



**Residential Program  
Evaluation Report  
Home Energy Rebates Program**

**FINAL**

**Energy Efficiency Plan:  
Gas Plan Year 4  
(6/1/2014-5/31/2015)**

**Presented to  
Peoples Gas and North Shore Gas**

**January 29, 2016**

Prepared by:

**Crystal Berry**                      **Katherine Wolf**  
**Navigant Consulting, Inc.**      **Navigant Consulting, Inc.**

[www.navigant.com](http://www.navigant.com)



**Submitted to:**

Peoples Gas  
North Shore Gas  
200 East Randolph Street  
Chicago, IL 60601

**Submitted by:**

Navigant Consulting, Inc.  
30 S. Wacker Drive, Suite 3100  
Chicago, IL 60606

**Contact:**

Randy Gunn, Managing Director  
312.583.5714  
Randy.Gunn@Navigant.com

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

Robert Neumann, Associate Director  
312.583.2176  
rob.neumann@navigant.com

Disclaimer: This report was prepared by Navigant Consulting, Inc. ("Navigant") for Peoples Gas ("PG") and North Shore Gas ("NSG") based upon information provided by PG and NSG 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**

- E. Executive Summary ..... 1**
  - E.1. Program Savings ..... 1
  - E.2. Program Savings by Measure ..... 2
  - E.3. Program Volumetric Detail ..... 4
  - E.4. Findings and Recommendations ..... 4
- 1 Introduction ..... 6**
  - 1.1 Program Description ..... 6
  - 1.2 Evaluation Objectives ..... 6
- 2 Evaluation Approach ..... 7**
  - 2.1 Overview of Data Collection Activities ..... 7
  - 2.2 Verified Savings Parameters ..... 7
    - 2.2.1 Verified Gross Program Savings Analysis Approach ..... 7
    - 2.2.2 Verified Net Program Savings Analysis Approach ..... 8
  - 2.3 Process Evaluation ..... 8
- 3 Gross Impact Evaluation ..... 9**
  - 3.1 Program Tracking Data Review ..... 9
  - 3.2 Program Volumetric Findings ..... 9
  - 3.3 Gross Program Impact Parameter Estimates ..... 11
  - 3.4 Verified Gross Program Impact Results ..... 13
- 4 Net Impact Evaluation ..... 16**
- 5 Process Evaluation ..... 18**
- 6 Findings and Recommendations ..... 19**

**List of Figures and Tables**

**Figures**

Figure 3-1. Peoples Gas: Savings Achieved by Measure Type ..... 10  
 Figure 3-2. North Shore Gas: Savings Achieved by Measure Type ..... 11

**Tables**

Table E-1. GPY4 Peoples Gas Home Energy Rebates Program Natural Gas Savings..... 1  
 Table E-2. GPY4 North Shore Gas Home Energy Rebates Program Natural Gas Savings..... 1  
 Table E-3. GPY4 Peoples Gas Home Energy Rebates Program Natural Gas Savings..... 2  
 Table E-4. GPY4 North Shore Gas Home Energy Rebates Program Natural Gas Savings..... 3  
 Table E-5. GPY4 Peoples Gas Home Energy Rebates Program Primary Participation Detail ..... 4  
 Table E-6. GPY4 North Shore Gas Home Energy Rebates Program Primary Participation Detail ..... 4

Table 2-1. Primary Data Collection Activities..... 7  
 Table 2-2. Additional Resources ..... 7  
 Table 2-3. GPY4 Verified Gross Savings Parameter Data Sources ..... 7  
 Table 3-1. GPY4 Peoples Gas Home Energy Rebates Program Primary Participation Detail..... 9  
 Table 3-2. GPY4 North Shore Gas Home Energy Rebates Program Primary Participation Detail..... 10  
 Table 3-3. GPY4 Home Energy Rebates Program Ex Ante and Verified Gross Savings Parameters ..... 12  
 Table 3-4. GPY4 Peoples Gas Home Energy Rebates Program Impact Results ..... 14  
 Table 3-5. GPY4 North Shore Gas Home Energy Rebates Program Impact Results ..... 14  
 Table 4-1. GPY4 Peoples Gas Home Energy Rebates Program Natural Gas Savings ..... 16  
 Table 4-2. GPY4 North Shore Gas Home Energy Rebates Program Natural Gas Savings ..... 17

## E. Executive Summary

This report presents a summary of the findings and results from the impact evaluation of the GPY4<sup>1</sup> Home Energy Rebates Program. Under the Home Energy Rebates Program cash incentives were offered to encourage Peoples Gas and North Shore Gas customers to purchase higher-efficiency water and space-heating equipment, as well as weatherization measures such as attic insulation and air sealing.

### E.1. Program Savings

Table E-1 summarizes the natural gas savings from the GPY4 Peoples Gas (PG) Home Energy Rebates Program.

**Table E-1. GPY4 Peoples Gas Home Energy Rebates Program Natural Gas Savings**

Program/Path	Ex Ante Gross Savings <sup>2</sup> (Therms)	Ex Ante Net Savings <sup>3</sup> (Therms)	Verified Gross RR <sup>4</sup>	Verified Gross Savings (Therms)	NTGR <sup>5</sup>	Verified Net Savings <sup>6</sup> (Therms)
Home Energy Rebates	579,477	475,592	1.01	584,679	0.82	479,436

Source: Evaluation analysis of GPY4 program tracking data (September 28, 2015 data extract) and Illinois Statewide Technical Reference Manuals.<sup>7</sup>

Table E-2 summarizes the natural gas savings from the GPY4 North Shore Gas (NSG) Home Energy Rebates Program.

**Table E-2. GPY4 North Shore Gas Home Energy Rebates Program Natural Gas Savings**

Program/Path	Ex Ante Gross Savings (Therms)	Ex Ante Net Savings (Therms)	Verified Gross RR	Verified Gross Savings (Therms)	NTGR	Verified Net Savings (Therms)
Home Energy Rebates	316,873	253,403	1.00	317,262	0.80	253,809

Source: Evaluation analysis of GPY4 program tracking data (September 28, 2015 data extract) and Illinois Statewide Technical Reference Manuals.

<sup>1</sup> The GPY4 program year began June 1, 2014 and ended May 31, 2015.

<sup>2</sup> The term “Ex Ante” refers to the forecasted savings reported by the Program Administrator that have not been independently verified through evaluation. Savings that have been independently verified by the Evaluation Contractor are referred to as “Verified”.

<sup>3</sup> GPY4 Ex Ante Net = (GPY4 Ex Ante Gross \* GPY3 Verified Gross RR) \* GPY4 Deemed NTGR

<sup>4</sup> Verified Gross Realization Rate (RR) = Verified Gross Savings/Ex Ante Gross Savings.

Verified Gross Savings = RR \* Ex Ante Gross Savings

<sup>5</sup> The Net-to-Gross Ratio (NTGR) used for calculating verified net savings is deemed prospectively through a consensus process managed by the Illinois Energy Efficiency Stakeholders Advisory Group (SAG). Deemed NTGRs (as well historical verified gross Realization Rates) are available at:

[http://ilsagfiles.org/SAG\\_files/NTG/2015\\_NTG\\_Meetings/Final\\_2015\\_Documents/Peoples\\_Gas\\_and\\_North\\_Shore\\_Gas\\_NTG\\_Summary\\_GPY1-5\\_2015-03-01\\_Final.pdf](http://ilsagfiles.org/SAG_files/NTG/2015_NTG_Meetings/Final_2015_Documents/Peoples_Gas_and_North_Shore_Gas_NTG_Summary_GPY1-5_2015-03-01_Final.pdf)

<sup>6</sup> Verified Net Savings = NTGR \* Verified Gross Savings

<sup>7</sup> Illinois Statewide Technical Reference Manual for Energy Efficiency (TRM).

Illinois\_Statewide\_TRM\_Effective\_060114\_Version\_3.0\_022414\_Clean.pdf;

Illinois\_Statewide\_TRM\_Effective\_060115\_Final\_02-24-15\_Clean.pdf (Version 4.0 for measure errata corrections).

Available at the Illinois Commerce Commission (ICC): <http://www.icc.illinois.gov/electricity/TRM.aspx>

## E.2 Program Savings by Measure

Table E-3 summarizes the natural gas savings from the GPY4 Peoples Gas Home Energy Rebates Program by measure.

**Table E-3. GPY4 Peoples Gas Home Energy Rebates Program Natural Gas Savings**

Measure	Ex Ante Gross Savings (Therms)	Ex Ante Net Savings (Therms)	Verified Gross RR	Verified Gross Savings (Therms)	NTGR	Verified Net Savings (Therms)
Air Sealing	73,466	60,141	1.00	73,466	0.82	60,242
Attic Insulation	63,126	51,764	1.00	63,126	0.82	51,764
Boiler – DHW Two-in-One	1,078	880	1.00	1,078	0.82	884
Boiler – Hot Water	20,863	17,093	1.00	20,863	0.82	17,107
Boiler – Steam	2,004	1,644	1.00	2,004	0.82	1,643
Duct Sealing	10,046	8,334	1.00	10,046	0.82	8,238
Furnace	392,924	322,646	1.00	392,934	0.82	322,198
Indirect Water Heater	253	208	1.00	253	0.82	208
Pipe Insulation – Hot Water Boiler	166	136	14.48	2,401	0.82	1,969
Pipe Insulation – Steam Boiler	617	505	7.12	4,389	0.82	3,599
Programmable Thermostat	12,108	9,924	1.00	12,108	0.82	9,929
Tankless Water Heater	2,827	2,318	0.71	2,021	0.82	1,657
<b>Total</b>	<b>579,477</b>	<b>475,592</b>	<b>1.01</b>	<b>584,679</b>	<b>0.82</b>	<b>479,436</b>

Source: Evaluation analysis of GPY4 program tracking data (September 28, 2015 data extract).

Table E-4 summarizes the natural gas savings from the GPY4 North Shore Gas Home Energy Rebates Program by measure.

**Table E-4. GPY4 North Shore Gas Home Energy Rebates Program Natural Gas Savings**

Measure	Ex Ante Gross Savings (Therms)	Ex Ante Net Savings (Therms)	Verified Gross RR	Verified Gross Savings (Therms)	NTGR	Verified Net Savings (Therms)
Air Sealing	4,760	3,801	1.00	4,760	0.80	3,808
Attic Insulation	10,535	8,428	1.00	10,535	0.80	8,428
Boiler – DHW Two-in-One	673	542	1.00	673	0.80	539
Boiler – Hot Water	9,592	7,681	1.00	9,592	0.80	7,674
Duct Sealing	23,457	19,081	1.00	23,457	0.80	18,766
Furnace	260,305	207,830	1.00	260,305	0.80	208,244
Indirect Water Heater	127	101	1.00	127	0.80	101
Pipe Insulation – Hot Water Boiler	20	16	14.48	288	0.80	230
Pipe Insulation – Steam Boiler	98	79	7.12	700	0.80	560
Programmable Thermostat	5,618	4,492	1.00	5,618	0.80	4,494
Tankless Water Heater	1,688	1,352	0.71	1,206	0.80	965
<b>Total</b>	<b>316,873</b>	<b>253,403</b>	<b>1.00</b>	<b>317,262</b>	<b>0.80</b>	<b>253,809</b>

Source: Evaluation analysis of GPY4 program tracking data (September 28, 2015 data extract).

Both pipe insulation measures received realization rates higher than 1.00 because of an error in the ex ante calculations. Additionally, the tankless water heater measure received a realization rate that was less than 1.00 as a result of an error in the ex ante calculations. More information on both of these findings is located in Section 3.

### E.3. Program Volumetric Detail

Table E-5 and Table E-6 below present GPY4 program participation reported by the Program Administrator Franklin Energy Services (FES) for the Peoples Gas and North Shore Gas programs. Detailed volumetric breakdown of the measure type and savings quantity are provided in the program-level analysis in Section 3.

**Table E-5. GPY4 Peoples Gas Home Energy Rebates Program Primary Participation Detail**

Participation	Program Total
Participants	2,533
Total Projects	2,683
Number of Projects/Participant	1.06
Verified Net Therms/Participant	179

Source: Navigant analysis of GPY4 program tracking data (September 28, 2015 data extract).

**Table E-6. GPY4 North Shore Gas Home Energy Rebates Program Primary Participation Detail**

Participation	Program Total
Participants	1,293
Total Projects	1,392
Number of Projects/Participant	1.08
Verified Net Therms/Participant	182

Source: Navigant analysis of GPY4 program tracking data (September 28, 2015 data extract).

### E.4. Findings and Recommendations

The following provides insight into key program findings and recommendations.<sup>8</sup> The GPY4 Peoples Gas Home Energy Rebates Program had 2,533 participants that received 2,683 projects and achieved verified net savings of 479,436 therms, exceeding its net energy savings target of 308,376 therms. The GPY4 North Shore Gas Home Energy Rebates Program had 1,293 participants that received 1,392 projects and achieved verified net savings of 253,809 therms, exceeding its net energy savings target of 95,013 therms.

#### Verified Gross Impacts and Realization Rate.

**Finding 1.** The ex ante and verified gross savings per unit for pipe insulation measures differ significantly. This is a result of a discrepancy in the insulation thickness and pipe circumference assumptions as shown in Section 3.3. The discrepancy results in much higher verified gross savings per unit for both pipe insulation measures.

**Recommendation 1.** Navigant recommends updating the ex ante gross savings calculations to average the circumferences of the most common pipe diameters for hot water boiler pipes to

<sup>8</sup> The Executive Summary presents the most important of the Section 6 Findings and Recommendations. Findings and Recommendations in the Executive Summary are numbered to match Section 6 for consistent reference to individual findings and recommendations. Therefore, gaps in numbering may occur in the Executive Summary.  
Peoples Gas and North Shore Gas Home Energy Rebates GPY4 Evaluation Report – Final



calculate the new circumference values instead of adding them. Using correct insulation thicknesses that correspond to insulation R-values will also be more accurate. Additionally, Navigant recommends using a common steam boiler pipe diameter in the corresponding savings calculations. This will ensure that measure level savings are accurate.

**Finding 2.** The tankless water heater ex ante gross savings per measure are slightly higher than the verified gross savings per measure. The Illinois TRM v3.0 specifies that if a water heater is a tankless unit, the rated efficiency must be multiplied by 0.91. The ex ante calculations do not take this into account.

**Recommendation 2.** Navigant recommends multiplying the tankless water heater rated efficiency by 0.91 in the ex ante gross savings estimates per the Illinois TRM v3.0. This will ensure that measure level savings are accurate.

## 1 Introduction

### 1.1 *Program Description*

Under the Home Energy Rebates Program, cash incentives and education were offered to encourage upgrading of water- and space-heating and weatherization equipment among residential customers of Peoples Gas and North Shore Gas. The Home Energy Rebates Program was designed to conserve natural gas and lower its participants' monthly energy bills. Both rental and owner-occupied dwellings are eligible for rebates. Customers must be active residential customers of Peoples Gas or North Shore Gas in order to receive rebates for gas saving measures. The premises must be used for residential purposes in existing buildings.

The Home Energy Rebates Program promises customers a quickly turned-around rebate to invest in long-term savings through better technology. Rebates are offered for the purchase and installation of high-efficiency furnaces, boilers, attic insulation, programmable thermostats, pipe insulation, water heaters, and duct and air sealing. The dollar amount of the rebate depends on the size and efficiency of the replacement measures. The duct and air sealing measures were added to the program on January 1, 2015. The GPY4 Home Energy Rebates Program ran from June 1, 2014 through May 31, 2015.

### 1.2 *Evaluation Objectives*

The Evaluation Team's main objectives for the GPY4 Home Energy Rebates Program were to determine the program's verified gross savings and verified net savings. Process and net-to-gross evaluation efforts will occur in GPY5 and GPY6, after additional planned program changes are implemented.

## 2 Evaluation Approach

This section provides an overview of the data collection methods, gross and net impact evaluation approaches, and process evaluation approaches that occurred for the GPY4 evaluation.

### 2.1 Overview of Data Collection Activities

The core data collection activities included an engineering analysis of the program data. The full set of data collection activities is shown in the following table.

**Table 2-1. Primary Data Collection Activities**

What	Who	Completions Achieved	When
Program Tracking Database	Participants	Census	September – October 2015
In Depth Interviews	Program Manager/Implementer Staff	1	March 2015

Source: Navigant.

**Table 2-2. Additional Resources**

Reference Source	Author	Application	Gross Impacts	Process
Illinois Statewide Technical Reference Manual for Energy Efficiency Version 3.0	N/A	Engineering Analysis	X	N/A

### 2.2 Verified Savings Parameters

#### 2.2.1 Verified Gross Program Savings Analysis Approach

Navigant estimated the verified per-unit savings for each program measure using impact algorithms and input assumptions as defined by the Illinois TRM for deemed measures<sup>9</sup> and evaluation research for non-deemed measures. Table 2-3 below presents the sources for parameters that were used in verified gross savings analysis, indicating which were examined through GPY4 evaluation research and which were deemed. In GPY4, all measures in the Home Energy Rebates Program were deemed.

**Table 2-3. GPY4 Verified Gross Savings Parameter Data Sources**

Parameter	Data Source	Deemed or Evaluated?
Measure Quantity Installed	Program tracking system	Evaluated
Verified Gross Realization Rate	Program tracking data, TRM, Navigant	Evaluated
Residential HVAC measure savings assumptions	Illinois TRM, version 3.0, section 5.3‡	Deemed
Residential hot water measure savings assumptions	Illinois TRM, version 3.0, section 5.4‡	Deemed
Residential pipe insulation savings assumptions	Illinois TRM, version 3.0, sections 5.3‡	Deemed
Programmable thermostat savings assumptions	Illinois TRM, version 3.0, section 5.3‡	Deemed

Source: Evaluation analysis of programs data and Illinois TRM documents.

‡ Source: State of Illinois Technical Reference Manuals. Integrys MMDB PY4 -052915, produced by Franklin Energy;

<sup>9</sup> Because the Illinois TRM provides multiple options for selecting input assumptions, Franklin Energy Services produces a “Master Measure Database” spreadsheet that documents their approach to compliance with the Illinois TRM. The spreadsheet is Integrys MMDB PY4 -052915, produced by Franklin Energy

### **2.2.2 Verified Net Program Savings Analysis Approach**

The verified net energy savings were calculated by multiplying the Verified Gross Savings estimates by a deemed net-to-gross ratio (NTGR). In GPY4, the NTGR estimates used to calculate the Verified Net Savings were based on past evaluation research and approved through a consensus process managed through the Illinois Energy Efficiency Stakeholders Advisory Group (SAG)<sup>10</sup>. The deemed NTGR for the GPY4 PG and NSG Home Energy Rebates programs are 0.82 and 0.80, respectively.

### **2.3 Process Evaluation**

The process evaluation activities in GPY4 for the programs were limited to interviews with program and implementation contractor staff to verify information about any changes that had been made to the program tracking database or to the measure savings calculations that may have impacted the GPY4 evaluation.

---

<sup>10</sup> Deemed NTGR values are available on the Illinois Energy Efficiency Stakeholders Advisory Group web site. [http://ilsagfiles.org/SAG\\_files/NTG/2015\\_NTG\\_Meetings/Final\\_2015\\_Documents/Peoples\\_Gas\\_and\\_North\\_Shore\\_Gas\\_NTG\\_Summary\\_GPY1-5\\_2015-03-01\\_Final.pdf](http://ilsagfiles.org/SAG_files/NTG/2015_NTG_Meetings/Final_2015_Documents/Peoples_Gas_and_North_Shore_Gas_NTG_Summary_GPY1-5_2015-03-01_Final.pdf)

### 3 Gross Impact Evaluation

The gross impact analysis involved a review of the tracking system and verification of measure savings. The verified savings were calculated by multiplying the quantity of measures installed by the verified measure per unit savings. The programs’ verified gross realization rates were determined by the ratio of the verified savings to the ex ante gross savings.

#### 3.1 Program Tracking Data Review

Franklin Energy provided updated tracking data report links from the previous year to enable Navigant to download the program tracking database for GPY4 impact evaluation.<sup>11</sup> Navigant used the data extracts from the program’s tracking system to verify the program’s GPY4 ex ante inputs, including the measure counts and ex ante savings. In addition to the tracking database, Franklin Energy updated and provided to Navigant a spreadsheet of the measure savings (*Integrays\_Master\_Measure\_Document*)<sup>12</sup> that were derived either from the Illinois TRM (Ver. 3.0) for the deemed measures, or from other engineering estimates for measures not included in the Illinois TRM.

#### 3.2 Program Volumetric Findings

As shown in Table 3-1 and Table 3-2, the Peoples Gas Home Energy Rebates Program reported 2,533 participants in GPY4 and rebated 2,683 projects. This translates to 1.06 projects per participant. The North Shore Gas Home Energy Rebates Program reported 1,293 participants in GPY4 and rebated 1,392 projects. This translates to 1.08 projects per participant.

**Table 3-1. GPY4 Peoples Gas Home Energy Rebates Program Primary Participation Detail**

Participation	Program Total
Participants	2,533
Total Projects	2,683
Number of Projects/Participant	1.06
Verified Net Therms/Participant	179

Source: Navigant analysis of GPY4 program tracking data (September 28, 2015 data extract).

<sup>11</sup> Date for the final data extract was 9/28/2015.

<sup>12</sup> Integrays MMDB PY4 -052915, produced by Franklin Energy.

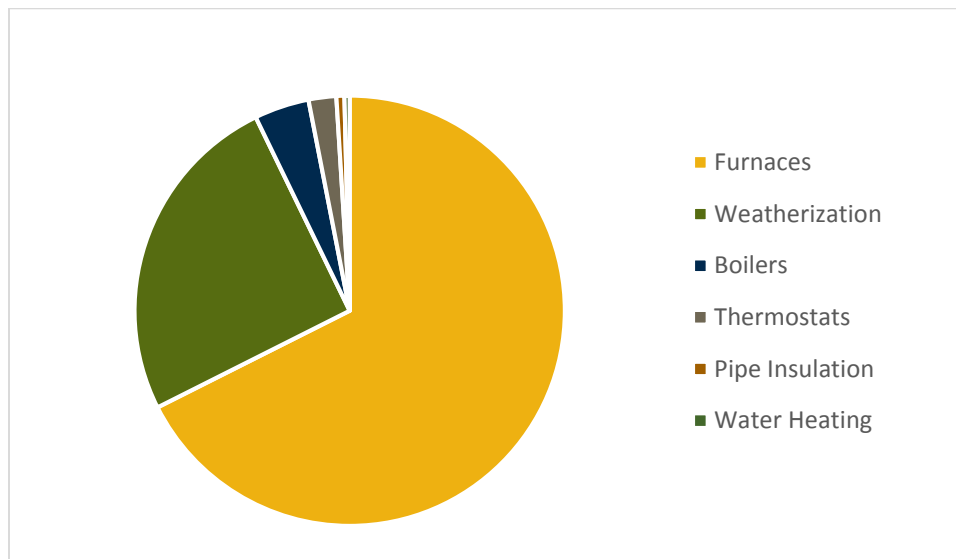
**Table 3-2. GPY4 North Shore Gas Home Energy Rebates Program Primary Participation Detail**

Participation	Program Total
Participants	1,293
Total Projects	1,392
Number of Projects/Participant	1.08
Verified Net Therms/Participant	182

Source: Navigant analysis of GPY4 program tracking data (September 28, 2015 data extract).

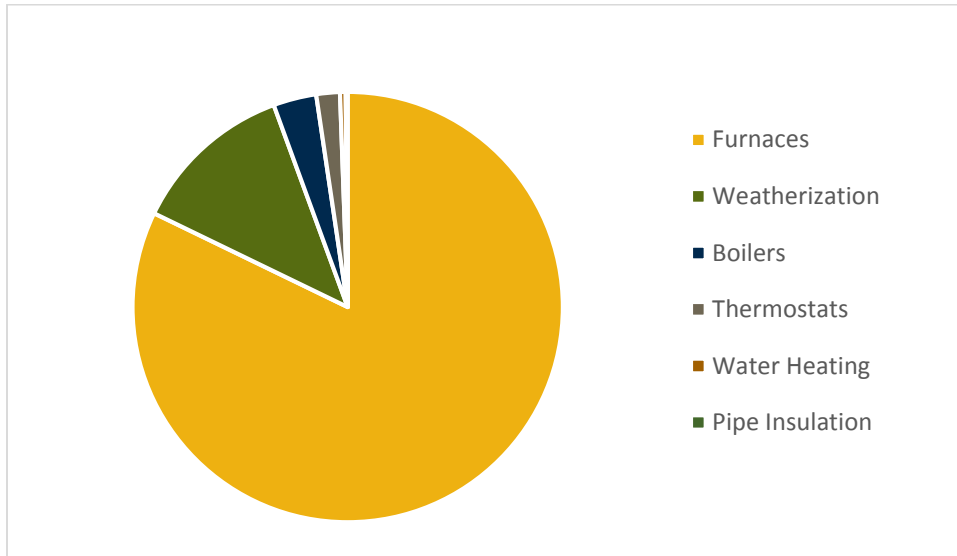
Figure 3-1 and Figure 3-2 disaggregate the measure mix by type. For Peoples Gas overall, furnaces contributed 68 percent of the program savings in GPY4, and weatherization measures contributed 25 percent. For North Shore Gas, furnaces contributed 82 percent of the program savings in GPY4, and weatherization (attic insulation, air sealing, and duct sealing) measures contributed 12 percent.

**Figure 3-1. Peoples Gas: Savings Achieved by Measure Type**



Source: Navigant Analysis

Figure 3-2. North Shore Gas: Savings Achieved by Measure Type



Source: Navigant Analysis

### 3.3 Gross Program Impact Parameter Estimates

As described in Section 2 Navigant estimated the verified per unit savings for each program measure using impact algorithms and input assumptions defined in the Illinois TRM and documentation of TRM compliance provided by Franklin Energy Services. Table 3-3 presents the key parameters and the references used in the verified gross savings calculations.

**Table 3-3. GPY4 Home Energy Rebates Program Ex Ante and Verified Gross Savings Parameters**

Measure	Ex Ante Gross Savings (Therms/Unit)	Verified Gross Savings (Therms/Unit)	Method	Data Source
Air Sealing	Varies	Varies	Deemed	Section 5.6.1 TRM V3.0
Attic Insulation	Varies	Varies	Deemed	Section 5.6.4 TRM V3.0
Boiler – DHW Two-in-One	134.70	134.70	Deemed	Sections 5.3.6 and 5.4.2 TRM V3.0
Boiler – Hot Water (Replace on Burnout)	101.27	101.27	Deemed	
Boiler – Hot Water (Early Replacement)	593.18	593.18	Deemed	Section 5.3.6 TRM V3.0
Boiler - Steam	500.91	500.91	Deemed	
Duct Sealing	Varies	Varies	Deemed	Section 5.3.4 TRM V3.0
Furnace (Replace on Burnout)	169.20	169.20	Deemed	Section 5.3.7 TRM V3.0
Furnace (Early Replacement)	421.73	421.73	Deemed	
Indirect Water Heater	42.19	42.19	Deemed	Section 5.4.2 TRM V3.0
Pipe Insulation – Hot Water Boiler	0.03	0.42	Deemed	Section 5.3.2 TRM V3.0
Pipe Insulation – Steam Boiler	0.28	1.97	Deemed	
Programmable Thermostat	34.89	34.89	Deemed	Section 5.3.11 TRM V3.0
Tankless Water Heater	42.19	30.16	Deemed	Section 5.4.2 TRM V3.0

Source: Navigant analysis of program tracking data and Franklin Energy Services documents. Deemed values are from Illinois TRM V3.0 or V4.0, available at <http://www.ilsag.info/technical-reference-manual.html>.

Key findings include:

1. The ex ante and verified gross savings per unit for hot water boiler pipe insulation differ significantly. This is the result of a discrepancy in the insulation thickness and pipe circumference assumptions used in the ex ante savings calculation, as shown below. The measure level savings for hot water boiler pipe insulation is calculated using the following equation:

$$\Delta Therm = \frac{\left( \left( \frac{1}{R_{exist}} \times C_{exist} \right) - \left( \frac{1}{R_{new}} \times C_{new} \right) \right) \times FLH_{heat} \times L \times \Delta T}{\eta_{Boiler}} / 100,000$$

In the above equation,  $C_{new}$  is the circumference of the hot water boiler pipe including the new insulation. Using a pipe insulation thickness of 0.5 inches for hot water boiler pipe insulation (corresponds to R-3 insulation), and averaging the two most common pipe diameters (0.5 inches and 0.75 inches),  $C_{new}$  can be calculated by the following equation and values, an approach that Navigant agrees with.



$$C_{new} = \left( \left( \frac{0.5 \text{ in} + 0.75 \text{ in}}{2} \right) + 2 \times 0.5 \text{ in} \right) \times \pi \times \frac{1 \text{ ft}}{12 \text{ in}} = 0.425 \text{ ft}$$

The ex ante savings calculation used a pipe insulation thickness of 0.375 inches, which does not correspond to the assumed R-value of 3. Additionally, the ex ante savings calculation did not average the two pipe diameters, but instead added them together, like in the equation below. This results in a  $C_{new}$  value of 0.720 feet.

$$C_{new} = \left( (0.5 \text{ in} + 0.75 \text{ in}) + 2 \times 0.375 \text{ in} \right) \times \pi \times \frac{1 \text{ ft}}{12 \text{ in}} = 0.720 \text{ ft}$$

When the higher  $C_{new}$  value (0.720) is included in the overall hot water boiler pipe insulation savings algorithm, the result is a much lower measure level savings value than when the lower  $C_{new}$  value (0.425) is included in the overall hot water boiler pipe insulation savings algorithm. The difference in the measure level savings values can be seen in Table 3-3 above.

The same averaging error appears in the steam boiler pipe insulation measure savings calculations. However, for steam boiler pipes, 1.5 inches is a more accurate pipe diameter assumption. The ex ante savings calculation assumes a  $C_{new}$  value of 0.850 feet (calculated by adding the pipe circumferences) while the verified gross savings calculation uses a  $C_{new}$  value of 0.654 feet (calculated by using a pipe diameter is 1.5 inches). The measure level savings difference for steam boiler pipe insulation is also shown in Table 3-3 above.

2. The tankless water heater ex ante gross savings per measure are slightly higher than the verified gross savings per measure. The Illinois TRM v3.0 specifies that if a water heater is a tankless unit, the rated efficiency must be multiplied by 0.91. The ex ante calculations do not take this into account.

### 3.4 *Verified Gross Program Impact Results*

As shown in Table 3-4, the GPY4 Peoples Gas Home Energy Rebates Program reported ex ante gross energy savings of 579,477 therms. Evaluation adjustments resulted in verified gross energy savings of 584,679 therms, reflecting the program’s gross realization rate that is 101 percent.

**Table 3-4. GPY4 Peoples Gas Home Energy Rebates Program Impact Results**

Measure Category	Quantity Unit	Verified Measure Quantity	Ex Ante Gross Savings (therms)	Verified Gross Realization Rate	Verified Gross Savings (therms)
Air Sealing	50 CFM	215,425	73,466	1.00	73,466
Attic Insulation	Square Foot	295,700	63,126	1.00	63,126
Boiler – DHW Two-in-One	Each	8	1,078	1.00	1,078
Boiler – Hot Water (Replace on Burnout)	Each	1	101	1.00	101
Boiler – Hot Water (Early Replacement)	Each	35	20,761	1.00	20,761
Boiler - Steam	Each	4	2,004	1.00	2,004
Duct Sealing	25 CFM	6,748	10,046	1.00	10,046
Furnace (Replace on Burnout)	Each	1,567	265,139	1.00	265,139
Furnace (Early Replacement)	Each	303	127,785	1.00	127,785
Indirect Water Heater	Each	6	253	1.00	253
Pipe Insulation – Hot Water Boiler	Linear Foot	5,779	166	14.48	2,401
Pipe Insulation – Steam Boiler	Linear Foot	2,225	617	7.12	4,389
Programmable Thermostat	Each	347	12,108	1.00	12,108
Tankless Water Heater	Each	67	2,827	0.71	2,021
<b>PG Home Energy Rebates Total</b>			<b>579,477</b>	<b>1.01</b>	<b>584,679</b>

Sources: Program tracking data and Navigant analysis

As shown in Table 3-5, the GPY4 North Shore Gas Home Energy Rebates Program reported ex ante gross energy savings of 316,873 therms. Evaluation adjustments resulted in verified gross energy savings of 317,262 therms, reflecting the program’s gross realization rate that is very close to 100%.

**Table 3-5. GPY4 North Shore Gas Home Energy Rebates Program Impact Results**

Measure Category	Quantity Unit	Verified Measure Quantity	Ex Ante Gross Savings (therms)	Verified Gross Realization Rate	Verified Gross Savings (therms)
Air Sealing	50 CFM	22,188	4,760	1.00	4,760
Attic Insulation	Square Foot	63,578	10,535	1.00	10,535
Boiler – DHW Two-in-One	Each	5	673	1.00	673
Boiler – Hot Water (Replace on Burnout)	Each	1	101	1.00	101
Boiler – Hot Water (Early Replacement)	Each	16	9,491	1.00	9,491
Duct Sealing	25 CFM	9,782	23,457	1.00	23,457
Furnace (Replace on Burnout)	Each	853	144,329	1.00	144,329
Furnace (Early Replacement)	Each	275	115,976	1.00	115,976
Indirect Water Heater	Each	3	127	1.00	127
Pipe Insulation – Hot Water Boiler	Linear Foot	693	20	14.48	288
Pipe Insulation – Steam Boiler	Linear Foot	355	98	7.12	700
Programmable Thermostat	Each	161	5,618	1.00	5,618
Tankless Water Heater	Each	40	1,688	0.71	1,206
<b>NSG Home Energy Rebates Total</b>			<b>316,873</b>	<b>1.00</b>	<b>317,262</b>

Source: Program tracking data and Navigant analysis

Key findings include:

1. As noted in Section 3.3 above, the pipe insulation measures both received realization rates higher than one as a result of the per unit savings adjustments.
2. As noted in Section 3.3 above, the tankless water heater measure received a realization rate less than one as a result of the per unit savings adjustment.

## 4 Net Impact Evaluation

The verified net energy savings were calculated by multiplying the verified gross savings estimates by the net-to-gross ratio. As noted in Section 2, the NTGR used to calculate the net verified savings for the GPY4 Home Energy Rebates Program was deemed through a consensus process managed by the Illinois SAG.

Table 4-1 summarizes the natural gas savings from the GPY4 Peoples Gas Home Energy Rebates Program by measure.

**Table 4-1. GPY4 Peoples Gas Home Energy Rebates Program Natural Gas Savings**

Measure	Ex Ante Gross Savings (Therms)	Ex Ante Net Savings (Therms)	Verified Gross RR	Verified Gross Savings (Therms)	NTGR	Verified Net Savings (Therms)
Air Sealing	73,466	60,141	1.00	73,466	0.82	60,242
Attic Insulation	63,126	51,746	1.00	63,126	0.82	51,764
Boiler – DHW Two-in-One	1,078	880	1.00	1,078	0.82	884
Boiler – Hot Water (Replace on Burnout)	101	83	1.00	101	0.82	83
Boiler – Hot Water (Early Replacement)	20,761	17,010	1.00	20,761	0.82	17,024
Boiler - Steam	2,004	1,644	1.00	2,004	0.82	1,643
Duct Sealing	10,046	8,334	1.00	10,046	0.82	8,238
Furnace (Replace on Burnout)	265,139	217,808	1.00	265,139	0.82	217,414
Furnace (Early Replacement)	127,785	104,838	1.00	127,785	0.82	104,784
Indirect Water Heater	253	208	1.00	253	0.82	208
Pipe Insulation – Hot Water Boiler	166	136	14.48	2,401	0.82	1,969
Pipe Insulation – Steam Boiler	617	505	7.12	4,389	0.82	3,599
Programmable Thermostat	12,108	9,924	1.00	12,108	0.82	9,929
Tankless Water Heater	2,827	2,318	0.71	2,021	0.82	1,657
<b>Total</b>	<b>579,477</b>	<b>475,592</b>	<b>1.01</b>	<b>584,679</b>	<b>0.82</b>	<b>479,436</b>

Source: Evaluation analysis of GPY4 program tracking data (September 28, 2015 data extract).

Table 4-2 summarizes the natural gas savings from the GPY4 North Shore Gas Home Energy Rebates Program by measure.

**Table 4-2. GPY4 North Shore Gas Home Energy Rebates Program Natural Gas Savings**

Measure	Ex Ante Gross Savings (Therms)	Ex Ante Net Savings (Therms)	Verified Gross RR	Verified Gross Savings (Therms)	NTGR	Verified Net Savings (Therms)
Air Sealing	4,760	3,801	1.00	4,760	0.80	3,808
Attic Insulation	10,535	8,428	1.00	10,535	0.80	8,428
Boiler – DHW Two-in-One	673	542	1.00	673	0.80	539
Boiler – Hot Water (Replace on Burnout)	101	81	1.00	101	0.80	81
Boiler – Hot Water (Early Replacement)	9,491	7,600	1.00	9,491	0.80	7,593
Duct Sealing	23,457	19,081	1.00	23,457	0.80	18,766
Furnace (Replace on Burnout)	144,329	115,155	1.00	144,329	0.80	115,463
Furnace (Early Replacement)	115,976	92,675	1.00	115,976	0.80	92,781
Indirect Water Heater	127	101	1.00	127	0.80	101
Pipe Insulation – Hot Water Boiler	20	16	14.48	288	0.80	230
Pipe Insulation – Steam Boiler	98	79	7.12	700	0.80	560
Programmable Thermostat	5,618	4,492	1.00	5,618	0.80	4,494
Tankless Water Heater	1,688	1,352	0.71	1,206	0.80	965
<b>Total</b>	<b>316,873</b>	<b>253,403</b>	<b>1.00</b>	<b>317,262</b>	<b>0.80</b>	<b>253,809</b>

Source: Evaluation analysis of GPY4 program tracking data (September 28, 2015 data extract).

## 5 Process Evaluation

The GPY4 Home Energy Rebates process evaluation activities for the programs were limited to interviews with program staff and the implementation contractor staff to verify information about changes made to the program tracking database or to the measure savings calculations that may have impacted the GPY4 evaluation. The information gathered through interviews and other communication did not raise concerns by the evaluation team that merited follow-up process research in GPY4. Process and net-to-gross evaluation efforts will occur in GPY5 and GPY6, after additional planned program changes are implemented.

## 6 Findings and Recommendations

This section summarizes the key impact and process findings and recommendations. The GPY4 Peoples Gas Home Energy Rebates Program had 2,533 participants that received 2,683 projects and achieved verified net savings of 479,436 therms, exceeding its net energy savings target of 308,376 therms. The GPY4 North Shore Gas Home Energy Rebates Program had 1,293 participants that received 1,392 projects and achieved verified net savings of 253,809 therms, exceeding its net energy savings target of 95,013 therms.

### Verified Gross Impacts and Realization Rate.

**Finding 1.** The ex ante and verified gross savings per unit for pipe insulation measures differ significantly. This is a result of a discrepancy in the insulation thickness and pipe circumference assumptions as shown in Section 3.3. The discrepancy results in much higher verified gross savings per unit for both pipe insulation measures.

**Recommendation 1.** Navigant recommends updating the ex ante gross savings calculations to average the circumferences of the most common pipe diameters for hot water boiler pipes to calculate the new circumference values instead of adding them. Using correct insulation thicknesses that correspond to insulation R-values will also be more accurate. Additionally, Navigant recommends using a common steam boiler pipe diameter in the corresponding savings calculations. This will ensure that measure level savings are accurate.

**Finding 2.** The tankless water heater ex ante gross savings per measure are slightly higher than the verified gross savings per measure. The Illinois TRM v3.0 specifies that if a water heater is a tankless unit, the rated efficiency must be multiplied by 0.91. The ex ante calculations do not take this into account.

**Recommendation 2.** Navigant recommends multiplying the tankless water heater rated efficiency by 0.91 in the ex ante gross savings estimates per the Illinois TRM v3.0.