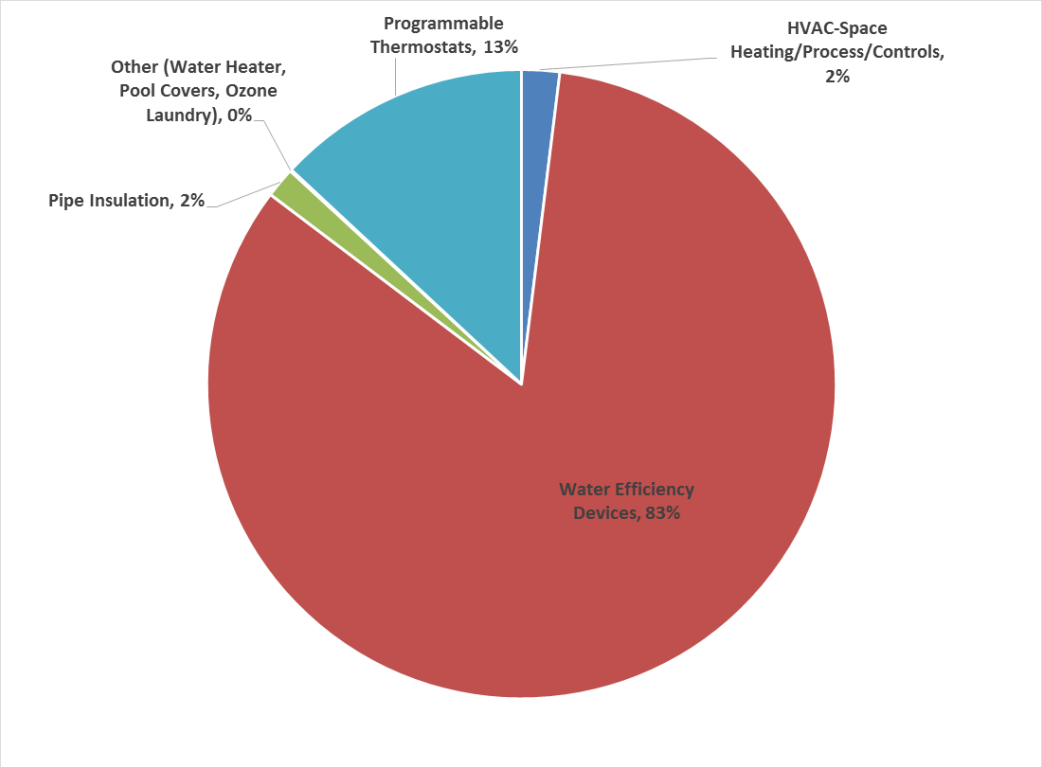
Participation	Direct Install (residential units)	Prescriptive/Custom (common areas)	Program Total
Participants	93*	154***	247
Completed Projects	209**	392	601
Installed Measures[12]	15,650	500	16,150

Source: Program tracking data and Navigant analysis.
** Note: a total of 137 assessment participants were identified and 93 of them received DI measures with realized savings.*
*** Note: Includes projects described as "Assessment Direct Install" (204), and the other "Direct Install" (5).*
**** Note: Includes 16 participants identified with both DI and Prescriptive projects.*

[12] For evaluation reporting purpose, if a measure quantity is reported in the tracking system in linear feet, MBH, or square feet, Navigant treated each row entry of such measure as one measure quantity in this table.

Figure 3-1 depicts the GPY5 volumetric measure counts by end-use category. Direct install water efficiency measures accounted for 83 percent of the measure count followed by programmable thermostats with 13 percent. A detailed breakdown of the GPY5 participants by program rebate units is provided in Table 3-2 below.

Figure 3-1. GPY5 MFHES Program Measure End-use Category: Installations



Source: Program tracking data and Navigant analysis.

Table 3-2. GPY5 Multi-Family Program Installed Measures by Rebate Unit

Measure Category	Unit of Rebate	Ex Ante Quantity	Verified Quantity
Bath Aerator	unit	4,855	4,855
Kitchen Aerator	unit	3,940	3,940
Pipe Insulation (DI)	Ln.ft	277	277
Programmable Thermostat (DI)	unit	2,109	2,109
Showerhead	unit	4,663	4,663
WH Set Back	unit	11	11
Boiler Reset Controls	unit	61	61
Boiler Tune Up, Space Heat	unit	179	179
Custom Measures	unit	6	6
Efficient Boiler	unit	49	49
Efficient Furnace	unit	19	19
Outdoor Pool Covers	Sq.ft	5,008	5,008
Pipe Insulation	Ln.ft	45,988	45,988
Programmable Thermostat (P)	unit	2	2
Spray Valves	unit	2	2
Storage Water Heater	Ln.ft	277	277

Source: Program tracking data and Navigant analysis.

3.3 Gross Program Impact Parameter Estimates

Navigant verified the ex ante savings using the assumptions and algorithms specified in the TRM (v4.0) or through engineering analysis for non-deemed measures. Table 3-3 summarizes the input parameters and unit of savings used to estimate program verified gross savings.

Table 3-3. Verified Gross Savings Parameters

Input Parameter	Value	Unit	Deemed or Evaluated?
Verified Gross Realization Rate	1.00		Evaluated
Bathroom Faucet Aerator	1.25	therms/unit	Deemed
Kitchen Faucet Aerator	5.13	therms/unit	Deemed
Showerhead	17.90	therms/unit	Deemed
WH Set Back	4.07	therms/unit	Deemed
Boiler Tune Up	Vary, some HOU adjustments	therms/unit	Deemed
Efficient Boiler	Vary, some adjustments	therms/unit	Evaluated
Efficient Furnace	Vary, acceptable as is	therms/unit	Evaluated
Commercial Pool Cover	2.61 for indoor, 1.01 for outdoor	therms/Sq.ft	Deemed
Ozone Laundry	30.72	therms/lb.-capacity	Deemed
Pipe Insulation	Vary. Adjustments due to pipe description and location	therms/Ln.ft	Deemed
Custom	Vary	therms/unit	Evaluated
Programmable Thermostat	Vary. Acceptable for DI, adjusted for common areas using GPY5 participation	therms/unit	Deemed
Storage Water Heater (EF>67%)	119 for standard, 251 therms for high efficiency	therms/unit	Deemed

Source: Navigant analysis

3.4 Development of the Verified Gross Realization Rate

Navigant determined the verified gross realization rates by comparing the ex ante gross savings with the verified gross savings. The overall program verified gross realization rate is 100 percent. Results by measure are summarized in Table 3-4 below. Pipe insulation (including domestic hot water, space heating and steam boilers) contributed 54 percent of the GPY5 verified gross savings. Water efficiency measures contributed 15 percent, programmable thermostats with 13 percent, and the remaining measures (space heating, process application, and boiler control) contributed 22 percent.

Table 3-4. GPY5 Verified Gross Savings by Measure

Research Category	Measure	Ex Ante Gross Savings (Therms)	Verified Gross Realization Rate‡	Verified Gross Savings (Therms)
Direct Install (dwelling units)	Bath Aerator	6,069	1.00	6,067
	Pipe Insulation	456	1.01	459
	Showerhead	83,421	1.00	83,436
	Kitchen Aerator	20,212	1.00	20,215
	Programmable Thermostat	85,415	1.00	85,418
	WH Set Back	45	1.00	45
DI Subtotal		*195,618*	*1.00*	*195,640*
Prescriptive/Custom Incentives (common areas)	Boiler Reset Controls	69,414	0.99	68,819
	Storage Water Heater	119	1.00	119
	Boiler Tune Up	43,054	1.09	47,138
	Efficient Boiler	44,157	0.87	38,301
	Condensing Unit Heaters	532	1.00	532
	Pipe Insulation	431,362	1.01	434,718
	Programmable Thermostat	69	1.10	76
	Outdoor Pool Covers	5,058	1.00	5,058
	Efficient Furnace	2,967	1.00	2,966
	Pre-Rinse Spray Valves	236	1.00	236
	Custom Measures	12,516	1.00	12,458
Common Area Subtotal		*609,484*	*1.00*	*610,422*
GPY5 Total		**805,102**	**1.00**	**806,062**

Source: Program tracking data and Navigant analysis.
‡ Based on evaluation research findings.

In Table 3-5 below, we provide a summary of the evaluation findings for the six custom projects installed in GPY5.

Table 3-5. GPY5 Verified Gross Savings Estimates for Custom Measures

ProjectID	Ex Ante Gross Savings (Therms)	Verified Gross RR	Verified Gross Savings (Therms)	Retrofit Name	Evaluation Findings
PRJ-512790	324	105%	341	Boiler Replacement	Project PRJ-512790 and PRJ-512345 are similar from the same customer. Savings verification utilized engineering analysis and estimated annual gas usage for heating from billing data, and applied the improvement from 80% (code) efficiency to 83% efficiency.
PRJ-512345	304	133%	404	Boiler Replacement	
PRJ-515979	333	89%	295	Attic Insulation	Used IL TRM v4.0 algorithm. Used TRM HDD of 5,113 for Chicago, and a custom adjustment factor of 100%. No frame factor was applied.
PRJ-516866	5,095	100%	5,095	Boiler Replacement	OK
PRJ-533587	4,587	100%	4,587	DHW Boiler Replacement	OK
PRJ-571490	1,874	93%	1,736	Boiler Controls	Billing analysis was utilized.

Source: Program tracking data and Navigant analysis.

Custom Projects Findings: 100% RR, 2% of Program Net Savings. The custom component of the Multi-Family Program realized installation of six custom projects in GPY5. Navigant requested documentation for the projects and performed engineering file reviews of the energy savings inputs and assumptions, including billing analysis for three projects. Using engineering and billing analysis, Navigant verified that two of the six projects had 100 percent gross realization rates, two projects increased in savings after engineering analysis of gas usage and efficiency improvement, and the remaining two projects were adjusted to less than 100 percent gross realization rate.

- Navigant found that custom project PRJ-533587, which consisted of a domestic hot water boiler replacement, assumed the baseload usage was exclusively for the purposes of hot water. There was no discussion of whether other potential baseload gas equipment, such as the heater for the rooftop pool, contributed to the baseload usage. Navigant's assessment was a 100 percent gross

realization rate, but recommends in the future that the implementation contractor include discussion of all potential contributors to baseload usage in the supporting project documents.

- The boiler replacement projects PRJ-512790 and PRJ-512345 were implemented at the same facility. Navigant reviewed the ex ante regression analysis approach used in the ex ante savings estimate, and requested additional gas usage history to verify the savings. Navigant determined that using regression approach for the savings verification approach was not reliable because the facility may have many variables affecting usage, such as occupancy and behavior plus operation of other gas equipment on site that the evaluation team could not verify using the billing analysis approach. Navigant relied upon an engineering approach similar to the pre-approval savings estimation approach. We estimated annual gas usage for heating from the billing data, and applied the improvement from 80 percent (code) efficiency to 83 percent efficiency. The projects had 105 percent and 133 percent gross savings realization rates respectively.
- For attic insulation project PRJ-515979, that uses custom assumptions, the implementation contractor used typical meteorological year (TMY3) data to determine the heat loss and the heating degree days (HDD). Navigant calculated an 89 percent realization rate using the Illinois TRM v4.0 algorithm and the TRM HDD value of 5,113 for Chicago. Other project with savings adjustment was PRJ-571490, which Navigant verified a 93 percent realization rate for the boiler controls project using billing analysis.

3.5 Verified Gross Program Impact Results

As shown in Table 3-6 below, the savings adjustments affected the verified savings and resulted in an increase of 960 therms between the ex ante gross savings and the verified gross savings, producing a verified gross realization rate of 100 percent at the program level.

Table 3-6. GPY5 Verified Gross Impact Savings Estimates

Program Category	Ex Ante Gross Savings (Therms)	Verified Gross Realization Rate‡	Verified Gross Savings (Therms)
Direct Install (residential units)	195,618	1.00	195,640
Prescriptive Incentives (common areas)	596,968	1.00	597,964
Custom Incentives (common areas)	12,516	1.00	12,458
GPY5 Total	**805,102**	**1.00**	**806,062**

Source: Program tracking data and Navigant analysis.

The overall key findings from the savings verification analysis include:

- GPY5 MFHES program realized 100 percent of its claimed ex ante savings. Pipe insulation continued to be the major contributor the program savings, with 54 percent of the program verified gross savings in GPY5.
- The GPY5 MFHES Program has experienced a large participation increase in its direct install offering, more so than in its prescriptive offering, compared with GPY4.
- The common area prescriptive and custom rebate program path contributed 76 percent (prescriptive 74 percent, custom two percent) of the verified gross savings. The direct install path contributed 24 percent, which is a significant increase from 11 percent compared with GPY4.
- Adjustments to custom measure savings were based on evaluation review of supplemental billing data and heating loads. The custom savings overall were 100 percent gross realization rate, as the evaluation adjustments balanced across projects with higher verified savings and those with lower savings. Navigant has provided recommendations to improve the custom data collection and savings calculation approach.
- The GPY5 verified total gross savings of 806,062 therms is 89 percent of its planning goal of 906,000 therms.

4. NET IMPACT EVALUATION

Table 4-1 presents the program net savings. Navigant used the Illinois SAG approved deemed NTG values of 0.95 for direct install residential measures and 0.94 for common area measures to calculate the GPY5 net savings. To calculate the verified net savings, Navigant multiplied the verified gross savings by the deemed NTG ratio to estimate 759,655 therms as the verified net savings. The verified net savings is 89 percent of the GPY5 planning goal of 850,876 therms.[13]

Table 4-1. GPY5 Verified Net Impact Savings Estimates

Program Category	Verified Gross Savings (Therms)	Net-to-Gross Ratio†	Verified Net Savings (Therms)
Direct Install (residential units)	195,640	0.95	185,858
Prescriptive Incentives (common areas)	597,964	0.94	562,086
Custom Incentives (common areas)	12,458	0.94	11,711
GPY5 Total	**806,062**	**n/a**	**759,655**

Source: Utility tracking data and Navigant analysis.
† Deemed values.
Source: http://ilsagfiles.org/SAG_files/NTG/2016_NTG_Meetings/Final_Documents/Nicor_Gas_NTG_Summary_GPY1-6_2016-02-29_Final.pdf

The direct install path contributed 24 percent of the total net savings (up from 11 percent in GPY4), and the prescriptive and custom paths contributed 76 percent (a decrease from 89 percent in GPY4). The measures with the most savings were pipe insulation at 54 percent. Other measures savings were space heating equipment (20 percent), programmable thermostats (11 percent), showerheads (10 percent), and other measures (5percent).

[13] Nicor Gas Energy Efficiency Plan, June 2014 - May 2017

5. PROCESS EVALUATION

The GPY5 process evaluation activities for the MFHES Program were limited to interviews with program and implementation contractor staff to verify information about the tracking system. These interviews with program staff were used to determine areas of interest or focus for the evaluation team to learn more about the program participation or operations for future program improvement research.

6. FINDINGS AND RECOMMENDATIONS

This section summarizes the key findings and recommendations.

Program Savings Achievement

Finding 1. Navigant verified net savings of 759,655 therms for the GPY5 MFHES Program, based on the SAG approved NTG ratio of 0.95 for direct install measures and 0.94 for common area measures. The verified net savings is 89 percent of the program net savings goal of 850,876 therms.[14] The direct install path contributed 24 percent of the total net savings (up from 11 percent in GPY4), and the prescriptive and custom paths contributed 76 percent (a decrease from 89 percent in GPY4). The measures with the most savings were pipe insulation (54 percent), space heating equipment (20 percent), programmable thermostats (11 percent), showerheads (10 percent), and the remaining 5 percent from other measures.

Gross Realization Rates

Finding 2. Navigant verified the program level gross savings realization rate was 100 percent. This is based on verified gross savings of 806,062 therms, an increase of 960 therms compared with the ex ante 805,102 therms. Notable adjustments were made to ex ante savings from pipe insulation, condensing boilers, boiler tune-ups, and custom HVAC measures. Details of the measure-level adjustments are presented in Section 3.

Finding 3. Six custom projects were implemented in the GPY5 Multi-Family Program, which involved space heating boiler replacements, domestic hot water (DHW) measures and attic insulation. Using engineering and billing analysis, Navigant verified that two of the six projects had 100 percent gross savings realization rates, two had realization rates above 100 percent after engineering analysis of gas usage and efficiency improvements, and the remaining two projects had less than 100 percent gross realization rate. The overall gross savings realization rate for the custom projects is 100 percent, as the evaluation adjustments balanced across projects with higher and lower verified savings. Details of the findings on the custom projects are highlighted below and in Section 3 (Table 3-5).

Finding 4. Navigant found that a custom project consisting of a domestic hot water (DHW) boiler replacement assumed the baseload usage was exclusively for the purposes of hot water. However, there was no discussion in the project documentation of whether other potential baseload gas equipment, such as the heater for the rooftop pool, contributed to the baseload usage. Navigant's assessment was a 100 percent gross realization rate, but with a recommendation for improving data collection for such projects.

Recommendation 1. For projects that estimate baseload usage for the purposes of quantifying DHW usage, the implementation contractor should include discussion of all potential contributors to baseload usage (e.g., presence of in-unit appliances, gas pool heaters, common area fireplaces, cafeteria) in the supporting project documents. Navigant acknowledges that Nicor Gas and CLEAResult are taking steps to discuss with customers and track pertinent information mentioned during post inspection customer interviews or through other communication channels.

[14] Nicor Gas Energy Efficiency Plan, June 2014 - May 2017

Tracking System Review

Finding 5. Navigant verified that the tracking system adequately tracks the program measure savings inputs and ex ante savings but requires additional update to the hours of use (HOU) inputs for boiler tune up, boiler replacement, and pipe insulation measures. For some projects, the HOU values have not been updated from the previous version of the TRM (2,050 hours for all multi-family building types) to the current versions of the TRM (v4.0 and v5.0) which estimate savings for various multi-family building types.

Recommendation 2. Navigant acknowledges that Nicor Gas and CLEAResult are taking the necessary steps that we recommend to update the GPY6 tracking system HOU assumptions for multi-family building types, as deemed in the approved TRM version for GPY6.

Finding 6. Navigant found that there is limited description in the tracking system about certain input parameters that feed into the ex ante savings calculation for pipe insulation. These include, in addition to HOU, the pipe location, primary pipe use, and thermal regain adjustment input parameters. Other inputs are deemed heating system efficiency values, for example, low-pressure steam boilers.

Recommendation 3. Nicor Gas and CLEAResult should review the tracking system input parameters for pipe insulation. Ensure the tracking thermal regain factors are consistent with the savings claim. Ensure the description of the pipe insulation type, and clearly indicate whether the primary piping use is non-recirculation or year-round recirculation, or a seasonal period of pipe use. Also review the tracking data boiler efficiency values for the steam pipe systems to be consistent with the TRM. Navigant acknowledges that Nicor Gas and CLEAResult are taking the necessary steps that we recommend to collect all types of system configuration and recirculation approaches on applications and to use these inputs to determine GPY6 savings inputs.

Finding 7. Ex ante savings for common area programmable thermostats was 34.27 therms per thermostat. This value was a weighted average estimate from GPY4 participating building types in the Business Energy Efficiency Rebate (BEER) Program, which were different from the MFHES GPY5 participation.

Recommendation 4. If the program adopts the deemed small commercial programmable thermostats assumptions in the TRM for multi-family common areas, the implementation contractor could calculate an average savings value from the TRM building types, assuming an unknown location. Navigant acknowledges that Nicor Gas and CLEAResult are reviewing the savings calculation approach for this measure in GPY6.

Program Participation

Finding 8. The GPY5 MFHES Program has experienced a large participation increase in its direct install offering, more so than in its prescriptive offering, when compared with GPY4. The program realized participation of 247 property owners or decision makers of multi-family properties who completed an assessment. This included 154 participants that received prescriptive or custom incentives, 93 participants that received no-cost direct install products or services, and 44 participants that completed an assessment without installing a measure. A total of 601 projects were completed, representing the installation of 16,150 measures.

Recommendation 5. Navigant recommends research to understand why some Assessment

customers do not receive no-cost direct install measures, if there is a trend in refusal of measures, and the graduation rate of customers from the Assessment to Rebate path within the offering.