



Residential Program Evaluation Report

Home Energy Jumpstart Program

FINAL

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

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

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Correction to January 25, 2017 Final Version

The January 25, 2017 version has been corrected to fix a cut and paste error of wrong values for ex ante gross therms for North Shore Gas. The January 25 version reported ex ante gross therms for Peoples Gas rather than North Shore Gas in Table 4-3. Verified savings, findings, and recommendations were not affected by the error or correction – only Table 4-3. This March 21, 2017 final version should replace the version from January 25, 2017.



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E. EXECUTIVE SUMMARY

This report presents a summary of the findings and recommendations from the impact and process evaluation of the GPY5¹ Home Energy Jumpstart (HEJ) program. The HEJ program is an assessment and direct install program jointly implemented by Commonwealth Edison Company (ComEd) and Peoples Gas and North Shore Gas (PG/NSG) with Franklin Energy Services (Franklin Energy) operating as implementer of the program. This report focuses solely on the natural gas savings from the program. Savings from electric measures are included in a separate evaluation report delivered to ComEd.

The primary objective of this residential direct install program was to secure energy savings through direct installation of low-cost efficiency measures, such as: water efficient showerheads and faucet aerators, pipe insulation and programmable thermostats at eligible single family residences. In addition, the installation teams performed services including programming new thermostats and reprogramming existing thermostats. New to the program in GPY5 was the introduction of co-pay smart thermostats. The secondary objective of this program was to function as the “gateway” for homeowners to participate in other residential programs. HEJ performed a brief assessment of the major retrofit opportunities (e.g., furnace, boiler, air conditioning, insulation, and air sealing) and sought to heighten awareness of the homeowners about available additional efficiency programs offered by ComEd, Peoples Gas and North Shore Gas.

E.1 Program Savings

Table E-1 summarizes the natural gas savings from the GPY5 Peoples Gas Home Energy Jumpstart Program.

Table E-1. GPY5 Peoples Gas Home Energy Jumpstart Program Natural Gas Savings

Program/Path	Ex Ante Gross Savings ² (Therms)	Verified Gross RR ³	Verified Gross Savings (Therms)	NTGR ⁴	Verified Net Savings ⁵ (Therms)
Home Energy Jumpstart	703,493	95%	665,936	0.96	639,298

Source: Evaluation analysis of GPY5 program tracking data (July 19, 2016 data extract) and Illinois Statewide Technical Reference Manuals.⁶

¹ The GPY5 program year began June 1, 2015 and ended May 31, 2016.

² 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”.

³ Verified Gross Realization Rate (RR) = Verified Gross Savings/Ex Ante Gross Savings.

Verified Gross Savings = RR * Ex Ante Gross Savings

⁴ 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 Stakeholder 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

⁵ Verified Net Savings = NTGR * Verified Gross Savings

⁶ Illinois Statewide Technical Reference Manual for Energy Efficiency (TRM). The effective TRM for GPY5 is Version 4.0, available from the Illinois Energy Efficiency Stakeholder Advisory Group web site: http://www.ilsag.info/il_trm_version_4.html. The list of TRM Version 4.0 errata in effect for GPY5 is provided in TRM Version 5.0, available at: http://www.ilsag.info/il_trm_version_5.html

Table E-2 summarizes the natural gas savings from the GPY5 North Shore Gas Home Energy Jumpstart Program.

Table E-2. GPY5 North Shore Gas Home Energy Jumpstart Program Natural Gas Savings

Program/Path	Ex Ante Gross Savings (Therms)	Verified Gross RR	Verified Gross Savings (Therms)	NTGR	Verified Net Savings (Therms)
Home Energy Jumpstart	93,236	99%	92,143	0.96	88,457

Source: Evaluation analysis of GPY5 program tracking data (July 19, 2016 data extract) and Illinois Statewide Technical Reference Manuals.

E.2 Program Savings by Measure

Table E-3 summarizes the natural gas savings from the GPY5 Peoples Gas HEJ Program by measure type.

Table E-3. GPY5 Peoples Gas HEJ Program Natural Gas Savings by Measure

Measure Type	Ex Ante Gross Savings (Therms)	Verified Gross RR	Verified Gross Savings (Therms)	NTGR	Verified Net Savings (Therms)
Showerheads	169,024	100%	169,111	0.96	162,346
Kitchen Faucet Aerators	32,264	100%	32,209	0.96	30,921
Bathroom Faucet Aerators	7,292	100%	7,283	0.96	6,992
DHW Pipe Insulation (feet)	25,245	100%	25,300	0.96	24,288
Hydronic Heating Pipe Insulation	178	461%	822	0.96	789
Prog/Re-Prog Tstat: Furnace	278,920	100%	278,900	0.96	267,744
Prog/Re-Prog Tstat: Boiler	148,825	75%	111,801	0.96	107,328
Smart Thermostats	41,745	97%	40,510	0.96	38,889
Total	703,493	95%	665,936	0.96	639,298

Source: Evaluation analysis of GPY5 program tracking data (July 19, 2016 data extract).

Table E-4 summarizes the natural gas savings from the GPY5 North Shore Gas HEJ Program by measure type.

Table E-4. GPY5 North Shore Gas HEJ Program Natural Gas Savings by Measure

Measure Type	Ex Ante Gross Savings (Therms)	Verified Gross RR	Verified Gross Savings (Therms)	NTGR	Verified Net Savings (Therms)
Showerheads	27,675	100%	27,680	0.96	26,572
Kitchen Faucet Aerators	3,154	100%	3,152	0.96	3,026
Bathroom Faucet Aerators	1,695	100%	1,702	0.96	1,634
DHW Pipe Insulation (feet)	3,434	100%	3,444	0.96	3,306
Hydronic Heating Pipe Insulation	17	457%	80	0.96	76
Prog/Re-Prog Tstat: Furnace	37,959	100%	37,947	0.96	36,429
Prog/Re-Prog Tstat: Boiler	7,723	75%	5,802	0.96	5,570
Smart Thermostats	11,578	107%	12,337	0.96	11,844
Total	93,236	99%	92,143	0.96	88,457

Source: Evaluation analysis of GPY5 program tracking data (July 19, 2016 data extract).

The realization rates for “Hydronic Heating Pipe Insulation” is exceptionally high. This is due to a minor algebra mistake on behalf of the implementer’s calculations and analysis. This mistake is discussed in Section 3.1, Finding 2.

E.3 Impact Estimate Parameters for Future Use

The net-to-gross (NTG) values for natural gas savings were deemed by program at 0.96 in this program year (GPY5) as well as next program year, based on the Illinois Stakeholder Advisory Group’s consensus process⁷ and from previous evaluation research. Navigant did not conduct NTG research in GPY5.

⁷ NTG values from Illinois Energy Efficiency Stakeholder Advisory Group. http://www.ilsag.info/ntg_2016.html

E.4 Program Volumetric Detail

Table E-5 and Table E-6 below present the GPY5 program participation and measures installed reported by Franklin Energy for the Peoples Gas and North Shore Gas programs. Detailed volumetric breakdown of the measure type and savings quantity are in Section 3. Participation counts are based only on projects and measures with natural gas savings, and do not reflect the total participation for the joint program.

Table E-5. GPY5 Peoples Gas HEJ Program Primary Participation† Detail

Participation Category†	Total Projects	Total Measures
Participants	10,011	62,551
Showerheads	9,279	12,042
Kitchen Faucet Aerators	5,293	5,753
Bathroom Faucet Aerators	6,657	10,501
Pipe Insulation (feet)*	4,693	25,524
Hydronic Heating Pipe Insulation*	89	2,420
Prog/Re-Prog Tstat: Furnace	4,476	4,476
Prog/Re-Prog Tstat: Boiler	1,214	1,214
Smart Thermostats	617	621
Total	32,318	62,551

Source: Navigant analysis of GPY5 program tracking data (July 19, 2016 data extract).

* Pipe insulation is counted on a "per foot" basis. Each "Measure" represents one foot of insulation, not a unique installation.

† Participation counts are based only on projects and measures with natural gas savings.

Table E-6. GPY5 North Shore Gas HEJ Program Primary Participation† Detail

Participation Category	Total Projects	Total Measures
Participants	1,402	9,573
Showerheads	1,291	1,971
Kitchen Faucet Aerators	526	563
Bathroom Faucet Aerators	1,006	2,454
Pipe Insulation (feet)*	630	3,474
Hydronic Heating Pipe Insulation*	9	234
Prog/Re-Prog Tstat: Furnace	609	609
Prog/Re-Prog Tstat: Boiler	63	63
Smart Thermostats	201	205
Total	4,335	9,573

Source: Navigant analysis of GPY5 program tracking data (July 19, 2016 data extract).

* Pipe insulation is counted on a "per foot" basis. Each "Measure" represents one foot of insulation, not a unique installation.

† Participation counts are based only on projects and measures with natural gas savings.

E.5 Findings and Recommendations

The following provides insight into key program findings and recommendations.⁸ After the recommendations were released in the November 23, 2016 draft evaluation report, Franklin Energy Services indicated they have adopted the six key recommendations made in this report.

Verified Gross Savings and Realization Rate.

Finding 2. There was a minor algebraic error by the implementer in calculating an average input parameter used in calculating savings for Hydronic Boiler pipe insulation. See Section 3.1, finding number 2, for more detail on the calculation. This error resulted in a realization rate for hydronic boiler pipe insulation of about 460 percent.

Recommendation 1. Correct the pipe insulation error going forward.

Finding 3. The Illinois TRM v4.0 does not explicitly define input parameters for installing programmable thermostats to control boiler systems. Navigant and the implementer used deemed boiler efficiencies from different sections of the TRM. Doing so led to a large discrepancy between verified and ex ante savings per measure installed.

The implementer assumed a boiler efficiency of 61.6 percent. This value is from Illinois TRM v4.0 Section 5.3.6, "Gas High Efficiency Boiler" and is a default baseline for early replacement if the actual baseline is unknown. By using this efficiency value, the implementer is assuming that all boilers controlled by the new programmable thermostats are old and have very low efficiencies.

Navigant instead used the value of 81.9 percent as described in Section 5.3.2, "Boiler Pipe Insulation." Eighty-one point nine percent is the default efficiency the TRM used to describe the average efficiency of an existing boiler in the population as a whole⁹.

Recommendation 2. Use the average boiler efficiency of 81.9 percent going forward, or begin collecting actual boiler efficiencies and use actual data.

Finding 4. The implementer used the savings percentages that were deemed for GPY6 in TRM v5.0 to calculate their GPY5 ex ante savings for smart thermostats. During our impact analysis for GPY5, Navigant found that the implementer did not correctly apply the savings percentages when setting per unit therm savings in the tracking system. The errors resulted in an overall deviation between ex ante and verified savings for smart thermostats.

Recommendation 3. Correct the smart thermostat measure savings tracking inputs for PG and NSG for the errors described in Section 3.3.

Program Volumetric Findings.

Finding 5. Peoples Gas claims four homes with two smart thermostats installed. North Shore Gas claims two homes with two smart thermostats installed, and one home with three smart thermostats installed. Full single-family household savings were claimed for each thermostat. The TRM defines deemed savings for programmable and smart thermostats on a per household basis, and applies a household factor of 65 percent for multifamily installations. The tracking database does not explicitly indicate whether homes as part of the program were single family homes, duplexes, triplexes, or other varieties of simple multifamily homes,

⁸ This is a subset of our findings and recommendations. Numbering on the findings and recommendations in this section are the same as those found in the Findings and Recommendations section of the evaluation report for ease of reference between each section.

⁹ "Average efficiency of boiler units found in Ameren PY3-PY4 data." IL TRM v4.0, pg. 547.

but each measure is identified as “SF” (“Single Family”) and each multiple-thermostat project has one gas account number and site address. Navigant capped the number of thermostats credited to a project with single family savings at one per household.

Recommendation 4. Identify whether a home is single family detached, single family attached (e.g. townhouse), or a multifamily home in the tracking data, and apply the appropriate savings factors on a household basis.

1. INTRODUCTION

1.1 Program Description

The GPY5¹⁰ Home Energy Jumpstart (HEJ) program is an assessment and direct install program jointly implemented by Commonwealth Edison Company (ComEd) and Peoples Gas and North Shore Gas (PG/NSG) with Franklin Energy Services (Franklin Energy) operating as implementer of the program. This report focuses solely on the natural gas savings from the program. Savings from electric measures are included in a separate evaluation report delivered to ComEd.

The primary objective of this residential direct install program was to secure energy savings through direct installation of low-cost efficiency measures, such as: water efficient showerheads and faucet aerators, pipe insulation, and programmable thermostats at eligible single family residences. In addition, the installation teams performed services including programming new thermostats and reprogramming existing thermostats. New to the program in GPY5 was the introduction of co-pay smart thermostats. The secondary objective of this program was to function as the “gateway” for homeowners to participate in other residential programs. HEJ performed a brief assessment of the major retrofit opportunities (e.g., furnace, boiler, air conditioning, insulation, and air sealing) and sought to heighten awareness of the homeowners about available additional efficiency programs offered by ComEd, Peoples Gas and North Shore Gas.

1.2 Evaluation Objectives

The objectives for the GPY5 evaluation were to determine the program’s verified gross and net savings and determine if the program met its energy savings targets. Navigant conducted limited process research for the HEJ program in GPY5.

¹⁰ The GPY5 program year began June 1, 2015 and ended May 31, 2016.

2. EVALUATION APPROACH

Navigant reviewed ex-ante gross savings estimates by totaling all Home Energy Jumpstart measures from the program tracking database. Navigant compared ex ante to ex post savings to find the measure- and program-level realization rates. The net-to-gross ratio (NTGR) for this program year was approved through the Illinois Stakeholder Advisory Group (IL SAG) stakeholder consensus process. Navigant conducted a limited process review that included in-depth interviews with program staff.

2.1 Overview of Data Collection Activities

The core data collection activities included review of program tracking data and verification of direct install savings according to the Illinois TRM v4.0. The full set of data collection activities is shown in the following tables.

Table 2-1. Primary Data Collection Activities

What	Who	Target Completes	Completions Achieved	When	Comments
Program Tracking Database	Participants	All	All	July – October 2016	Source of information for verified gross analysis
In Depth Interviews	Program Manager/Implementer Staff	4	4	Summer 2016	Included program management and implementation contractor staff

Source: Navigant.

Table 2-2. Additional Resources

Reference Source	Author	Application	Gross Impacts
Illinois Technical Reference Manual Version 4.0	Illinois Stakeholder Advisory Group	HEJ measure impact analysis	X

2.2 Verified Savings Parameters

Navigant calculated verified gross and net program impacts for six types of measures with deemed savings values: low-flow showerheads, kitchen and bathroom faucet aerators, pipe insulation, programmable thermostats, and smart thermostats. These measures account for all quantifiable GPY5 natural gas savings.

2.2.1 Verified Gross Program Savings Analysis Approach

Navigant estimated verified per-unit savings for each program measure using impact algorithms and input assumptions defined by the Illinois TRM for deemed measures¹¹, 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 GPY5 evaluation research and which were deemed.

Table 2-3. GPY5 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 hot water measure savings assumptions	Illinois TRM, version 4.0, section 5.4‡	Deemed
Residential pipe insulation savings assumptions	Illinois TRM, version 4.0, sections 5.3 and 5.4‡	Deemed
Programmable thermostat savings assumptions	Illinois TRM, version 4.0, section 5.3.11‡	Deemed
Advanced thermostat savings assumptions	Illinois TRM, version 5.0, section 5.3.16*†	Evaluated

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

‡ Source: State of Illinois Technical Reference Manuals. PG&NSG MMDB PY5 - 04122016, produced by Franklin Energy;

* This measure was added to the Illinois Technical Reference Manual in version 5.0. It was not present in prior TRM versions, and was not deemed at the start of GPY5.

2.2.2 Verified Net Program Savings Analysis Approach

Verified net energy savings were calculated by multiplying the verified gross savings estimates by a deemed net-to-gross ratio (NTGR). In GPY5, 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 Stakeholder Advisory Group (SAG)¹². The approved, deemed NTGR for the GPY5 PG and NSG HEJ program was 0.96.

2.3 Process Evaluation

A limited process evaluation was conducted for GPY5. It was based on interviews with program staff and the implementation contractor and the analysis leave-behind pre-paid survey responses collected by Franklin Energy. These interviews discussed the program’s energy savings and participation as well as changes implemented in GPY5.

¹¹ 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 PG&NSG MMDB PY5 - 04122016, produced by Franklin Energy.

¹² Source: Deemed NTGR values are available on the Illinois Energy Efficiency Stakeholder 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

3. GROSS IMPACT EVALUATION

This section includes Navigant’s gross impact evaluation results. Navigant performed a tracking system review on the program tracking system and calculated verified gross program savings. The program reported ex ante gross savings of 703,493 therms for Peoples Gas and 93,236 therms for North Shore Gas. Navigant reports verified gross savings of 665,936 therms and 92,143 therms for Peoples Gas and North Shore Gas, respectively, with corresponding verified gross realization rates of 95 percent and 99 percent, respectively.

3.1 Program Tracking Data Review

For the GPY5 evaluation, Navigant reviewed the PG and NSG program tracking system to verify the completeness and accuracy of the tracking system data and to identify any issues that would affect the impact evaluation of the HEJ Program. Navigant found the tracking data documents sufficient to complete the gross impact evaluation of the HEJ program.

The key findings from the tracking system review include:

1. Peoples Gas claims four homes with two smart thermostats installed. North Shore Gas claims two homes with two smart thermostats installed, and one home with three smart thermostats installed. Full single-family household savings were claimed for each thermostat. The TRM defines deemed savings for programmable and smart thermostats on a per household basis, and applies a household factor of 65 percent for multifamily installations. The tracking database does not explicitly indicate whether homes as part of the program were single family homes, duplexes, triplexes, or other varieties of simple multifamily homes, but each measure is identified as “SF” (“Single Family”) and each multiple-thermostat project has one gas account number and site address. Navigant capped the number of thermostats credited to a project with single family savings at one per household.
2. There was a minor calculation error in how the implementers calculated savings for hydronic boiler pipe insulation. The implementers averaged variables between 0.5” and 0.75” pipe, but when averaging the “C_{new}” or efficient circumference of the pipe with insulation, a minor algebraic error has major effects on the energy savings. The implementers’ “C_{new}” calculation is as follows

$$C_{new} = ((0.5 + 2) + (0.75 + 2)/2) * 3.14/12$$

Where:

- 0.5 and 0.75 = pipe diameters (in.)
- 2 = additional diameter added by the insulation (in.)
- “/2” is an attempt to average the diameters of both pipes
- * 3.14 is multiplying the “average diameter” by an approximation of pi to convert to circumference
- /12 is converting the circumference from inches to feet

Inspection of the equation shows that only the “0.75+2” is divided by two. Instead of producing an average diameter (2.625”) this produces a flawed number (3.875”). When this erroneous “C_{new}” is inserted into the algorithm a factor multiplied by “C_{new}” is subtracted from a factor

multiplied by the baseline existing pipe circumference “C_{exist}”. The result greatly underestimates the calculated ex ante savings.

3.2 Program Volumetric Findings

The participation counts in this section are based only on projects and measures with natural gas savings, and do not reflect the total participation for the joint program with ComEd. As shown in Table 3-1 and Table 3-2, the Peoples Gas HEJ Program reported 10,011 unique participants in GPY5 and distributed 62,551 total measures. This translates to 6.2 measures per project. The North Shore Gas HEJ Program reported 1,402 unique participants in GPY5 and distributed 9,573 measures. This translates to 6.8 measures per project.

Table 3-1. GPY5 Peoples Gas HEJ Program Participation Detail

Measure Category	Measures
Direct Install Measures	62,551
Showerheads	12,042
Kitchen Faucet Aerators	5,753
Bathroom Faucet Aerators	10,501
Pipe Insulation (feet)	27,944
Total Hot Water Measures	56,240
Prog/Re-Prog Tstat: Furnace	4,476
Prog/Re-Prog Tstat: Boiler	1,214
Smart Thermostats	621
Total Thermostat Measures	6,311

Source: Navigant analysis of GPY5 program tracking data (July 19, 2016 data extract).

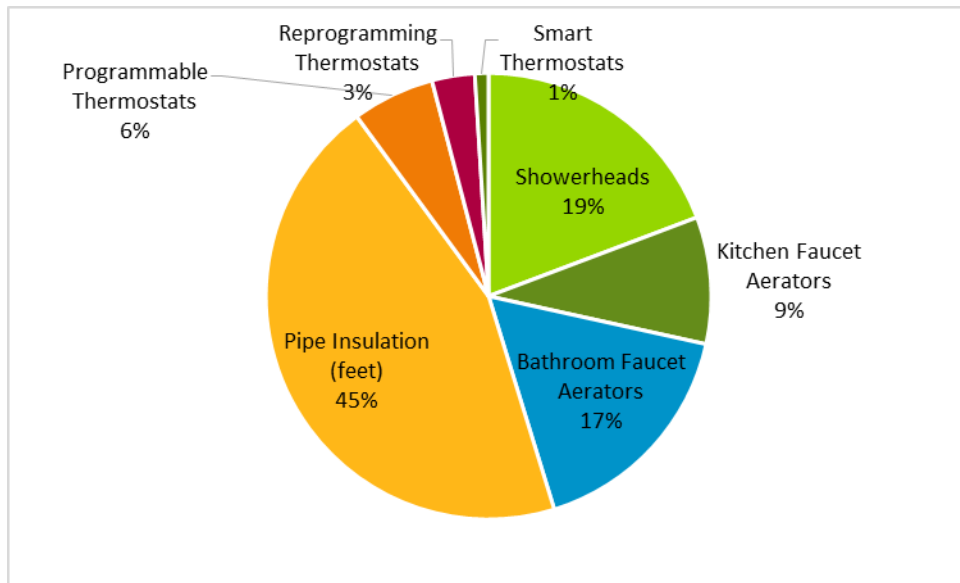
Table 3-2. GPY5 North Shore Gas HEJ Program Participation Detail

Measure Category	Measures
Direct Install Measures	9,573
Showerheads	1,971
Kitchen Faucet Aerators	563
Bathroom Faucet Aerators	2,454
Pipe Insulation (feet)	3,708
Total Hot Water Measures	8,696
Prog/Re-Prog Tstat: Furnace	609
Prog/Re-Prog Tstat: Boiler	63
Smart Thermostats	205
Total Thermostat Measures	877

Source: Navigant analysis of GPY5 program tracking data (July 19, 2016 data extract).

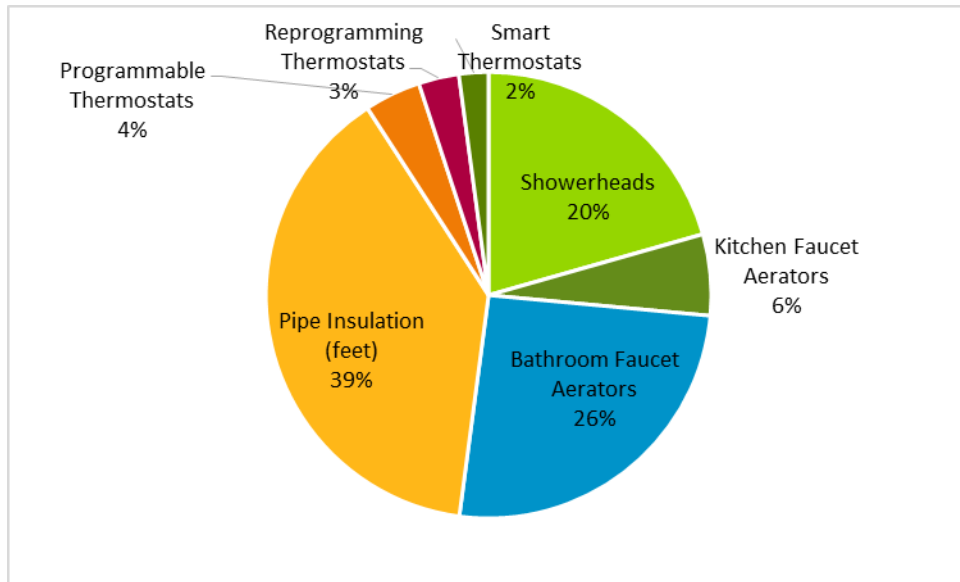
Figure 3-1 and Figure 3-2 disaggregate the measure mix by type. For Peoples Gas overall, hot water measures (including showerheads, faucet aerators, and pipe insulation) contributed 90 percent of the measure quantity in GPY5, and thermostat measures (including new programmable and smart thermostats and reprogramming old thermostats) contributed the remaining 10 percent. For North Shore Gas, hot water measures contributed 91 percent of the measure quantity in GPY5, and thermostat measures contributed the remaining 9 percent. It should be noted that pipe insulation is counted on a per-foot basis, not a per-application basis. This results in an inflated number of pipe insulation “measures” as the average application includes approximately five and a half feet of pipe insulation for domestic hot water applications and nine feet for hydronic boiler applications.

Figure 3-1. Peoples Gas: Number of HEJ Measures Installed by Type



Source: Navigant Analysis
 Note: Pipe Insulation is counted on a "per foot" basis, not a per application basis, which may inflate its perceived installed quantity.

Figure 3-2. North Shore Gas: Number of HEJ Measures Installed by Type



Source: Navigant Analysis
 Note: Pipe Insulation is counted on a "per foot" basis, not a per application basis, which may inflate its perceived installed quantity.

3.3 Gross Program Impact Parameter Estimates

As described in Section 2, Navigant estimated 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. GPY5 HEJ Program Ex Ante and Verified Gross Savings Parameters

Measure	PG Ex Ante Average Gross Savings (Therms/Unit)	PG Verified Average Gross Savings (Therms/Unit)	NSG Ex Ante Average Gross Savings (Therms/Unit)	NSG Verified Average Gross Savings (Therms/Unit)
Showerheads	14.04	14.04	14.04	14.04
Kitchen Aerators	5.61	5.60	5.60	5.60
Bathroom Aerators	0.69	0.69	0.69	0.69
DHW Pipe Insulation	0.99	0.99	0.99	0.99
Hydronic Boiler Pipe Insulation	0.07	0.34	0.07	0.34
Programmable/Re-Program Thermostat for Furnace	62.31	62.31	62.33	62.31
Programmable/Re-Program Thermostat for Boiler	122.59	92.09	122.59	92.09
Smart Thermostat*	67.15	65.66	56.48	61.38

Source: Navigant analysis of program tracking data and Franklin Energy Services documents. The effective TRM for GPY5 is Version 4.0, available from the Illinois Energy Efficiency Stakeholder Advisory Group web site: http://www.ilsag.info/il_trm_version_4.html. The list of TRM Version 4.0 errata in effect for GPY5 is provided in TRM Version 5.0, available at: http://www.ilsag.info/il_trm_version_5.html

** Smart thermostats are divided into manual, programmable, and unknown baseline types, each with different savings. Different quantities of baseline types result in different average savings values.*

Key findings include:

1. An algebraic error in the implementer’s calculations resulted in a realization rate of 471 percent for hydronic boiler pipe insulation measures. This mistake is discussed in detail in Section 3.1, Finding 2.
2. The Illinois TRM v4.0 does not explicitly define input parameters for installing programmable thermostats to control boiler systems. Navigant and the implementer used deemed boiler efficiencies from different sections of the TRM. Doing so led to a large discrepancy between verified and ex ante savings per measure installed.

The implementer assumed a boiler efficiency of 61.6 percent. This value is from Illinois TRM v4.0 Section 5.3.6, “Gas High Efficiency Boiler” and is a default baseline for early replacement if the actual baseline is unknown. By using this efficiency value, the implementer is assuming that all boilers controlled by the new programmable thermostats are old and have very low efficiencies.

Navigant instead used the value of 81.9 percent as described in Section 5.3.2, “Boiler Pipe Insulation.” Eighty-one point nine percent is the default efficiency the TRM used to describe the average efficiency of an existing boiler in the population as a whole¹³.

- At the beginning of GPY5, approved algorithms and parameters were not available to deem savings for smart thermostats. Smart (or “Advanced”) thermostats were not present in TRM v4.0. During the update process for IL TRM v5.0 in fall of 2015, Navigant completed a billing analysis of smart thermostat savings in Illinois. The TRM v5.0 Technical Advisory Committee and the SAG approved deeming the results as the natural gas percent savings values for “Advanced Thermostats”, effective for GPY6. Although the savings values were not deemed for GPY5, Navigant concluded they represented the best available gas heating savings estimates for Illinois at the time – which was midway through GPY5. The implementer used the savings percentages to calculate their GPY5 ex ante savings for smart thermostats. During our impact analysis for GPY5, Navigant found that the implementer did not correctly apply the savings percentages when setting per unit therm savings in the tracking system. The errors resulted in an overall deviation between ex ante and verified savings for smart thermostats.

The implementer split smart thermostat installations into three separate measures based on the previously existing equipment, as described in TRM v5.0. “Manual Baseline” measures had a manual or standard thermostat prior to the upgrade. “Unknown Baseline” measures had an undocumented existing thermostat. The third category did not specify a baseline, but the savings values used by the implementer matched the savings values appropriate for a programmable thermostat as the baseline. Each baseline category has a different savings value, as shown in Table 3-4.

Table 3-4. Advanced (Smart) Thermostat Heating Savings in TRM v5.0

Existing Thermostat Type	Heating Reduction
Manual	8.8%
Programmable	5.6%
Unknown (Blended Average)	7.4%

Source: Illinois TRM Version 5.0.

For NSG, the implementer used the same savings value, 56.29 gross therms per thermostat, for all three baselines (with the exception of one project). The value of 56.29 gross therms is correct for a household with a programmable thermostat baseline, but significantly underestimates the savings for manual and unknown baselines. This resulted in varying realization rates, dependent on the pre-existing thermostat, with the overall result being a 107 percent realization rate for NSG smart thermostats.

Peoples Gas tracked different savings values for the three different measure baselines. The ex ante net savings for a household with a programmable thermostat baseline was correct in the tracking system. However, the implementer used TRM v5.0 gross therm savings per unit when tracking net savings for the manual and unknown baselines, slightly overestimating the net

¹³ “Average efficiency of boiler units found in Ameren PY3-PY4 data.” IL TRM v4.0, pg. 547.

savings for those two measures. As a result, the overall realization rate for smart thermostats was 97 percent for PG.

As described in Section 3.1, Finding 1, four projects for PG and three for NSG claimed savings for multiple thermostats. Navigant capped the number of thermostats credited to a project with single family savings at one per household.

3.4 Verified Gross Program Impact Results

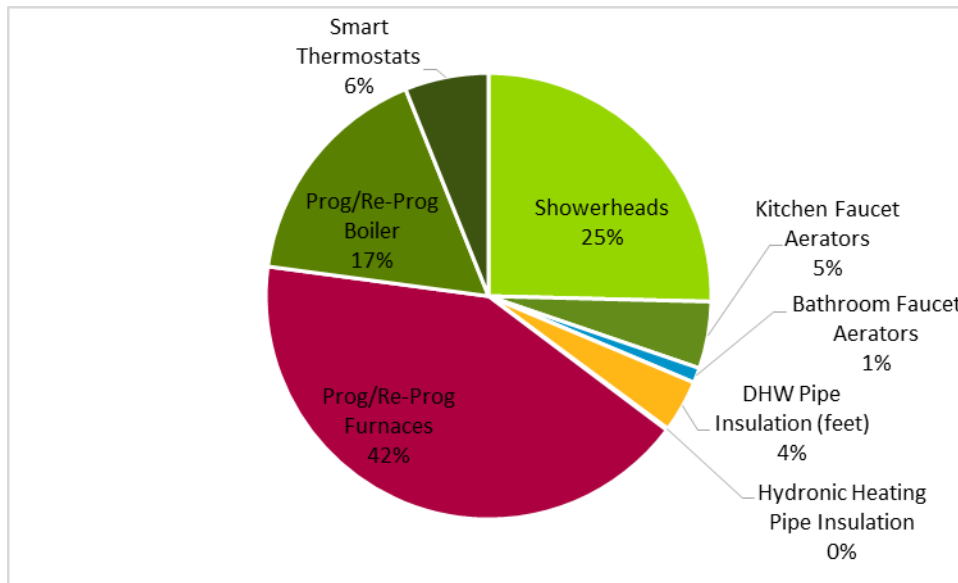
As shown in Table 3-5, the GPY5 Peoples Gas HEJ Program reported ex ante gross energy savings of 703,493 therms. Evaluation adjustments resulted in verified gross energy savings of 665,936 therms, reflecting the program’s gross realization rate of 95%. Figure 3-3 shows the distribution of verified gross savings by measure, graphically.

Table 3-5. GPY5 Peoples Gas HEJ Program Impact Results

Measure	Quantity Unit	Verified Measure Quantity	Ex Ante Gross Savings (therms)	Verified Gross Savings (therms)	Verified Gross Realization Rate
Showerheads	Each	12,042	169,024	169,111	100%
Kitchen Faucet Aerators	Each	5,753	32,264	32,209	100%
Bathroom Faucet Aerators	Each	10,501	7,292	7,283	100%
DHW Pipe Insulation	Feet	25,524	25,245	25,300	100%
Hydronic Heating Pipe Insulation	Feet	2,420	178	822	461%
Prog/Re-Prog Tstat: Furnace	Each	4,476	278,920	278,900	100%
Prog/Re-Prog Tstat: Boiler	Each	1,214	148,825	111,801	75%
Smart Thermostats	Each	621	41,745	40,510	97%
Total		62,551	703,493	665,936	95%

Sources: Program tracking data and Navigant analysis

Figure 3-3. GPY5 Peoples Gas HEJ Program Verified Gross Savings by Measure Type



Source: Program tracking data and Navigant analysis

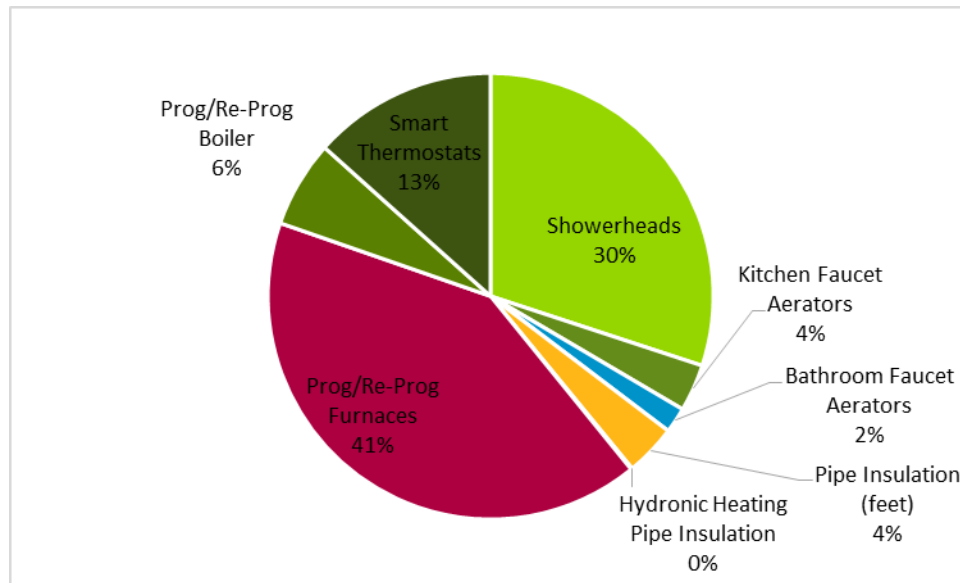
As shown in Table 3-6, the GPY5 North Shore Gas HEJ Program reported ex ante gross energy savings of 93,236 therms. Evaluation adjustments resulted in verified gross energy savings of 92,143 therms, reflecting the program’s gross realization rate of 99%. Figure 3-4 shows the distribution of verified gross savings by measure, graphically.

Table 3-6. GPY5 North Shore Gas HEJ Program Impact Results

Measure	Quantity Unit	Verified Measure Quantity	Ex Ante Gross Savings (therms)	Verified Gross Savings (therms)	Verified Gross Realization Rate
Showerheads	Each	1,971	27,675	27,680	100%
Kitchen Faucet Aerators	Each	563	3,154	3,152	100%
Bathroom Faucet Aerators	Each	2,454	1,695	1,702	100%
DHW Pipe Insulation	Feet	3,474	3,434	3,444	100%
Hydronic Heating Pipe Insulation	Feet	234	17	80	457%
Prog/Re-Prog Tstat: Furnace	Each	609	37,959	37,947	100%
Prog/Re-Prog Tstat: Boiler	Each	63	7,723	5,802	75%
Smart Thermostats	Each	205	11,578	12,337	107%
Total		9,573	93,236	92,143	99%

Source: Program tracking data and Navigant analysis

Figure 3-4. GPY5 North Shore Gas HEJ Program Verified Gross Savings by Measure Type



Source: Program tracking data and Navigant analysis

4. NET IMPACT EVALUATION

Verified net energy savings were calculated by multiplying the verified gross savings estimates by a NTGR. As noted in Section 2, the NTGR of 0.96 was used to calculate the net verified savings for the GPY5 program and was deemed through a consensus process managed by the Illinois SAG.

When converting ex ante gross to ex ante net savings for tracking and reporting, Franklin Energy combines an additional adjustment factor with the net-to-gross ratio. The additional factor accounts for potential gross realization rate adjustments, and is based on a previous year realization rate. This factor must be accounted for when converting ex ante net savings reported in the tracking system to ex ante gross savings. The equations for GPY5 are:

$$\text{GPY5 Ex Ante Net} = \text{Values reported in the GPY5 program tracking data}$$

$$\text{GPY5 Ex Ante Net} = (\text{GPY5 Ex Ante Gross} * \text{GPY3 Verified Gross RR}) * \text{GPY5 Deemed NTGR}$$

$$\text{GPY5 Ex Ante Gross} = \text{GPY5 Ex Ante Net} / (\text{GPY3 Verified Gross RR} * \text{GPY5 Deemed NTGR})$$

Table 4-1 below presents the realization rate and NTGRs used to calculate the program-level net savings.

Table 4-1. Peoples Gas and North Shore Gas GPY5 HEJ Program RR and NTGR Values

Program/Path	Embedded GPY3 RR Adjustment Factors	GPY3 RR Source	GPY5 Deemed NTGR	NTGR Source
PG HEJ	0.99	Navigant GPY3 Evaluation†	0.96	SAG‡
NSG HEJ	0.98	Navigant GPY3 Evaluation†	0.96	SAG‡

Source: †Navigant evaluation report for the GPY3 Program is available at <http://www.ilsag.info/evaluation-documents.html>.

‡ Deemed Net-to-Gross Ratios (as well as historical Realization Rates) are available from:

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

Table 4-2 summarizes the natural gas savings from the GPY5 Peoples Gas HEJ Program by measure.

Table 4-2. GPY5 Peoples Gas HEJ Program Natural Gas Savings

Measure	Ex Ante Gross Savings (Therms)	Ex Ante Net Savings (Therms)	Verified Gross Savings (Therms)	Verified Gross RR	NTGR	Verified Net Savings (Therms)
Showerheads	169,024	160,640	169,111	100%	0.96	162,346
Kitchen Faucet Aerators	32,264	30,663	32,209	100%	0.96	30,921
Bathroom Faucet Aerators	7,292	6,931	7,283	100%	0.96	6,992
DHW Pipe Insulation	25,245	23,993	25,300	100%	0.96	24,288
Hydronic Heating Pipe Insulation	178	169	822	461%	0.96	789
Prog/Re-Prog Tstat: Furnace	278,920	265,086	278,900	100%	0.96	267,744
Prog/Re-Prog Tstat: Boiler	148,825	141,443	111,801	75%	0.96	107,328
Smart Thermostats	41,745	39,675	40,510	97%	0.96	38,889
Total	703,493	668,600	665,936	95%	0.96	639,298

Source: Evaluation analysis of GPY5 program tracking data (July 19, 2016 data extract).

Table 4-3 summarizes the natural gas savings from the GPY5 North Shore Gas HEJ Program by measure.

Table 4-3. GPY5 North Shore Gas HEJ Program Natural Gas Savings

Measure	Ex Ante Gross Savings (Therms)	Ex Ante Net Savings (Therms)	Verified Gross Savings (Therms)	Verified Gross RR	NTGR	Verified Net Savings (Therms)
Showerheads	27,675	26,037	27,680	100%	0.96	26,572
Kitchen Faucet Aerators	3,154	2,967	3,152	100%	0.96	3,026
Bathroom Faucet Aerators	1,695	1,595	1,702	100%	0.96	1,634
DHW Pipe Insulation	3,434	3,231	3,444	100%	0.96	3,306
Hydronic Heating Pipe Insulation	17	16	80	457%	0.96	76
Prog/Re-Prog Tstat: Furnace	37,959	35,712	37,947	100%	0.96	36,429
Prog/Re-Prog Tstat: Boiler	7,723	7,266	5,802	75%	0.96	5,570
Smart Thermostats	11,578	10,892	12,337	107%	0.96	11,844
Total	93,236	87,716	92,143	99%	0.96	88,457

Source: Evaluation analysis of GPY5 program tracking data (July 19, 2016 data extract).

5. PROCESS EVALUATION

A limited process evaluation was conducted for the HEJ Program in GPY5. Navigant conducted telephone interviews with program managers and implementation staff to learn about changes made to the program in GPY5 as well as changes planned for GPY6.

5.1 Program Changes since GPY4

There were several changes made to the HEJ program in GPY5 including adjustments to net savings goals, the measures offered, and the number of energy advisors sent to participant's homes to complete the assessment. These changes are discussed in the sections below.

5.1.1 Net Energy Savings Goals

The HEJ Program's net energy savings goals for PG were decreased in GPY5 while the NSG goal was increased in GPY5 compared with GPY4. In GPY4 the savings goal for the program in the PG territory was 597,352 net therms while the goal for GPY5 was 511,652 net therms. The savings goal for the program in the NSG territory was 79,647 net therms in GPY4 while the goal for GPY5 was 102,576 net therms. The PG HEJ Program exceeded its GPY5 energy savings goal with 639,298 verified net therms, a substantial increase over the 381,403 verified net savings of GPY4. The NSG HEJ Program grew to 88,457 verified net therms in GPY5 compared with 67,792 verified net therms for GPY4, but fell short of the GPY5 goal.

In addition to completing more homes in GPY5 than in GPY4, the GPY5 program achieved higher savings per home, from about 50 therms per home in GPY4 to about 58 to 60 therms per home in GPY5. The implementer primarily attributes this to additional thermostat installs (new programmable thermostat installations and re-programming existing thermostats).

5.1.2 Measures Offered

A major change for the HEJ program in GPY6 was the addition of new electric and gas measures, including measures with co-pays. A smart thermostat with a co-pay of \$150 was introduced to the program in GPY5. Because the utilities had never offered co-pay measures before, they were not sure how participants were going to respond. The smart thermostat measure performed well with a 10 percent average installation rate among customers.

On the electric side, ComEd offered the following new measures: free direct install outdoor LEDs, indoor LEDs with a co-pay, and tier one advanced power strip. In the beginning of the program year, the customer uptake for the co-pay LEDs was lower than expected. ComEd decreased the co-pay range amount from \$3.00 - \$10.00 to \$3.00 - \$5.00 in March to better align with the price in the market place. After this decrease in co-pay amounts, ComEd saw an increase in co-pay LED installations. The advanced power strip performed well with a higher number of measures installed per home than expected.

5.1.3 Energy Advisor Teams

Another change in GPY5 was size of the energy advisor teams sent into participants' homes. In GPY4 the program utilized two-person teams where they would do six to seven appointments in one day. In GPY5 this was changed to a single person that would do four to five appointments in one day. In the beginning of the program year there were 14 energy advisors. Towards the end of the program year, due to high interest in the program, the number increased to approximately 19 energy advisors. Customer experience was the main driver for this change. Based on previous years' experience, the implementation staff learned that customers felt more comfortable having only one person in their home and were also willing to engage in more meaningful conversations about energy usage.

5.2 Marketing and Outreach

In GPY5, Franklin Energy hosted 330 outreach events which was a major driver of program participation. These events generated 5,600 leads (someone who signs up on paper or requests a call back), and Franklin Energy's goal was to try to increase conversion rates from these leads. In Q1 and Q2 of GPY5/EPY8, they introduced a sign up tool which included bringing either iPads or laptops to these events to get customers to sign up for an assessment on the spot. There was a ramp up period in Q1 and Q2 but in Q3 and Q4, they noticed the conversion rate increase to almost 50 percent compared to the 20 to 25 percent they saw in previous program years. Their goal for GPY6 is to get 50 percent of the program year's participants to sign up onsite at outreach events.

5.3 Participant Feedback

The HEJ program used a leave-behind pre-paid survey requesting customers fill it out and return it, or to enter their feedback online via a website. Overall the participant satisfaction for the program in GPY5 was very high, scoring 4.9 out of 5.¹⁴

5.4 Program Changes in GPY6

PG and NSG has several changes planned for the program in GPY6 including higher savings goals and modifying the electric measures being offered by ComEd. As stated in Section 5.1.1 above, the savings goals for GPY5 were 511,652 net therms for PG and 102,576 net therms for NSG. The savings goal for GPY6 has been increased to 700,000 net therms for PG and 147,000 net therms for NSG due to the expected amount of savings each home should achieve.

¹⁴ GPY5 HEJ / EPY8 HEA Franklin Customer Survey Responses from Franklin Energy.

6. FINDINGS AND RECOMMENDATIONS

This section summarizes the key impact and process findings and recommendations. After the recommendations were released in the November 23, 2016 draft evaluation report, Franklin Energy Services indicated they have adopted the six key recommendations made in this report.

Program Participation

Finding 1. The Peoples Gas HEJ Program exceeded its GPY5 energy savings goal of 511,652 net therms with verified savings of 639,298 net therms, a substantial increase over the 381,403 verified net savings of GPY4. The Peoples Gas program reported 10,011 unique participants with natural gas savings in GPY5 and distributed 62,551 total measures. The North Shore Gas HEJ Program grew to 88,457 verified net therms in GPY5 compared with 67,792 verified net therms for GPY4, but fell short of the GPY5 goal of 102,576 net therms. The North Shore Gas program reported 1,402 unique participants with natural gas savings in GPY5 and distributed 9,573 measures.

Verified Gross Savings and Realization Rate.

Finding 2. There was a minor algebraic error by the implementer in calculating an average input parameter used in calculating savings for Hydronic Boiler pipe insulation. See Section 3.1, finding number 2, for more detail on the calculation. This error resulted in a realization rate for hydronic boiler pipe insulation of about 460 percent.

Recommendation 1. Correct the pipe insulation error going forward.

Finding 3. The Illinois TRM v4.0 does not explicitly define input parameters for installing programmable thermostats to control boiler systems. Navigant and the implementer used deemed boiler efficiencies from different sections of the TRM. Doing so led to a large discrepancy between verified and ex ante savings per measure installed.

The implementer assumed a boiler efficiency of 61.6 percent. This value is from Illinois TRM v4.0 Section 5.3.6, "Gas High Efficiency Boiler" and is a default baseline for early replacement if the actual baseline is unknown. By using this efficiency value, the implementer is assuming that all boilers controlled by the new programmable thermostats are old and have very low efficiencies.

Navigant instead used the value of 81.9 percent as described in Section 5.3.2, "Boiler Pipe Insulation." Eighty-one point nine percent is the default efficiency the TRM used to describe the average efficiency of an existing boiler in the population as a whole¹⁵.

Recommendation 2. Use the average boiler efficiency of 81.9 percent going forward, or begin collecting actual boiler efficiencies and use actual data.

Finding 4. The implementer used the savings percentages that were deemed for GPY6 in TRM v5.0 to calculate their GPY5 ex ante savings for smart thermostats. During our impact analysis for GPY5, Navigant found that the implementer did not correctly apply the savings percentages when setting per unit therm savings in the tracking system. The errors resulted in an overall deviation between ex ante and verified savings for smart thermostats.

Recommendation 3. Correct the smart thermostat measure savings tracking inputs for PG and NSG for the errors described in Section 3.3.

¹⁵ "Average efficiency of boiler units found in Ameren PY3-PY4 data." IL TRM v4.0, pg.547.

Program Volumetric Findings.

Finding 5. Peoples Gas claims four homes with two smart thermostats installed. North Shore Gas claims two homes with two smart thermostats installed, and one home with three smart thermostats installed. Full single-family household savings were claimed for each thermostat. The TRM defines deemed savings for programmable and smart thermostats on a per household basis, and applies a household factor of 65 percent for multifamily installations. The tracking database does not explicitly indicate whether homes as part of the program were single family homes, duplexes, triplexes, or other varieties of simple multifamily homes, but each measure is identified as “SF” (“Single Family”) and each multiple-thermostat project has one gas account number and site address. Navigant capped the number of thermostats credited to a project with single family savings at one per household.

Recommendation 4. Identify whether a home is single family detached, single family attached (e.g. townhouse), or a multifamily home in the tracking data, and apply the appropriate savings factors on a household basis.

Finding 6. Peoples Gas has two project ids which claim 12 feet of pipe insulation and one project which claims 18 feet. While the TRM does not explicitly limit the amount of pipe insulation for which savings can be claimed, it does state that the deemed savings values are “appropriate for up to six feet of the hot water pipes and three feet of the cold [water pipes].”¹⁶ As such, savings should be limited to nine feet of insulation per household or per water heater. However, the tracking database does not indicate whether homes were duplexes, triplexes, or other varieties of simple multifamily homes, or whether they had more than one water heater. Navigant based verified savings on a single family home with a single water heater.

Recommendation 5. Identify whether a home is single family detached, single family attached (e.g. townhouse), or a multifamily home in the tracking data, and whether there are multiple water heaters.

Process Evaluation

Finding 7. The program is performing well. Comments about the program from participants are generally uniformly positive with a satisfaction rating of 4.9 out of 5.¹⁷

TRM Update Recommendations

Finding 8. As discussed in Finding 3 above, the current versions of the TRM do not specify a default boiler efficiency for programmable and advanced thermostat measures.

Recommendation 6. Navigant recommends establishing a default boiler efficiency in the thermostat measures section(s) of the TRM to resolve this issue.

¹⁶ IL TRM v4.0, Section 5.4.1, pg. 634.

¹⁷ GPY5 HEJ and EPY8 HEA Franklin Customer Survey Responses from Franklin Energy.