



# Income Qualified Programs Impact Evaluation Report

Energy Efficiency Plan: Plan Year 6 Bridge Period (PY6-BP)  
(6/1/2017-12/31/2017)

Presented to  
Nicor Gas Company

**DRAFT**

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## 1. INTRODUCTION

This report presents the results of the impact evaluation of the Nicor Gas Income Qualified programs operated during the PY6 “Bridge Period” (PY6-BP). It presents a summary of the energy impacts for the total programs and broken out by relevant measure and program structure details. The appendix presents the impact analysis methodology. PY6-BP covers June 1, 2017 through December 31, 2017.

## 2. PROGRAM DESCRIPTION

The Income Qualified programs provided energy efficiency upgrades to income qualified customers in the Nicor Gas service territory. The programs are categorized by four program paths: Illinois Home Weatherization Assistance Program (IHWAP), Affordable Housing New Construction (AHNC), Income Qualified (IQ) Retrofit Program and Public Housing Authority (PHA) Efficient Living Program.

The PY6-BP IHWAP Program was jointly implemented by Commonwealth Edison Company (ComEd), Peoples Gas and North Shore Gas (PGL/NSG), and Nicor Gas, with Franklin Energy operating as implementer of the program. The natural gas measures for IHWAP included attic insulation, wall insulation, air leakage reduction, high efficiency furnace, and efficient gas water heater.

The PY6-BP AHNC Program provides incentives for energy efficient construction and major renovation of affordable housing. The program offers technical assistance and incentive funding and serves both single-family and multi-family housing. The program targets income-qualified customers in the Nicor Gas service territory with incomes at or below 80 percent of the Area Median Income. An additional goal of the program is to educate housing developers on cost-effective energy efficient building practices. The program is a coordinated program with ComEd. The program has three participation levels: major renovation, new multi-family, and new single-family. The program provides building guidelines which include requirements for energy efficient air sealing, HVAC equipment, lighting, appliances, windows, and insulation.

The PY6-BP IQ Retrofit Program provides direct install and prescriptive incentives to income qualified Illinois single family and multifamily building owners and managers to implement energy efficiency retrofits, including custom projects. The natural gas measures for the IQ Retrofit program included attic insulation, programmable thermostats, furnaces, storage water heaters, water efficiency measures, and boiler tune-ups.

The PY6-BP PHA program provides incentives for Illinois public housing authorities to implement energy efficiency improvements, including retrofit, new construction, and custom projects. The natural gas measures for the PHA program included boilers and water heaters.

This report focuses solely on the natural gas savings from the programs for Nicor Gas. Savings for other utilities are included in a separate evaluation report delivered to respective utilities.

The programs had 301 participants in PY6-BP and completed 303 projects as shown in the following table.

**Table 2-1. PY6-BP Volumetric Summary, by Program Path**

Participation	IHWAP	AHNC	IQ Retrofit (MF & SF)‡	PHA	Total
Participants*	268	1	28	4	301
Installed Projects†	270	1	28	4	303

Source: Nicor Gas tracking data, Seventhwave project documentation for AHNC, and Navigant team analysis.  
 \* IHWAP and SF participants are defined as unique site addresses; AHNC and MF participants are defined as unique projects, which may include more than one building  
 † Installed Projects are defined as unique vendor project IDs  
 ‡ Income Qualified participants and projects include single family and multifamily facilities.

Table 2-2 summarizes the installed measure quantities that are the basis for verified energy savings.

**Table 2-2. PY6-BP Installed Measure Quantities**

Program Path	Measure	Quantity Unit	Installed Quantity
IHWAP	High Efficiency Furnace	Each	205
	Efficient Gas Water Heater	Each	120
	Air Sealing	Home	170
	Attic Insulation	Square Feet	202,646
	Wall Insulation	Square Feet	128,623
AHNC	Air Sealing	Project	1
	Windows	Square feet	5,167
	Insulation	Square feet	22,698
	Efficient Gas Water Heater	Each	2
	High Efficiency Boiler	Each	2
IQ Retrofit	Attic Insulation	Square Feet	9,918
	Programmable Thermostat	Each	51
	High Efficiency Furnace	Each	11
	Storage Water Heater, >88% TE	Each	277
	Bathroom Aerator	Each	213
	Kitchen Aerator	Each	35
	Showerhead	Each	56
	Space Boiler Tune Up	Each	4
PHA	MF Custom Projects	Projects	4

Source: Nicor Gas tracking data, Seventhwave project documentation for AHNC, and Navigant team analysis.

### 3. PROGRAM SAVINGS SUMMARY

Table 3-1 summarizes the energy savings the Income Qualified programs achieved by path in PY6-BP.

**Table 3-1. PY6-BP Annual Energy Savings Summary**

Program Path	Ex Ante Gross Savings (Therms)	Verified Gross RR*	Verified Gross Savings (Therms)	NTGR†	Verified Net Savings (Therms)
IHWAP	143,438	73%	105,030	1.00	105,030
AHNC	7,034	100%	7,044	1.00	7,044
IQ Retrofit‡	25,735	115%	29,605	1.00	29,605
PHA	33,552	112%	37,532	1.00	37,532
<b>Total</b>	<b>209,759</b>	<b>85%</b>	<b>179,211</b>	<b>1.00</b>	<b>179,211</b>

Source: Nicor Gas tracking data and Navigant team analysis.

\* Realization Rate (RR) is the ratio of verified gross savings to ex ante gross savings, based on evaluation research findings.

† Net-to-Gross Ratio (NTGR) is the ratio of verified net savings to verified gross savings. The NTGR is a deemed value. Source: Table 4-1 of IL-TRM\_Effective\_060116\_v5.0\_Vol\_4\_X-Cutting\_Measures\_and\_Attach.\_021116\_Final.pdf, which is to be found on the Illinois SAG web site: [http://ilsagfiles.org/SAG\\_files/Technical\\_Reference\\_Manual/Version\\_5/Final](http://ilsagfiles.org/SAG_files/Technical_Reference_Manual/Version_5/Final).

‡ Income Qualified include participation and savings from single family and multifamily facilities.

## 4. PROGRAM SAVINGS BY MEASURE

The programs include 20 measures as shown in Table 4.1. The IHWAP measures contributed the most savings. The verified gross realization rate for the programs combined is 85 percent. The factors that contributed the most to this realization rate are adjustment of climate zone data, using updated savings assumptions consistent with the TRM (v5.0) or engineering adjustment of custom inputs. The details are explained in Section 5, Impact Analysis Findings and Recommendations.

**Table 4-1. PY6-BP Annual Energy Savings by Measure**

Program Path	Research Category	Ex Ante Gross Savings (Therms)	Verified Gross RR*	Verified Gross Savings (Therms)	NTGR†	Verified Net Savings (Therms)
IHWAP	High Efficiency Furnace	53,505	64%	34,071	1.00	34,071
	Efficient Gas Water Heater	9,360	120%	11,192	1.00	11,192
	Air Sealing	32,130	76%	24,504	1.00	24,504
	Attic Insulation	26,096	66%	17,274	1.00	17,274
	Wall Insulation	22,347	81%	17,990	1.00	17,990
	<b>IHWAP Total</b>	<b>143,438</b>	<b>73%</b>	<b>105,030</b>	<b>1.00</b>	<b>105,030</b>
AHNC	Windows	1,167	100%	1,167	1.00	1,167
	Air Sealing	1,446	94%	1,354	1.00	1,354
	Insulation	199	100%	199	1.00	199
	High Efficiency Boiler	3,646	102%	3,728	1.00	3,728
	Efficient Gas Water Heater	576	104%	596	1.00	596
	<b>AHNC Total</b>	<b>7,034</b>	<b>100%</b>	<b>7,044</b>	<b>1.00</b>	<b>7,044</b>
IQ Retrofits	Attic Insulation	1,686	47%	797	1.00	797
	Programmable Thermostat	2,066	100%	2,066	1.00	2,066
	High Efficiency Furnace	2,982	100%	2,982	1.00	2,982
	Storage Water Heater, >88% TE	7,728	167%	12,925	1.00	12,925
	Bathroom Aerator	703	32%	228	1.00	228
	Kitchen Aerator	116	133%	154	1.00	154
	Showerhead	1,002	100%	1,002	1.00	1,002
	Space Boiler Tune Up	2,613	100%	2,613	1.00	2,613
	Pipe Fitting	6,838	100%	6,838	1.00	6,838
<b>IQ Retrofit Total</b>	<b>25,735</b>	<b>115%</b>	<b>29,605</b>	<b>1.00</b>	<b>29,605</b>	
PHA	MF Custom Projects	33,552	112%	37,532	1.00	37,532
	<b>PHA Total</b>	<b>33,552</b>	<b>112%</b>	<b>37,532</b>	<b>1.00</b>	<b>37,532</b>
<b>Income Qualified Total</b>		<b>209,759</b>	<b>85%</b>	<b>179,211</b>	<b>1.00</b>	<b>179,211</b>

Source: Nicor Gas tracking data, Seventhwave project documentation for AHNC, and Navigant team analysis.

\* Realization Rate (RR) is the ratio of verified gross savings to ex ante gross savings, based on evaluation research findings.

† Net-to-Gross Ratio (NTGR) is the ratio of verified net savings to verified gross savings. The NTGR is a deemed value. Source: Table 4-1 of IL-TRM\_Effective\_060116\_v5.0\_Vol\_4\_X-Cutting\_Measures\_and\_Attach\_021116\_Final.pdf, which is to be found on the Illinois SAG web site: [http://ilsagfiles.org/SAG\\_files/Technical\\_Reference\\_Manual/Version\\_5/Final](http://ilsagfiles.org/SAG_files/Technical_Reference_Manual/Version_5/Final).

## 5. IMPACT ANALYSIS FINDINGS AND RECOMMENDATIONS

### Impact Parameter Estimates

Table 5-1 shows the unit therm savings and realization rate findings by measure from our review. The realization rate is the ratio of the verified savings to the ex ante savings. Following the table, we provide findings and recommendations, including discussion of measures with realization rates above or below 100 percent. Appendix 1 provides a description of the impact analysis methodology.

**Table 5-1. Verified Gross Savings Parameters**

Program Path	Measure	Unit Basis	Ex Ante Gross (therms/unit)	Verified Gross (therms/unit)	RR	Data Source(s)
IHWAP	High Efficiency Furnace, >95%	Each	261	Varies	64%	IL TRM, v5.0*, Section 5.3.7 and PTD†
	Efficient Gas Water Heater	Each	78	Varies	120%	IL TRM v5.0*, Section 5.4.2 and PTD†
	Air Sealing	Home	189	Varies	76%	IL TRM v5.0*, Section 5.6.1 and PTD†
	Attic Insulation	Square Feet	0.72	Varies	66%	IL TRM v5.0*, Section 5.6.4 and PTD†
	Wall Insulation	Square Feet	0.34	Varies	81%	IL TRM v5.0*, Section 5.6.4 and PTD†
AHNC	Windows	Square Feet	0.23	0.23	100%	IL TRM v5.0*, Section 5.6.4, Seventhwave project documentation‡, Navigant project file review
	Air Sealing	Project	1,445.65	1,354.04	94%	IL TRM v5.0 Section 5.6.1, Seventhwave project documentation‡, Navigant project file review
	Insulation	Square Feet	0.01	0.01	100%	IL TRM v5.0 Section 5.6.4, Seventhwave project documentation‡, Navigant project file review
	High Efficiency Boiler	Boiler	1,823.02	1,864.03	102%	IL TRM v5.0 Section 4.4.10, Seventhwave project documentation‡, Navigant project file review
	Water Heating	Water Heater	287.93	298.08	104%	IL TRM v5.0 Section 4.3.7, Seventhwave project documentation‡, Navigant project file review
IQ Retrofits	Attic Insulation	Square Feet	0.17	Varies	47%	IL TRM v5.0*, Section 5.6.4 and PTD†
	Programmable Thermostat	Each	40.5	40.5	100%	IL TRM v5.0*, Section 5.3.11
	High Efficiency Furnace	Each	271.1	271.1	100%	IL TRM v5.0*, Section 4.4.11
	Storage Water Heater, >88% TE	Gallon	27.9	46.66	167%	IL TRM v5.0*, Section 5.4.2
	Bathroom Aerator	Each	3.3	1.07	32%	IL TRM v5.0*, Section 5.4.4



Program Path	Measure	Unit Basis	Ex Ante Gross (therms/unit)	Verified Gross (therms/unit)	RR	Data Source(s)
	Kitchen Aerator	Each	3.3	4.4	133%	IL TRM v5.0*, Section 5.4.4
	Showerhead	Each	17.89	17.89	100%	IL TRM v5.0*, Section 5.4.5
	Space Boiler Tune Up	Each	Vary	Verified as acceptable	100%	IL TRM v5.0 Section 4.4.2
	Pipe Fitting	Each	Vary	Verified as acceptable	100%	IL TRM v5.0 Section 4.4.14
PHA	MF Custom	Project	Vary	Vary	112%	IL TRM v5.0*, PTD, Navigant project file review

\* State of Illinois Technical Reference Manual version 5.0 from <http://www.ilsag.info/technical-reference-manual.html>.

† Program Tracking Data (PTD) provided by Nicor Gas, extract dated January 30, 2018.

‡ Seventhwave project documentation provided by ComEd, extract dated February 8, 2018

## IHWAP Findings and Recommendations

### Tracking Data Reported Savings

The implementation contractor tracked all necessary inputs to calculate savings using IL TRM algorithms listed in Table 5-1 for each project. However, the implementation contractor reported ex ante savings using an average for each measure based on previous year results from similar measures. For high efficiency furnace, efficient gas water heater, and air sealing, reported savings was an average per project. For attic and wall insulation, reported savings was an average per square foot. The cited document for these averages was the ADM Associates, Inc. draft report “Evaluation of Low Income Residential Retrofit Program, June 2015 through May 2016” prepared for IL DCEO. Navigant was unable to replicate the average savings based on results shown in this draft report.

**Recommendation 1.** Navigant recommends the implementation contractor calculate unique ex ante savings for each project based on gathered project data and appropriate IL TRM algorithms listed in Table 5-1.

### Climate Zone

Navigant verified the reported climate zone for each project using the project zip code. Navigant found discrepancies between tracked climate zone and verified climate zone for one percent of projects. This resulted in differences between tracked and verified values for heating degree days and gas furnace heating load.

**Recommendation 2.** Navigant recommends the implementation contractor ensure that each project climate zone is accurately tracked to obtain accurate values of heating degree days and gas furnace heating load.

## AHNC Findings and Recommendations

### *Air Sealing*

The realization rate for air sealing is 94 percent. The ex ante savings calculations used results from a specific field study to convert infiltration at 75 pascals to infiltration at 50 pascals, whereas Navigant used a standard conversion formula:

$$CFM50 = CFM75 * \frac{50 CFM^{0.65}}{75 CFM} = CFM75 * 0.768$$

**Recommendation 3.** Navigant recommends using a standard conversion formula to convert infiltration at 75 pascals to infiltration at 50 pascals.

### *High Efficiency Boilers*

The ex ante savings calculations used the boiler output capacity instead of the input capacity to calculate savings. Navigant used the boiler input capacity which resulted in a realization rate of 102 percent.

**Recommendation 4.** Navigant recommends carefully reviewing product documentation, specification sheets, and the TRM to determine baseline and efficient product specifications.

### *Water Heating*

The realization rate for water heating is 104 percent. The ex ante calculations multiplied the input rating and tank volume by two to calculate savings. However, the savings for two separate water heaters is not the same as the savings for one water heater that is twice the size. Navigant calculated the savings for one water heater and then multiplied the savings by two to account for two water heaters.

**Recommendation 5.** Navigant recommends calculating savings for each water heater separately.

## IQ Retrofit Findings and Recommendations

### *Single Family Attic Insulation*

The realization rate for attic insulation is 47 percent. The ex ante savings calculations used pre-installation R value of five for all four projects. However, the tracking data lists five for only one of the projects and pre-installation values of 15 and 19 for the other three. Navigant used pre-installation R values shown in the tracking data to calculate verified energy savings.

**Recommendation 6.** Navigant recommends establishing quality control procedures to make sure pre-installation R values of insulation correspond to ex ante savings calculations.

### *Multifamily*

The implementation contractor tracked all necessary inputs to calculate custom savings but used IL TRM algorithms listed in Table 5-1 for savings calculation. The ex ante savings assumed average per unit savings of 3.3 therms for faucet aerators. Navigant calculated the savings separately for bathroom and kitchen aerators based on the TRM and tracking data. For storage gas water heater, Navigant calculated a 167 percent gross realization rate based on the TRM and tracking input of 96 percent thermal efficiency.

**Recommendation 7.** Whenever the tracking savings uses supplemental assumptions other than those provided in the tracking system or that differ from the TRM, Navigant recommends that the implementation contractor include a note explaining why such assumptions were used.

## PHA Findings and Recommendations

### Custom Projects

The realization rate for custom projects is 112 percent, which results from reviewing the four PHA projects that were received in the PY6-BP.

The effective useful life (EUL) value of the PHA program is 15.6 years. This value is a weighted average, by verified energy savings, accounting for the various measures involved in the projects. The details of this are provided in Table 5-2.

**Table 5-2. EUL Details for the PHA Program**

Project ID	Measure Description	Verified Gross Energy Savings (Therms)	Effective Useful Life (Years)	Source
PHA-1	Space Heating Boilers	17,281	20	IL TRM v5.0*, Section 4.4.10
PHA-1	Central Water Heaters	1,699	15	IL TRM v5.0*, Section 4.3.1
PHA-1	Boiler Reset Controls	7,229	20	IL TRM v5.0*, Section 4.4.4
PHA-2	In-Unit Water Heaters	1,136	13	IL TRM v5.0*, Section 5.4.2
PHA-3	In-Unit Water Heaters	422	13	IL TRM v5.0*, Section 5.4.2
PHA-4	Air Conditioner Covers	9,765	5	IL TRM v6.0†, Section 4.4.38
<b>PHA Total</b>		<b>37,532</b>	<b>15.6</b>	

\* State of Illinois Technical Reference Manual version 5.0 from <http://www.ilsag.info/technical-reference-manual.html>.

† This measure was not included in the IL TRM until version 6.0. State of Illinois Technical Reference Manual version 6.0 from <http://www.ilsag.info/technical-reference-manual.html>.

The PHA Program project documentation provided in the project files included the pre-application, pre-approval letter, and invoice. In some cases, the equipment model numbers were identified and others were not provided. The ex ante calculation was not provided or explained. The verified savings are based on tracking data, project documentation, and the IL TRM v5.0. Navigant used engineering judgement and the IL TRM to supplement the project documentation and calculated the verified energy savings based on IL TRM algorithms. The verified gross savings realization rate was 112 percent.

**Recommendation 8.** Navigant recommends the project documentation include at a minimum: the final application, invoice with relevant equipment information (e.g., manufacturer and model numbers), calculation file, any pre- and post-inspection documents, and any other documents that may help explain the ex ante savings estimate.

The “MeasureNotes” field in the tracking data provided the description of project and PHA measures installed. However, the descriptions did not match exactly the findings from project documentation, details of which are shown in Table 5-3. This finding did not affect the savings realization rates of the projects.

**Recommendation 9.** Review the tracking data for accuracy and consistency with project documentation, especially custom projects documentation.

**Table 5-3. PHA Project Descriptions**

Project ID	MeasureNotes Field	Verified Project Description
PHA-1	Cook County Golden Towers - Boiler Replacements & Boiler Reset Controls	HACC* Golden Tower - Boiler Replacements, Boiler Reset Controls, and Water Heater Replacements
PHA-2	Housing Authority of Cook County - AC Covers	HACC* Mackler Homes - Water Heater Replacement
PHA-3	Cook County Chicago Heights-Mackler Homes - Residential Water Heaters	HACC* Wheeling Scattered Sites - Water Heater Replacement
PHA-4	Cook County Wheeling Scattered Sites - Residential Water Heaters	HACC* Various Sites - AC Covers

\* "HACC" refers to Housing Authority of Cook County

## 6. APPENDIX 1. IMPACT ANALYSIS METHODOLOGY

Navigant followed algorithms outlined in the IL TRMs v5.0 and v6.0<sup>1</sup> to calculate verified gross savings for the Income Qualified programs. The evaluation team verified that these algorithms and appropriate deemed input parameters were correctly applied and validated custom parameters that were used. Navigant calculated verified net savings by multiplying verified gross savings by a NTGR of 1.00 which is deemed in the IL TRM v5.0.

### AHNC Methodology

Navigant completed an in-depth project documentation review to assess the engineering methods, parameters, and assumptions used to generate all ex ante impact estimates. To support this review, the implementation contractor provided project documentation in electronic format. Documentation included savings calculators, program forms and applications; architectural, landscape, mechanical, and plumbing drawings; and appliance, lighting, HVAC, and window specifications. The implementer also provided photos and reports from site visits and testing results. The evaluation team analyzed all documentation and verified that savings and measure counts reported in the project savings calculators were consistent with the provided project documentation and program tracking data.

### PHA Methodology

Navigant conducted file reviews of the PHA projects to verify the program's energy savings. The documentation did not contain calculations or clear explanations for the ex ante savings values. Navigant used engineering judgement and the IL TRM to supplement the project documentation and calculated the verified energy savings based on IL TRM algorithms.

## 7. APPENDIX 2. TOTAL RESOURCE COST DETAIL

Table 7-1, the Total Resource Cost (TRC) variable table, only includes cost-effectiveness analysis inputs available at the time of finalizing the PY6-BP Income Qualified 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 PY6-BP savings and program data, are subject to change and are not final.

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<sup>1</sup> IL TRM v6.0 was used for the Air Conditioner Cover measure, which is not in IL TRM v5.0.

**Table 7-1. Total Resource Cost Savings Summary for Nicor Gas**

Measure	Units	Quantity	Effective Useful Life (Years)	Ex Ante Gross Savings (Therms)	Verified Gross Savings (Therms)	Verified Net Savings (Therms)
High Efficiency Furnace	Each	205	20	53,505	34,071	34,071
Efficient Gas Water Heater	Each	120	13	9,360	11,192	11,192
Air Sealing	Home	170	15	32,130	24,504	24,504
Attic Insulation	Square Feet	202,646	25	26,096	17,274	17,274
Wall Insulation	Square Feet	128,623	25	22,347	17,990	17,990
Windows	Square Feet	5,167	25	1,167	1,167	1,167
Air Sealing	Project	1	15	1,446	1,354	1,354
Insulation	Square Feet	22,698	25	199	199	199
High Efficiency Boiler	Boiler	2	20	3,646	3,728	3,728
Water Heating	Water heater	2	15	576	596	596
Attic Insulation	Square Feet	9,918	25	1,686	797	797
Programmable Thermostat	Each	51	5	2,066	2,066	2,066
High Efficiency Furnace	Each	11	20	2,982	2,982	2,982
Storage Water Heater, >88% TE	Gallons	277	13	7,728	12,925	12,925
Bathroom Aerator	Each	213	9	703	228	228
Kitchen Aerator	Each	35	9	116	154	154
Showerhead	Each	56	10	1,002	1,002	1,002
Boiler Tune Up	Each	4	15	2,613	2,613	2,613
Pipe Fitting	Each	17	3	6,838	6,838	6,838
MF Custom	Project	4	15.6	33,552	37,532	37,532

Source: Nicor Gas tracking data, Seventhwave project documentation for AHNC, and Navigant team analysis.