

# Multi-Family Home Energy Savings Program GPY2 Evaluation Report

Final

Energy Efficiency Plan:  
Nicor Gas Plan Year 2  
(6/1/2012-5/31/2013)

Presented to  
Nicor Gas Company

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## E. Executive Summary

This report presents a summary of the findings and results from the impact evaluation of the Nicor Gas Multi-Family Home Energy Savings (MFHES) program.<sup>1</sup> The MFHES program is in the second year of joint implementation with Commonwealth Edison Company (ComEd), which is ComEd electric program year 5 (EPY5) and Nicor Gas program year 2 (GPY2).<sup>2</sup> The MFHES program achieves natural gas energy savings for Nicor Gas customers and electric energy savings for ComEd customers. This evaluation report includes program impacts for the Nicor Gas program. Separate evaluation reports include total ComEd electric impacts from all of the jointly implemented programs and natural gas impacts from the Peoples Gas and North Shore Gas programs.

The MFHES program is designed to secure energy savings through direct installation of low-cost efficiency measures, such as CFLs, water efficient showerheads and faucet aerators in residential dwelling units of eligible multi-family residences. During EPY5/GPY2, the MFHES program expanded its scope to offer direct installation measures in common areas (i.e. hallways or exterior locations) of eligible multi-family properties. The program added assisted living, senior housing and public housing market segments to eligible properties.

In March 2013, the ComEd/Nicor Gas program transitioned to a new design and delivery structure, called the Multi-Family Comprehensive Energy Efficiency Program (MCEEP).<sup>3</sup> The MCEEP provides direct install measures in residential dwelling units and common areas, as before. In addition, the new program offers technical services and financial incentives to install whole-building energy efficient measures at eligible multi-family properties. Such whole-building measures may include upgrades or improvements to central plant and HVAC systems and controls, central lighting systems and building shell improvements, among others. Honeywell Smart Grid Solutions (Honeywell) implemented the program from the beginning of the program year until the program's transition in March 2013. In March 2013, Franklin Energy Services, LLC (Franklin Energy) became the primary implementation contractor for the ComEd/Nicor Gas program. Franklin Energy is also the implementation contractor for the ComEd/Peoples Gas and North Shore Gas programs.

### E.1. Program Savings

Table E-1 includes GPY2 Nicor Gas Multi-Family program savings.

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<sup>1</sup> In March 2013, the program expanded its scope and changed its name to the Multi-Family Comprehensive Energy Efficiency Program. For purposes of this evaluation report, the program is referred to as the Multi-Family Home Energy Savings program.

<sup>2</sup> The EPY5/GPY2 program year began June 1, 2012 and ended May 31, 2013.

<sup>3</sup> In practice, the MCEEP program continued to implement existing MFHES measures through the end of the EPY5/GPY2 program year as new MCEEP program components were being developed. Therefore, this report presents results from the complete program year in one section.

**Table E-1. GPY2 Multi-Family Program Savings**

Savings Category	Residential Units	Common Areas	Total Program
Ex-Ante Gross Savings (Therms)	602,173	25,915	628,088
Verified Gross Realization Rate	100%‡	100% ‡	100% ‡
Verified Gross Savings (Therms)	602,173	25,899	628,071
Net to Gross Ratio (NTGR)	0.96†	0.93†	0.96‡
Verified Net Savings (Therms)	578,086	24,086	602,171

Source: Navigant analysis of GPY2 Multi-Family program tracking data (August 27, 2013 data extract).

† Deemed value, except for program level NTGR, which is verified net savings/verified gross savings.

‡ Based on evaluation research findings. The value of 100 is rounded.

### E.2. Program Savings by Equipment End-Use Type

Table E-2 summarizes GPY2 Nicor Gas Multi-Family Home Energy Savings Program energy savings results by measure or equipment end-use type. Water efficiency measures installed in residential dwelling units, which includes showerheads, kitchen aerators and bathroom aerators, were the measure category with the largest savings.

**Table E-2. GPY2 Multi-Family Program Savings by Measure Type**

Measure Type	Ex-Ante Gross Savings (therms)	Verified Gross Savings (therms)	Verified Gross Realization Rate‡	Net-to-Gross Ratio†	Verified Net Savings (therms)
Water Efficiency Measures Residential Units	407,142	407,142	100%	0.96	390,856
Water Efficiency Measures Common Areas	3,719	3,702	99%	0.93	3,443
Programmable Thermostats Residential Units	194,780	194,780	100%	0.96	186,989
Programmable Thermostats Common Areas	1,068	1,068	100%	0.93	993
Water Heater Temperature Setback Residential Units	307	307	100%	0.96	295
Hot Water Pipe Wrap Insulation	10,122	10,122	100%	0.93	9,413
Boiler Pipe Wrap Insulation	11,007	11,007	100%	0.93	10,236
<b>TOTALS</b>	<b>628,088</b>	<b>628,071</b>	<b>100%</b>	<b>0.96</b>	<b>602,171</b>

Source: Navigant analysis of GPY2 Multi-Family program tracking data (August 27, 2013 data extract).

† Deemed value, except for program level NTGR, which is verified net savings/verified gross savings.

‡ Based on evaluation research findings. The value of 100 is rounded.

### E.3. Impact Estimate Parameters

To estimate verified gross and net savings, the evaluation team used a variety of parameters in its calculations. Some of those parameters were deemed for this program year and others were adjusted based on evaluation research. The key parameters used in the analysis are shown in Table E-3.

**Table E-3. GPY2 Multi-Family Program Verified Gross and Net Savings Parameter Data Sources**

Parameter	Data Source	Deemed or Evaluated?
Measure-level NTGR	Illinois Stakeholder Advisory Group Consensus Process †	Deemed
Program-level NTGR	Calculation of Verified Net Savings/Verified Gross Savings	Evaluated
Realization Rate	Evaluation research	Evaluated
Number of measures installed	Program tracking system	Evaluated
Direct Install Showerhead	Illinois TRM, version 1.0, section 5.4.5.‡	Deemed
Direct Install Bathroom and Kitchen Aerator	Illinois TRM, version 1.0, section 5.4.4.‡	Deemed
Direct Install Programmable and Setback Thermostat	Illinois TRM, version 1.0, section 5.3.10.‡	Deemed
Water Heater Temperature Setback	Illinois TRM, version 1.0, section 5.4.6.‡	Deemed
Direct Install Hot Water Pipe Wrap Insulation	Illinois TRM, version 1.0, section 5.4.1.‡	Deemed
Common Area Showerhead	Illinois TRM, version 1.0, section 4.3.3.‡	Deemed
Common Area Bathroom and Kitchen Aerator	Illinois TRM, version 1.0, section 4.3.2.‡	Deemed
Common Area Programmable Thermostat	Implementation Contractor Records & Evaluation Research	Evaluated
Common Area Hot Water Pipe Wrap Insulation & Boiler Pipe Insulation	Implementation Contractor Records & Evaluation Research	Evaluated

† Document provided by Nicor Gas to the SAG summarizing the SAG-approved NTGR for Nicor Gas for GPY1-GPY3 as negotiated in March-August 2013. Distributed in the SAG meeting on August 5-6, 2013.

[http://ilsagfiles.org/SAG\\_files/Meeting\\_Materials/2013/August 5-6, 2013 Meeting/Nicor Gas Net-to-Gross Results and Application GPY1-3.pdf](http://ilsagfiles.org/SAG_files/Meeting_Materials/2013/August%205-6,%202013%20Meeting/Nicor%20Gas%20Net-to-Gross%20Results%20and%20Application%20GPY1-3.pdf).

‡ State of Illinois Technical Reference Manual, final as of September 14, 2012, effective June 1, 2012;

[http://ilsagfiles.org/SAG\\_files/Technical\\_Reference\\_Manual/Illinois\\_Statewide\\_TRM\\_Version\\_1.0.pdf](http://ilsagfiles.org/SAG_files/Technical_Reference_Manual/Illinois_Statewide_TRM_Version_1.0.pdf)

**E.4. Impact Estimate Parameters For Future Use**

Navigant conducted evaluation research into two measures that may assist the Illinois TRM Technical Advisory Committee annual updating process: steam pipe insulation and showerhead restriction valves. Additional details are included in Section 7.1 of this evaluation report.

**E.5. Participation Information**

In GPY2, Nicor Gas program participation included 15,801 residential dwelling units and 102 common areas. Overall, the program installed a total of 46,402 measures in residential dwelling units and common areas (excluding common area pipe insulations). A total of 45,961 measures were installed in residential dwelling units, including 40,221 water efficiency measures, 5,692 programmable thermostats and performed 48 water heater temperature turndowns. The program installed 441 measures in common areas, including 435 water efficiency measures and 6 programmable thermostats. In addition, the program installed 9,253 linear feet of hot water pipe wrap insulation (including all types and sizes of hot water pipe wrap and/or boiler pipe insulation) primarily in common areas. Program participation totals are shown in Table E-4.

**Table E-4. GPY2 Multi-Family Program Primary Participation Detail**

Participation	Residential Units	Common Areas	Total Program
Participants	15,801	102	15,903
Water Efficiency Measures (units)	40,221	435	40,656
Thermostats (units)	5,692	6	5,698
Water Heater Temperature Setback (units)	48	-	48
Total Direct Installed Measures (w/o pipe insulation)	45,961	441	46,402
Hot Water Pipe Wrap Insulation & Boiler Pipe Insulation (linear feet)	-	9,253	9,253

Source: Navigant analysis of GPY2 Multi-Family program tracking data (August 27, 2013 data extract).

**E.6. Conclusions and Recommendations**

Overall, the GPY2 Multi-Family program tracking system is accurately recording measure savings and counts. The majority of program savings were from direct install measure installations in residential dwelling units, as opposed to common areas. Although the program fell short of its energy savings and participation goals in GPY2, the GPY3 program’s expanded design and delivery may enable it to achieve a higher percentage of planned energy savings.

**Program Savings Attainment**

**Finding 1.** The GPY2 Multi-Family program achieved evaluation verified net savings of 602,171 therms, which was approximately 27 percent of the program’s original net



savings target of 2,225,025 therms and a similar portion of the program’s net savings goals that Nicor Gas revised for their implementation contractor.<sup>4</sup> Of the total program savings in GPY2, approximately 96 percent (578,086 verified net therms) were from measures installed in residential dwelling units.

**Recommendation 1.** None. As already planned in GPY3 to increase energy savings, the program has expanded its scope and added new offerings designed to encourage participants to implement common area measures. The implementation contractor should continue to identify common area and whole-building measure energy savings opportunities for participants.

### Verified Gross Realization Rates

**Finding 2.** The program is accurately tracking measure counts. Appropriate quality control and quality assurance procedures are in place. With minor exceptions as identified in the report, the program tracking system is accurately recording measure savings estimates based on deemed or partially deemed values from the Illinois TRM. The GPY2 Multi-Family program verified gross realization rate was 100 percent.<sup>5</sup>

**Recommendation 2.** As detailed below, Navigant recommends making minor adjustments to ex-ante measure savings for kitchen aerators and bathroom aerators installed in common areas.

### Savings Estimates

**Finding 3.** Kitchen aerators and bathroom aerators installed in common areas were the only measures with savings estimates that the evaluators changed. These measures accounted for all of the differences in the program’s ex-ante gross savings and verified gross savings.

**Recommendation 3.** The implementation contractor should make minor adjustments to ex-ante measure savings for kitchen aerators and bathroom aerators installed in common areas.

### Future Evaluation Risk

**Finding 4.** The GPY2 Multi-Family program achieved a 100 percent verified gross realization rate,<sup>6</sup> but the program design is changing in GPY3.

**Recommendation 4.** Based on GPY2 program evaluation findings, evaluation risk associated with the direct installation portion of the program is relatively limited. The GPY3 program is expanding its scope to include additional measures that have not been evaluated under the Multi-Family program, which carries some risk associated with new design and delivery mechanisms. However, this risk is somewhat mitigated by the fact that most of the measures associated with the GPY3 program have been evaluated as part of other Nicor Gas programs, including the Business Energy Efficiency Rebate program and the Business Custom program and/or included in the Illinois Technical Reference Manual (IL TRM). The related measure research in the Illinois TRM, evaluation research realization rates and NTG ratios are available to calibrate ex ante savings to assure realistic projections.

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<sup>4</sup> The GPY2 MFHES program goals as filed in the Nicor Gas Energy Efficiency Plan 2011-2014 (Revised Plan Filed Pursuant to Order Docket No. 10-0562, Dated: May 24, 2011).

<sup>5</sup> The value of 100 percent is rounded.

<sup>6</sup> Id.

## 1. Introduction

### 1.1 Program Description

This report presents a summary of the findings and results from the impact evaluation of the GPY2 Nicor Gas Multi-Family Home Energy Savings (MFHES) program.<sup>7</sup> The Multi-Family Home Energy Savings (MFHES) program is in the second year of joint implementation with Commonwealth Edison Company (ComEd), which is ComEd electric program year 5 (EPY5) and Nicor Gas program year 2 (GPY2).<sup>8</sup> This evaluation report includes total Nicor Gas impacts from the jointly implemented program. Separate evaluation reports include the electric impacts from the jointly delivered ComEd programs and the natural gas impacts of the Peoples Gas and North Shore Gas programs.

The MFHES program achieves electric energy and demand savings for ComEd customers and natural gas energy savings for customers of Nicor Gas. The MFHES program secures energy savings through direct installation of low-cost efficiency measures, such as water efficient showerheads, faucet aerators, programmable thermostats, water heater temperature setbacks and hot water pipe wrap insulation at eligible multi-family residences. A secondary objective of the program is to identify energy saving opportunities in the common areas of multi-family buildings through a brief visual inspection of common area lighting and/or central plant locations to channel customers to other programs offered by the utilities. Primary target markets for the program include property management firms, trade and professional organizations, building owners and contractors who service multi-family buildings. During EPY5/GPY2, the MFHES program expanded its scope to offer direct installation measures in common areas of eligible multi-family properties. Eligible buildings may have individual meters or master-metered systems.

In March 2013, the ComEd/Nicor Gas program transitioned to a new design and delivery structure, called the Multi-Family Comprehensive Energy Efficiency Program (MCEEP).<sup>9</sup> The MCEEP provides direct install measures in residential dwelling units and common areas, as before. In addition, the new program offers technical services and financial incentives to install whole-building energy efficient measures at eligible multi-family properties. Such whole-building measures may include upgrades or improvements to central plant and HVAC systems and controls, central lighting systems and building shell improvements, among others. These measures may be installed by contractors or by a participant's own maintenance staff. Honeywell Smart Grid Solutions (Honeywell) implemented the program from the beginning of the program year until the program's transition in March 2013. In March 2013, Franklin Energy Services, LLC (Franklin Energy) became the primary implementation

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<sup>7</sup> In March 2013, the program expanded its scope and changed its name to the Multi-Family Comprehensive Energy Efficiency Program. For purposes of this evaluation report, the program is referred to as the Multi-Family Home Energy Savings program. In EPY6/GPY3, the ComEd, Peoples Gas and North Shore Gas program expanded its scope and changed its name to the Multi-Family Comprehensive Energy Efficiency Program.

<sup>8</sup> The EPY5/GPY2 program year began June 1, 2012 and ended May 31, 2013.

<sup>9</sup> In practice, the MCEEP program continued to implement existing MFHES measures through the end of the EPY5/GPY2 program year as new MCEEP program components were being developed. Therefore, this report presents results from the complete program year in one section.

contractor for the ComEd/Nicor Gas program. Franklin Energy is also the implementation contractor for the ComEd/Peoples Gas and North Shore Gas programs.

## 1.2 Evaluation Objectives

Navigant conducted a limited verified gross impact evaluation in GPY2 because most of the MFHES program's savings were deemed based on the Illinois TRM. Navigant's previous evaluation of the jointly implemented multi-family program included a detailed review of the programs' tracking system.<sup>10</sup>

Navigant identified the following key researchable questions for the GPY2 Multi-Family program evaluation:

### 1.2.1 Impact Questions

1. What is the status of the implementation of Navigant's recommendations detailed in the team's Verification, Due Diligence and Tracking System Review memo dated May 21, 2012 (revised November 2, 2012) for ComEd/Nicor Gas?
2. What is the MFHES program's verified net and gross savings?
3. Are TRM algorithms appropriately applied and are the programs' tracking system correctly calculating and tracking deemed measure values?
4. What are the energy savings associated with new program measures, such as Showerstart™ devices or electric savings from programmable thermostats installed in residential dwelling units?<sup>11</sup>

### 1.2.2 Process Questions

Process research related to the EPY5/GPY2 evaluation report was limited to interviews with program staff and the implementation contractor staff to verify information about the Multi-Family program's measures, tracking system and quality assurance /quality control procedures.

The program evaluation plan for GPY2 included a review or development of a program logic model and program theory for the new program component implemented in GPY2,<sup>12</sup> as well as a review of multi-family program best practices. Navigant's multi-family program best practices research is presently underway and will be reported on separately in a memo and incorporated into the GPY3 evaluation report.

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<sup>10</sup> Navigant, *EPY4-GPY1 ComEd, Nicor Gas Multi-Family Home Energy Savings Program Evaluation Report FINAL* (June 5, 2013).

<sup>11</sup> Navigant's research memorandum on Showerstart™ devices was delivered on September 6, 2013 and is included in Section 7.2.1.2. Navigant is in the process of researching potential electric savings associated with programmable thermostats installed in residential dwelling units. Evaluation research will be delivered in a separate memorandum.

<sup>12</sup> ComEd developed a program logic model and program theory for the new ComEd-Nicor Gas MCEEP program component implemented in GPY2.

## 2. Evaluation Approach

Navigant conducted a verified gross impact evaluation in GPY2 through an engineering review of per unit savings parameters and the program tracking system and data. Navigant interviewed utility program staff, consultants, and implementation contractors to verify information about the program and review the tracking system. In GPY2, the Net-to-Gross Ratio (NTGR) estimates used to calculate the Net Verified Savings were deemed through a consensus process by the Illinois Stakeholder Advisory Group (SAG)<sup>13</sup> based on GPY1 evaluation research. The Net-to-Gross Ratio for gas measures installed in residential dwelling units was 0.96 and for measures installed in common areas was 0.93. Navigant applied the deemed program NTGR to obtain verified net savings for each program component. The program-level NTGR was obtained through evaluation research by dividing verified net savings/verified gross savings based on evaluation research findings.

### 2.1 Primary Data Collection

#### 2.1.1 Overview of Data Collection Activities

The core data collection activity was reviewing the programs' tracking system to verify that all fields are appropriately populated, as shown in the Table 2-1.

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

N	What	Who	Target Completes	Completes Achieved	When	Comments
<i>Impact Assessment</i>						
1	Measure Savings Review	Program Tracking System	All	All	July-August 2013	Source of information for verified gross analysis
<i>Process Assessment</i>						
2	Interviews	Program Managers/Implementer Staff	4	4	July 2013	Includes interviews with staff from ComEd, Nicor Gas and Franklin Energy

Source: Navigant

#### 2.1.2 Verified Savings Parameters

Navigant estimated verified per unit savings for each program measure using impact algorithm sources found in the Illinois TRM for deemed measures, and evaluation research for non-deemed

<sup>13</sup> Document provided by Nicor Gas to the SAG summarizing the SAG-approved NTGR for Nicor Gas for GPY1-GPY3 as negotiated in March-August 2013. Distributed in the SAG meeting on August 5-6, 2013. [http://ilsagfiles.org/SAG\\_files/Meeting\\_Materials/2013/August 5-6, 2013 Meeting/Nicor Gas Net-to-Gross Results and Application GPY1-3.pdf](http://ilsagfiles.org/SAG_files/Meeting_Materials/2013/August 5-6, 2013 Meeting/Nicor Gas Net-to-Gross Results and Application GPY1-3.pdf).

measures. Table 2-2 below presents the sources for parameters that were used in verified gross savings analysis indicating which were examined through GPY2 evaluation research and which were deemed. For measures not included in the Illinois TRM, Navigant reviewed ex-ante values and engineering assumptions provided by the implementation contractor, including hot water pipe wrap insulation measures and boiler pipe insulation measures in building common areas.

**Table 2-2. Verified Gross and Net Savings Parameter Data Sources**

Parameter	Data Source	Deemed or Evaluated?
Measure-level NTGR	Illinois Stakeholder Advisory Group Consensus Process †	Deemed
Program-level NTGR	Calculation of Verified Net Savings/Verified Gross Savings	Evaluated
Realization Rate	Evaluation research	Evaluated
Number of measures installed	Program tracking system	Evaluated
Direct Install Showerhead	Illinois TRM, version 1.0, section 5.4.5.‡	Deemed
Direct Install Bathroom and Kitchen Aerator	Illinois TRM, version 1.0, section 5.4.4.‡	Deemed
Direct Install Programmable and Setback Thermostat	Illinois TRM, version 1.0, section 5.3.10.‡	Deemed
Water Heater Temperature Setback	Illinois TRM, version 1.0, section 5.4.6.‡	Deemed
Direct Install Hot Water Pipe Wrap Insulation	Illinois TRM, version 1.0, section 5.4.1.‡	Deemed
Common Area Showerhead	Illinois TRM, version 1.0, section 4.3.3.‡	Deemed
Common Area Bathroom and Kitchen Aerator	Illinois TRM, version 1.0, section 4.3.2.‡	Deemed
Common Area Programmable Thermostat	Implementation Contractor Records & Evaluation Research	Evaluated
Common Area Hot Water Pipe Wrap Insulation & Boiler Pipe Insulation	Implementation Contractor Records & Evaluation Research	Evaluated

† Document provided by Nicor Gas to the SAG summarizing the SAG-approved NTGR for Nicor Gas for GPY1-GPY3 as negotiated in March-August 2013. Distributed in the SAG meeting on August 5-6, 2013.

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‡ State of Illinois Technical Reference Manual, final as of September 14, 2012, effective June 1, 2012;

[http://ilsagfiles.org/SAG\\_files/Technical\\_Reference\\_Manual/Illinois\\_Statewide\\_TRM\\_Version\\_1.0.pdf](http://ilsagfiles.org/SAG_files/Technical_Reference_Manual/Illinois_Statewide_TRM_Version_1.0.pdf)

### 2.1.3 Verified Gross Program Savings Analysis Approach

Navigant reviewed the programs' tracking systems and procedures to verify that the program accurately reported measure counts. The majority of program savings were derived based on deemed values and algorithms from the State of Illinois Energy Efficiency Technical Reference Manual (Illinois TRM v1.0).<sup>14</sup> For Nicor Gas, the Illinois TRM provides the per unit savings for gas measures, with some exceptions for measures that were not included in the applicable TRM version. For measures not included in the Illinois TRM, Navigant reviewed ex-ante values and engineering assumptions provided by the implementation contractor, including steam pipe insulation measures. Verified per unit savings reflect evaluation adjustments to per unit savings values based on Navigant measure review. The verified gross savings are the product of verified per unit savings and verified measure quantities.

### 2.1.4 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 GPY2, the NTGR estimates used to calculate the Net Verified Savings were deemed through a consensus process by the Illinois Stakeholder Advisory Group (SAG)<sup>15</sup> based on GPY1 evaluation research. The Net-to-Gross Ratio for gas measures installed in residential dwelling units was 0.96 and for measures installed in common areas was 0.93. Navigant applied the deemed program NTGR to obtain verified net savings for each program component. The program-level NTGR is verified net savings/verified gross savings based on evaluation research findings.

#### 2.1.4.1 Free-Ridership

The GPY2 free-ridership estimate used to calculate the NTGR was deemed through a consensus process by the Illinois Stakeholder Advisory Group (SAG) based on GPY1 evaluation research. The program evaluation plan did not include new free-ridership research during the GPY2 program year.

#### 2.1.4.2 Spillover

The GPY2 spillover estimate used to calculate the NTGR was deemed through a consensus process by the Illinois Stakeholder Advisory Group (SAG) based on GPY1 evaluation research. The program evaluation plan did not include new spillover research during the GPY2 program year.

### 2.1.5 Process Evaluation

Process research related to the EPY5/GPY2 evaluation report was limited to interviews with program staff and the implementation contractor staff to verify information about the Multi-Family program's measures, tracking system and quality assurance /quality control procedures.

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<sup>14</sup> State of Illinois Technical Reference Manual, final as of September 14, 2012, effective June 1, 2012; [http://ilsagfiles.org/SAG\\_files/Technical\\_Reference\\_Manual/Illinois\\_Statewide\\_TRM\\_Version\\_1.0.pdf](http://ilsagfiles.org/SAG_files/Technical_Reference_Manual/Illinois_Statewide_TRM_Version_1.0.pdf)

<sup>15</sup> Document provided by Nicor Gas to the SAG summarizing the SAG-approved NTGR for Nicor Gas for GPY1-GPY3 as negotiated in March-August 2013. Distributed in the SAG meeting on August 5-6, 2013. [http://ilsagfiles.org/SAG\\_files/Meeting\\_Materials/2013/August\\_5-6,\\_2013\\_Meeting/Nicor\\_Gas\\_Net-to-Gross\\_Results\\_and\\_Application\\_GPY1-3.pdf](http://ilsagfiles.org/SAG_files/Meeting_Materials/2013/August_5-6,_2013_Meeting/Nicor_Gas_Net-to-Gross_Results_and_Application_GPY1-3.pdf).

The program evaluation plan for GPY2 included a review or development of a program logic model and program theory for the new program component implemented in GPY2,<sup>16</sup> as well as a review of multi-family program best practices. Navigant’s multi-family program best practices research is presently underway and will be reported on separately in a memo and incorporated into the GPY3 evaluation report.

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<sup>16</sup> ComEd developed a program logic model and program theory for the new ComEd-Nicor Gas MCEEP program component implemented in GPY2.

### 3. Gross Impact Evaluation

Navigant determined that the GPY2 Multi-Family program achieved verified gross savings of 628,071 therms and a 100 percent verified gross realization rate.<sup>17</sup>

#### 3.1.1 Tracking System Review

For this evaluation, Navigant verified that the GPY2 Multi-Family program tracking system (using the Bensight Data Management platform) continued to capture relevant data required to track the program's actions for reporting and evaluation activities. Navigant found that the programs had implemented quality assurance and quality control procedures to minimize the likelihood of data entry errors and that the programs continued to maintain or improve upon these procedures.

Over the course of the GPY2 program year, Navigant and the program implementation contractor maintained close contact regarding program tracking system updates to follow up from previous program evaluation recommendations. The implementation contractor granted Navigant direct access to the program tracking system, enabling Navigant to obtain real-time information from the tracking system. Navigant verified that the program tracking system was accurately recording measure counts. Except for a minor adjustment for programmable and setback thermostats savings values, Navigant verified that measure savings values were accurately recorded in the tracking system. Navigant's previous evaluation of the jointly implemented multi-family programs included a detailed review of the programs' tracking system.<sup>18</sup>

#### 3.1.2 Program Volumetric Findings

In GPY2, the Nicor Gas program participation included 15,801 residential dwelling units and 102 common areas. Overall, the program installed a total of 46,402 measures in residential dwelling units and common areas (excluding common area pipe insulations). A total of 45,961 measures were installed in residential dwelling units, including 40,221 water efficiency measures, 5,692 programmable thermostats and performed 48 water heater temperature turndowns. The program installed 441 measures in common areas, including 435 water efficiency measures and 6 programmable thermostats. In addition, the program installed 9,253 linear feet of hot water pipe wrap insulation (including all types and sizes of hot water pipe wrap and/or boiler pipe insulation) primarily in common areas. Program participation totals are shown in Table 3-1 below.

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<sup>17</sup> The value of 100 percent is rounded.

<sup>18</sup> Navigant, *EPY4-GPY1 ComEd, Nicor Gas Multi-Family Home Energy Savings Program Evaluation Report FINAL* (June 5, 2013).



**Table 3-1. GPY2 Multi-Family Program Primary Participation Detail**

Participation	Residential Units	Common Areas	Total Program
Participants (residential dwelling units)	15,801	102	15,903
Water Efficiency Measures (units)	40,221	435	40,656
Thermostats (units)	5,692	6	5,698
Water Heater Temperature Setback (units)	48	-	48
<i>Total Direct Install Measures</i>	<i>45,961</i>	<i>441</i>	<i>46,402</i>
Hot Water Pipe Wrap Insulation & Boiler Pipe Insulation (linear feet)	-	9,253	9,253

Source: Navigant analysis of GPY2 Multi-Family program tracking data (August 27, 2013 data extract).

Table 3-2 below includes GPY2 Multi-Family program volumetric detail by measure.

**Table 3-2. GPY2 Multi-Family Program Verified Quantities**

Detail	Verified Quantities
Participants (residential dwelling units and common areas)	15,903
Showerhead (Residential Unit)	12,580
Kitchen Aerator (Residential Unit)	12,111
Bathroom Aerator (Residential Unit)	15,530
<i>Sub-Total Water Efficiency Measures (Residential Units)</i>	<i>40,221</i>
Programmable Thermostat (Residential Unit)	5,692
Water Heater Temperature Setback	48
Showerhead (common area)	101
Kitchen Aerator (common area)	63
Bathroom Aerator (common area)	271
<i>Sub-total Water Efficiency Measures (common area)</i>	<i>435</i>
Programmable Thermostat (common area)	6
<i>Sub-total Direct Install Measures</i>	<i>46,402</i>
Hot Water Pipe Wrap Insulation (all types) (linear ft.)	5,379
Boiler Insulation Measures (all types) (linear ft.)	3,874
<i>Sub-total Pipe Insulation Measures (all types) (linear ft.)</i>	<i>9,253</i>
<b>Total</b>	<b>55,655</b>

Source: Navigant analysis of GPY2 Multi-Family program tracking data (August 27, 2013 data extract)

Table 3-3 compares GPY2 Multi-Family program ex-ante measure counts with verified measure counts.

**Table 3-3. GPY2 Multi-Family Program Ex-Ante and Verified Measure Count**

Measure	Unit	Ex-Ante Measure Count	Verified Measure Count
Showerheads – Residential Units	Unit	12,580	12,580
Kitchen Aerators – Residential Units	Unit	12,111	12,111
Bathroom Aerators – Residential Units	Unit	15,530	15,530
Programmable Thermostat – Residential Units	Unit	5,692	5,692
Hot Water Temperature Setback	Unit	48	48
Showerheads - Common area	Unit	101	101
Kitchen Aerators - Common area	Unit	63	63
Bathroom Aerators - Common area	Unit	271	271
Programmable Thermostat - Common area	Unit	6	6
Hot Water Pipe Wrap Insulation	Linear Ft	15	15
Hot Water Pipe Wrap Insulation (Large) Common area	Linear Ft	483	483
Hot Water Pipe Wrap Insulation (Medium) Common area	Linear Ft	1,739	1,739
Hot Water Pipe Wrap Insulation (Small) Common area	Linear Ft	3,142	3,142
Boiler Pipe Wrap Insulation (Large)	Linear Ft	360	360
Boiler Pipe Wrap Insulation (Medium)	Linear Ft	1,371	1,371
Boiler Pipe Wrap Insulation (Small)	Linear Ft	2,143	2,143
<b>GPY2 Nicor Gas Total</b>		<b>55,655</b>	<b>55,655</b>

Source: Navigant analysis of GPY2 Multi-Family program tracking data (August 27, 2013 data extract)

### 3.1.3 Gross Program Impact Parameter Estimates

As described in Section 2, Navigant calculated verified gross energy savings (therms) using Illinois TRM methodology and algorithms for deemed measures. Navigant verified that ex-ante measure savings were accurately recorded in the tracking system.

Navigant conducted research to validate engineering assumptions for parameter values not specified in the Illinois TRM, including programmable thermostats installed in building common areas, hot water pipe wrap insulation measures and boiler pipe wrap insulation measures in building common areas, which were supplied by the program’s implementation contractor.<sup>19</sup> Navigant reviewed the implementation contractor’s engineering input assumptions and determined that these engineering

<sup>19</sup> Integrys\_Master\_Measure\_Document 010213.xls (see spreadsheet Tab 31: MF Common Area Pipe Wrap).

assumptions were reasonable. While Navigant made no adjustments to ex-ante savings for hot water pipe wrap insulation measures and boiler pipe wrap insulation measures in building common areas, Navigant recommends further research to validate engineering assumptions, as documented in this report's findings and recommendations. Additional evaluation research is included in Section 7.2.1.1.

Navigant's research indicates that installing a thermostatically initiated shower restriction valve (i.e. Showerstart™ device) on a showerhead can potentially save an additional 4.2 therms/yr in multi-family homes, although additional research is required. Additional evaluation research is included in Section 7.2.1.2.

Navigant calculated verified gross energy savings (therms) using measure savings values identified in Table 3-4 below. Navigant made minor adjustments to ex-ante measure savings values for bathroom and kitchen aerators installed in common areas, which accounted for the entire difference between ex-ante gross savings and verified gross savings.<sup>20</sup>

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<sup>20</sup> Ex-ante measure savings values for bathroom and kitchen aerators installed in common areas was 4.59 therms/unit. Navigant calculated verified gross savings of 4.54 therms/unit. The difference in these measure savings values accounted for the entire difference between ex-ante gross savings and verified gross savings, which was 17 therms.

**Table 3-4. GPY2 Multi-Family Program Ex-Ante and Verified Gross Savings Parameters**

Measure	Ex-Ante Gross Savings (Therms/Unit)	Verified Gross Savings (Therms/Unit)	Method	Source (IL-TRM)
Showerheads	26.21	26.21	Deemed	v1.0 section 5.4.5
Kitchen Aerators	2.52	2.52	Deemed	v1.0 section 5.4.4
Bathroom Aerators	3.02	3.02	Deemed	v1.0 section 5.4.4
Hot Water Pipe Wrap Insulation	0.91	0.91	Deemed	v1.0 section 5.4.1
Programmable Thermostat	34.21	34.21	Deemed	v1.0 section 5.3.10
Water Heater Temperature Setback	6.40	6.40	Deemed	v1.0 section 5.4.6
Common Area Showerheads	21.64	21.64	Deemed	v1.0 section 4.3.3
Common Area Kitchen Aerators	4.59	4.54	Deemed	v1.0 section 4.3.2
Common Area Bathroom Aerators	4.59	4.54	Deemed	v1.0 section 4.3.2
Common Area Programmable Thermostat	178.00	178.00	Evaluated	engineering inputs from implementation contractor
Hot Water Pipe Wrap Insulation (Large) Common area	4.49	4.49	Evaluated	
Hot Water Pipe Wrap Insulation (Medium) Common area	2.56	2.56	Evaluated	
Hot Water Pipe Wrap Insulation (Small) Common area	1.11	1.11	Evaluated	

Measure	Ex-Ante Gross Savings (Therms/Unit)	Verified Gross Savings (Therms/Unit)	Method	Source (IL-TRM)
Boiler Pipe Wrap Insulation (Large)	6.59	6.59	Evaluated	
Boiler Pipe Wrap Insulation (Medium)	3.75	3.75	Evaluated	
Boiler Pipe Wrap Insulation (Small)	1.63	1.63	Evaluated	

Source: State of Illinois Technical Reference Manual, final as of September 14, 2012, effective June 1, 2012; [http://ilsagfiles.org/SAG\\_files/Technical\\_Reference\\_Manual/Illinois\\_Statewide\\_TRM\\_Version\\_1.0.pdf](http://ilsagfiles.org/SAG_files/Technical_Reference_Manual/Illinois_Statewide_TRM_Version_1.0.pdf)

### 3.1.4 Development of the Verified Gross Realization Rate

The verified gross realization rate is the ratio of verified gross savings to ex-ante gross savings from the program tracking system. Navigant calculated verified gross energy savings (therms) using Illinois TRM methodology and algorithms and engineering analysis. Navigant applied verified measure quantities found in the program tracking systems in Table 3-3 to per unit measure savings values as displayed in Table 3-4 to calculate verified gross savings.

As shown in Table 3-5, Nicor Gas GPY2 program achieved verified gross energy savings of 628,071 therms and a realization rate of 100 percent.<sup>21</sup> Verified gross savings were the same as ex-ante gross savings with the exception of kitchen aerators and bathroom aerators installed in common areas, as described in Section 3.1.3.

<sup>21</sup> Realization rate = verified gross / ex-ante gross from the tracking system. The value of 100 is rounded.

**Table 3-5. GPY2 Multi-Family Program Ex-Ante and Verified Gross Savings by Measure**

Measure	Ex-Ante Gross Savings (therms)	Verified Gross Savings (therms)	Verified Gross Realization Rate
Showerheads (IU)	329,722	329,722	100%
Kitchen Aerators (IU)	30,520	30,520	100%
Bathroom Aerators (IU)	46,901	46,901	100%
Programmable Thermostat (IU)	194,723	194,723	100%
Hot Water Temperature Setback	307	307	100%
Showerheads - common area	2,186	2,186	100%
Kitchen Aerators - common area	289	286	99%
Bathroom Aerators - common area	1,244	1,230	99%
Programmable Thermostat - common area	1,068	1,068	100%
Hot Water Pipe Wrap Insulation	14	14	100%
Hot Water Pipe Wrap Insulation (Large) Common area	2,169	2,169	100%
Hot Water Pipe Wrap Insulation (Medium) Common area	4,452	4,452	100%
Hot Water Pipe Wrap Insulation (Small) Common area	3,488	3,488	100%
Boiler Pipe Wrap Insulation (Large)	2,372	2,372	100%
Boiler Pipe Wrap Insulation (Medium)	5,141	5,141	100%
Boiler Pipe Wrap Insulation (Small)	3,493	3,493	100%
<b>GPY2 Nicor Gas Total</b>	<b>628,088</b>	<b>628,071</b>	<b>100%</b>

Source: Navigant analysis of GPY2 Multi-Family program tracking data (August 27, 2013 data extract).

### 3.1.5 Verified Gross Program Impact Results

As shown in Table 3-6 below, the GPY2 Multi-Family program reported ex-ante gross energy savings of 628,088 therms. Evaluation adjustments described in the sections above resulted in evaluation verified gross energy savings of 628,071 therms. Savings by program measure end-use are included in the following table.

**Table 3-6. GPY2 Multi-Family Program Verified Gross Impact Savings by End-Use**

	Sample	Gross Energy Savings (Therms)	90/10 Significance?
<b>Residential Unit Measures</b>			
Ex-Ante Gross Savings		602,173	
Verified Gross Realization Rate‡	NA†	100%	NA†
Verified Gross Savings		602,173	
<b>Common Area Measures</b>			
Ex-Ante Gross Savings		25,915	
Verified Gross Realization Rate‡	NA†	100%	NA†
Verified Gross Savings		25,899	
<b>GPY2 Multi-Family Program Total</b>			
Ex-Ante Gross Savings		628,088	
Verified Gross Realization Rate‡	NA†	100%	NA†
Verified Gross Savings		628,071	

Source: Navigant analysis of GPY2 Multi-Family program tracking data (August 27, 2013 data extract).

†NA when the TRM determines the gross savings.

‡ Based on evaluation research findings. The value of 100 is rounded.

## 4. Net Impact Evaluation

Navigant calculated verified net savings of 602,171 therms for the GPY2 Multi-Family program. The Net-to-Gross Ratio (NTGR) estimates used to calculate the Net Verified Savings were deemed through a consensus process by the Illinois Stakeholder Advisory Group (SAG)<sup>22</sup> based on GPY1 evaluation research. The Net-to-Gross Ratio for gas measures installed in residential dwelling units was 0.96 and for measures installed in common areas was 0.93. Navigant applied the deemed program NTGR to obtain verified net savings for each program component. The program-level NTGR is verified net savings/verified gross savings based on evaluation research findings. As noted in Section 2.1.4, the GPY2 evaluation plan did not include new free-ridership or spillover research.

Navigant calculated verified net savings of 602,171 therms for the GPY2 Multi-Family program, as indicated in Table 4-1 below. As indicated in the table below, measure savings are derived from the Illinois TRM and engineering analysis of program population-level data, so sample size and statistical significance are not applicable. The table presents savings at the measure group level including groups where the NTGR estimate is not statistically significant at the 90/10 level.

**Table 4-1. GPY2 Multi-Family Program Savings by End-Use Type**

	Sample	Energy Savings (Therms)	90/10 Significance?
<b>Residential Unit Installation</b>			
Ex-Ante Gross Savings	NA†	602,173	NA†
Verified Gross Realization Rate‡		100%	
Verified Gross Savings		602,173	
Net-to-Gross Ratio (NTGR)*		0.96	
Verified Net Savings		578,086	
<b>Common Area Installation</b>			
Ex-Ante Gross Savings	NA†	25,915	NA†
Verified Gross Realization Rate‡		100%	
Verified Gross Savings		25,899	
Net-to-Gross Ratio (NTGR)*		0.93	
Verified Net Savings		24,086	
<b>GPY2 Multi-Family Program Total</b>			
Ex-Ante Gross Savings	NA†	628,088	NA†
Verified Gross Realization Rate‡		100%	
Verified Gross Savings		628,071	
Net-to-Gross Ratio (NTGR)*		0.96	
Verified Net Savings		602,171	

Source: Navigant analysis of GPY2 Multi-Family program tracking data (August 27, 2013 data extract). †NA when the TRM determines the gross savings.

‡ Based on evaluation research findings. The value of 100 is rounded.

\* Deemed values, except for program level NTGR, which is verified net savings/verified gross savings.

<sup>22</sup> Document provided by Nicor Gas to the SAG summarizing the SAG-approved NTGR for Nicor Gas for GPY1-GPY3 as negotiated in March-August 2013. Distributed in the SAG meeting on August 5-6, 2013. [http://ilsagfiles.org/SAG\\_files/Meeting\\_Materials/2013/August 5-6, 2013 Meeting/Nicor Gas Net-to-Gross Results and Application GPY1-3.pdf](http://ilsagfiles.org/SAG_files/Meeting_Materials/2013/August 5-6, 2013 Meeting/Nicor Gas Net-to-Gross Results and Application GPY1-3.pdf).



Ex-Ante Gross, Verified Gross savings and Verified Net savings by measure type are included in Table 4-2 below.

**Table 4-2. GPY2 Multi-Family Program Savings by Measure Type**

Measure Type	Ex-Ante Gross Savings (therms)	Verified Gross Savings (therms)	Verified Gross Realization Rate <sup>‡</sup>	Net-to-Gross Ratio <sup>†</sup>	Verified Net Savings (therms)
Water Efficiency Measures Residential Units	407,142	407,142	100%	0.96	390,856
Water Efficiency Measures Common Areas	3,719	3,702	99%	0.93	3,443
Programmable Thermostats Residential Units	194,780	194,780	100%	0.96	186,989
Programmable Thermostats Common Areas	1,068	1,068	100%	0.93	993
Water Heater Temperature Setback Residential Units	307	307	100%	0.96	295
Hot Water Pipe Wrap Insulation	10,122	10,122	100%	0.93	9,413
Boiler Pipe Wrap Insulation	11,007	11,007	100%	0.93	10,235
<b>TOTALS</b>	<b>628,088</b>	<b>628,071</b>	<b>100%</b>	<b>0.96</b>	<b>602,171</b>

Source: Navigant analysis of GPY2 Multi-Family program tracking data (August 27, 2013 data extract).

<sup>†</sup> Deemed value, except for program level NTGR, which is verified net savings/verified gross savings.

<sup>‡</sup> Based on evaluation research findings. The value of 100 is rounded.

#### 4.1.1 Program Planned v. Actual Accomplishments

The GPY2 Multi-Family program achieved evaluation verified net savings of 602,171 therms, which was approximately 27 percent of the program’s filed net savings target of 2,225,025 therms and a similar portion of the program’s net savings goals that Nicor Gas revised for their implementation contractor.<sup>23</sup> Table 4-3 below includes GPY2 planned and actual detail.

<sup>23</sup> The GPY2 MFHES program goals as filed in the Nicor Gas Energy Efficiency Plan 2011-2014 (Revised Plan Filed Pursuant to Order Docket No. 10-0562, Dated: May 24, 2011).

**Table 4-3. GPY2 Multi-Family Program Planned v. Actual Detail**

Detail	GPY2 Planned	GPY2 Actual	Planned v. Actual
Participants (residential dwelling units)	55,000	15,801	29%
Verified Net Savings (therms)	2,225,025	602,171	27%

*Source: Nicor Gas Rider 30 EEP Program Portfolio Operating Plan, 1/24/2013; Navigant analysis of GPY2 Multi-Family program tracking data (August 27, 2013 data extract); ICC Quarterly Report 4th Quarter PY2 Final*

Table 4-4 below includes a comparison of GPY1 Multi-Family program detail against GPY2 Multi-Family program detail. The program installed measures at 15,801 residential dwelling units, approximately 36% fewer units than the previous year. In GPY2, the volume of participating residential dwelling units decreased by approximately one-third. Participation decreased from 24,744 residential dwelling units in GPY1 to 15,801 residential dwelling units in GPY2. The program saw a similar drop in the number of energy efficiency measures installed.

**Table 4-4. Multi-Family Program Yearly Comparison**

Detail	GPY1	GPY2	Year over Year Difference
Participants (Residential Dwelling Units)	24,744	15,801	64% (-36%)
Total Installed Measures	80,541	55,655	69% (-31%)
Verified Net Savings (therms)	959,087	602,171	63% (-37%)

*Source: Nicor Gas Rider 30 EEP Program Portfolio Operating Plan, 1/24/2013; Navigant analysis of GPY2 Multi-Family program tracking data (August 27, 2013 data extract); Navigant EPY4-GPY1 ComEd, Nicor Gas Multi-Family Home Energy Savings Program Evaluation Report FINAL (June 5, 2013)*

## 5. Process Evaluation

Process research related to the EPY5/GPY2 evaluation report was limited to interviews with program staff and the implementation contractor staff to verify information about the Multi-Family program’s measures, tracking system and quality assurance /quality control procedures.

The program evaluation plan for GPY2 included a review or development of a program logic model and program theory for the new program component implemented in GPY2,<sup>24</sup> as well as a review of multi-family program best practices. Navigant’s multi-family program best practices research is presently underway and will be reported on separately in a memo and incorporated into the GPY3 evaluation report.

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<sup>24</sup> ComEd developed a program logic model and program theory for the new ComEd-Nicor Gas MCEEP program component implemented in GPY2.

## 6. Conclusions and Recommendations

Overall, the GPY2 Multi-Family program tracking system is accurately recording measure savings and counts. The majority of program savings were from direct install measure installation in residential dwelling units, as opposed to common areas. Although the program fell short of its energy savings and participation goals in GPY2, the GPY3 program's expanded design and delivery may enable it to achieve a higher percentage of planned energy savings. In GPY2, the Net-to-Gross Ratios used to calculate the Net Verified Savings were deemed through a consensus process by the Illinois Stakeholder Advisory Group<sup>25</sup> based on GPY1 evaluation research. The Net-to-Gross Ratio for gas measures installed in residential dwelling units was 0.96 and for measures installed in common areas was 0.93. Navigant applied the deemed program NTGR to obtain verified net savings for each program component. The program-level NTGR is verified net savings/verified gross savings based on evaluation research findings.

### Program Savings Attainment<sup>26</sup>

**Finding 1.** The GPY2 Multi-Family program achieved evaluation verified net savings of 602,171 therms, which was approximately 27 percent of the program original savings goal of 2,225,025 net therms and a similar portion of the program's net savings goals that Nicor Gas revised for their implementation contractor.<sup>27</sup> Of the total program savings in GPY2, approximately 96 percent (578,086 verified net therms) were from measures installed in residential dwelling units.

**Recommendation 1.** None. As already planned in GPY3 to increase energy savings, the program has expanded its scope and added new offerings designed to encourage participants to implement common area measures. The implementation contractor should continue to identify common area and whole-building measure energy savings opportunities for participants.

### Verified Gross Realization Rates

**Finding 2.** The program is accurately tracking measure counts. Appropriate quality control and quality assurance procedures are in place. With minor exceptions as identified in the report, the program tracking system is accurately recording measure savings estimates based on deemed or partially deemed values from the Illinois TRM. The GPY2 Multi-Family program verified gross realization rate was 100 percent.<sup>28</sup>

**Recommendation 2.** As detailed below, Navigant recommends making minor adjustments to ex-ante measure savings for kitchen aerators and bathroom aerators installed in common areas.

<sup>25</sup> Document provided by Nicor Gas to the SAG summarizing the SAG-approved NTGR for Nicor Gas for GPY1-GPY3 as negotiated in March-August 2013. Distributed in the SAG meeting on August 5-6, 2013. [http://ilsagfiles.org/SAG\\_files/Meeting\\_Materials/2013/August 5-6, 2013 Meeting/Nicor Gas Net-to-Gross Results and Application GPY1-3.pdf](http://ilsagfiles.org/SAG_files/Meeting_Materials/2013/August%205-6,%202013%20Meeting/Nicor%20Gas%20Net-to-Gross%20Results%20and%20Application%20GPY1-3.pdf).

<sup>26</sup> Findings and recommendations 1, 2, 3, 5 and 6 also appear in the Executive Summary.

<sup>27</sup> The GPY2 MFHES program goals as filed in the Nicor Gas Energy Efficiency Plan 2011-2014 (Revised Plan Filed Pursuant to Order Docket No. 10-0562, Dated: May 24, 2011).

<sup>28</sup> The value of 100 percent is rounded.

### Savings Estimates

**Finding 3.** Kitchen aerators and bathroom aerators installed in common areas were the only measures with savings estimates that the evaluators changed. These measures accounted for all of the differences in the program’s ex-ante gross savings and verified gross savings.

**Recommendation 3.** The implementation contractor should make minor adjustments to ex-ante measure savings for kitchen aerators and bathroom aerators installed in common areas.

**Finding 4.** Navigant’s research indicates that installing a thermostatically initiated shower restriction valve (i.e. Showerstart™ device) on a showerhead can potentially save an additional 4.2 therms/yr in multi-family homes, although additional research is required.

**Recommendation 4.** Additional evaluation research findings detailed recommendations are included in Section 7.2.1.2.

### Future Evaluation Risk

**Finding 5.** The GPY2 Multi-Family Program achieved a 100 percent verified gross realization rate,<sup>29</sup> but the program design is changing in GPY3.

**Recommendation 5.** Based on GPY2 program evaluation findings, evaluation risk associated with the direct installation portion of the program is relatively limited. The GPY3 program is expanding its scope to include additional measures that have not been evaluated under the Multi-Family program, which carries some risk associated with new design and delivery mechanisms. However, this risk is somewhat mitigated by the fact that most of the measures associated with the GPY3 program have been evaluated as part of other Nicor Gas programs, including the Business Energy Efficiency Rebate program and the Business Custom program and/or included in the Illinois Technical Reference Manual (IL TRM). The related measure research in the Illinois TRM, evaluation research realization rates and NTG ratios are available to calibrate ex ante savings to assure realistic projections.

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<sup>29</sup> The value of 100 percent is rounded.

## 7. Appendix

### 7.1 Glossary.

#### High Level Concepts

##### Program Year

- EPY1, EPY2, etc. Electric Program Year where EPY1 is June 1, 2008 through May 31, 2009, EPY2 is June 1, 2009 through May 31, 2010, etc.
- GPY1, GPY2, etc. Gas Program Year where GPY1 is June 1, 2011 through May 31, 2012, GPY2 is June 1, 2012 through May 31, 2013.

There are two main tracks for reporting impact evaluation results, called Verified Savings and Impact Evaluation Research Findings.

##### Verified Savings composed of

- Verified Gross Energy Savings
- Verified Gross Demand Savings
- Verified Net Energy Savings
- Verified Net Demand Savings

These are savings using deemed savings parameters when available and after evaluation adjustments to those parameters that are subject to retrospective adjustment for the purposes of measuring savings that will be compared to the utility's goals. Parameters that are subject to retrospective adjustment will vary by program but typically will include the quantity of measures installed. In EPY5/GPY2 the Illinois TRM was in effect and was the source of most deemed parameters. Some of ComEd's deemed parameters were defined in its filing with the ICC but the TRM takes precedence when parameters were in both documents.

**Application:** When a program has deemed parameters then the Verified Savings are to be placed in the body of the report. When it does not (e.g., Business Custom, Retrocommissioning), the evaluated impact results will be the Impact Evaluation Research Findings.

##### Impact Evaluation Research Findings composed of

- Research Findings Gross Energy Savings
- Research Findings Gross Demand Savings
- Research Findings Net Energy Savings
- Research Findings Net Demand Savings

These are savings reflecting evaluation adjustments to any of the savings parameters (when supported by research) regardless of whether the parameter is deemed for the verified savings analysis. Parameters that are adjusted will vary by program and depend on the specifics of the research that was performed during the evaluation effort.

**Application:** When a program has deemed parameters then the Impact Evaluation Research Findings are to be placed in an appendix. That Appendix (or group of appendices) should be labeled Impact Evaluation Research Findings and designated as "ER" for short. When a program does not have deemed parameters (e.g., Business Custom, Retrocommissioning), the Research Findings are to be in the body of the report as the only impact findings. (However, impact findings may be summarized in

the body of the report and more detailed findings put in an appendix to make the body of the report more concise.)

### Program-Level Savings Estimates Terms

N	Term Category	Term to Be Used in Reports‡	Application†	Definition	Otherwise Known As (terms formerly used for this concept)§
1	Gross Savings	Ex-ante gross savings	Verification and Research	Savings as recorded by the program tracking system, unadjusted by realization rates, free ridership, or spillover.	Tracking system gross
2	Gross Savings	Verified gross savings	Verification	Gross program savings after applying adjustments based on evaluation findings for only those items subject to verification review for the Verification Savings analysis	Ex post gross, Evaluation adjusted gross
3	Gross Savings	Verified gross realization rate	Verification	Verified gross / tracking system gross	Realization rate
4	Gross Savings	Research Findings gross savings	Research	Gross program savings after applying adjustments based on all evaluation findings	Evaluation-adjusted ex post gross savings
5	Gross Savings	Research Findings gross realization rate	Research	Research findings gross / ex-ante gross	Realization rate
6	Gross Savings	Evaluation-Adjusted gross savings	Non-Deemed	Gross program savings after applying adjustments based on all evaluation findings	Evaluation-adjusted ex post gross savings
7	Gross Savings	Gross realization rate	Non-Deemed	Evaluation-Adjusted gross / ex-ante gross	Realization rate
1	Net Savings	Net-to-Gross Ratio (NTGR)	Verification and Research	1 – Free Ridership + Spillover	NTG, Attribution
2	Net Savings	Verified net savings	Verification	Verified gross savings times NTGR	Ex post net
3	Net Savings	Research Findings net savings	Research	Research findings gross savings times research NTGR	Ex post net
4	Net Savings	Evaluation Net Savings	Non-Deemed	Evaluation-Adjusted gross savings times NTGR	Ex post net
5	Net Savings	Ex-ante net savings	Verification and Research	Savings as recorded by the program tracking system, after adjusting for realization rates, free ridership, or spillover and any other factors the program may choose to use.	Program-reported net savings

‡ “Energy” and “Demand” may be inserted in the phrase to differentiate between energy (kWh, Therms) and demand (kW) savings.

† **Verification** = Verified Savings; **Research** = Impact Evaluation Research Findings; **Non-Deemed** = impact findings for programs without deemed parameters. We anticipate that any one report will either have the first two terms or the third term, but never all three.

§ Terms in this column are not mutually exclusive and thus can cause confusion. As a result, they should not be used in the reports (unless they appear in the “Terms to be Used in Reports” column).

## Individual Values and Subscript Nomenclature

The calculations that compose the larger categories defined above are typically composed of individual parameter values and savings calculation results. Definitions for use in those components, particularly within tables, are as follows:

**Deemed Value** – a value that has been assumed to be representative of the average condition of an input parameter and documented in the Illinois TRM or ComEd’s approved deemed values. Values that are based upon a deemed measure shall use the superscript “D” (e.g., delta watts<sup>D</sup>, HOU-Residential<sup>D</sup>).

**Non-Deemed Value** – a value that has not been assumed to be representative of the average condition of an input parameter and has not been documented in the Illinois TRM or ComEd’s approved deemed values. Values that are based upon a non-deemed, researched measure or value shall use the superscript “E” for “evaluated” (e.g., delta watts<sup>E</sup>, HOU-Residential<sup>E</sup>).

**Default Value** – when an input to a prescriptive saving algorithm may take on a range of values, an average value may be provided as well. This value is considered the default input to the algorithm, and should be used when the other alternatives listed for the measure are not applicable. This is designated with the superscript “DV” as in X<sup>DV</sup> (meaning “Default Value”).

**Adjusted Value** – when a deemed value is available and the utility uses some other value and the evaluation subsequently adjusts this value. This is designated with the superscript “AV” as in X<sup>AV</sup>

## Glossary Incorporated From the TRM

Below is the full Glossary section from the TRM Policy Document as of October 31, 2012<sup>30</sup>.

**Evaluation:** Evaluation is an applied inquiry process for collecting and synthesizing evidence that culminates in conclusions about the state of affairs, accomplishments, value, merit, worth, significance, or quality of a program, product, person, policy, proposal, or plan. Impact evaluation in the energy efficiency arena is an investigation process to determine energy or demand impacts achieved through the program activities, encompassing, but not limited to: *savings verification, measure level research, and program level research*. Additionally, evaluation may occur outside of the bounds of this TRM structure to assess the design and implementation of the program.

*Synonym:* **Evaluation, Measurement and Verification (EM&V)**

**Measure Level Research:** An evaluation process that takes a deeper look into measure level savings achieved through program activities driven by the goal of providing Illinois-specific

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<sup>30</sup> IL-TRM\_Policy\_Document\_10-31-12\_Final.docx



research to facilitate updating measure specific TRM input values or algorithms. The focus of this process will primarily be driven by measures with high savings within Program Administrator portfolios, measures with high uncertainty in TRM input values or algorithms (typically informed by previous savings verification activities or program level research), or measures where the TRM is lacking Illinois-specific, current or relevant data.

**Program Level Research:** An evaluation process that takes an alternate look into achieved program level savings across multiple measures. This type of research may or may not be specific enough to inform future TRM updates because it is done at the program level rather than measure level. An example of such research would be a program billing analysis.

**Savings Verification:** An evaluation process that independently verifies program savings achieved through prescriptive measures. This process verifies that the TRM was applied correctly and consistently by the program being investigated, that the measure level inputs to the algorithm were correct, and that the quantity of measures claimed through the program are correct and in place and operating. The results of savings verification may be expressed as a program savings realization rate (verified ex post savings / ex ante savings). Savings verification may also result in recommendations for further evaluation research and/or field (metering) studies to increase the accuracy of the TRM savings estimate going forward.

**Measure Type:** Measures are categorized into two subcategories: custom and prescriptive.

**Custom:** Custom measures are not covered by the TRM and a Program Administrator’s savings estimates are subject to retrospective evaluation risk (retroactive adjustments to savings based on evaluation findings). Custom measures refer to undefined measures that are site specific and not offered through energy efficiency programs in a prescriptive way with standardized rebates. Custom measures are often processed through a Program Administrator’s business custom energy efficiency program. Because any efficiency technology can apply, savings calculations are generally dependent on site-specific conditions.

**Prescriptive:** The TRM is intended to define all prescriptive measures. Prescriptive measures refer to measures offered through a standard offering within programs. The TRM establishes energy savings algorithm and inputs that are defined within the TRM and may not be changed by the Program Administrator, except as indicated within the TRM. Two main subcategories of prescriptive measures included in the TRM:

**Fully Deemed:** Measures whose savings are expressed on a per unit basis in the TRM and are not subject to change or choice by the Program Administrator.

**Partially Deemed:** Measures whose energy savings algorithms are deemed in the TRM, with input values that may be selected to some degree by the Program Administrator, typically based on a customer-specific input.

In addition, a third category is allowed as a deviation from the prescriptive TRM in certain circumstances, as indicated in Section 3.2:

**Customized basis:** Measures where a prescriptive algorithm exists in the TRM but a Program Administrator chooses to use a customized basis in lieu of the partially or fully deemed inputs. These measures reflect more customized, site-specific calculations (e.g., through a simulation model) to estimate savings, consistent with Section 3.2.

## 7.2 Detailed Impact Research Findings and Approaches

Navigant conducted evaluation research into two measure categories: 1) steam pipe insulation measures and 2) a thermostatically initiated shower restriction valve on a showerhead. Navigant is including this information in evaluation reports to ComEd, Nicor Gas and Peoples Gas and North Shore Gas for their reference.

### 7.2.1 Gross Impact Results

#### 7.2.1.1 Steam Pipe Insulation Measures

As written in Section 3.1.3, Navigant conducted research to validate engineering assumptions for parameter values not specified in the IL TRM, including steam pipe insulation measures in building common areas, which were supplied by the program’s implementation contractor.<sup>31</sup> Navigant used the algorithm presented in Figure 7-1 below to calculate verified gross savings for steam pipe insulation measures.

#### Figure 7-1. Verified Gross Savings Algorithm – Steam Pipe Insulation

$$\begin{aligned} \text{Verified Gross Annual Therm Savings per Foot} \\ = ((Q_{\text{base}} - Q_{\text{eff}}) * \text{HOURS}) / (100,000 * \eta_{\text{Boiler}}) * \text{CF} \end{aligned}$$

**Where:**

- $Q_{\text{base}}$  = Heat Loss from Bare Pipe (Btu/hr/ft). See Table 7-1 below.
- $Q_{\text{eff}}$  = Heat Loss from Insulated Pipe (Btu/hr/ft). See Table 7-1 below.
- Hours = Annual operating hours (actual or defaults by piping use and building type)
- 100,000 = conversion factor (1 Therm = 100,000 Btu)
- $\eta_{\text{Boiler}}$  = Efficiency of the boiler being used to generate the hot water or steam in the pipe (=80.7% for steam boilers)
- CF = Heat loss correction factor of 0.67

Navigant reviewed steam pipe insulation measure savings inputs from the program implementation contractor. The implementation contractor developed heat loss estimates ( $Q_{\text{base}}$  and  $Q_{\text{eff}}$ ) using the 3E Plus v4.0 software program<sup>32</sup>. The energy savings analysis is based on engineering assumptions using an average of 1.5-inch insulation around bare pipe. Details of the input parameters to 3E plus used to develop savings estimates are shown in Table 7-1 below.

<sup>31</sup> Integrys\_Master\_Measure\_Document 010213.xlsx (see spreadsheet Tab 31: MF Common Area Pipe Wrap).

<sup>32</sup> 3E Plus is a heat loss calculation software provided by the NAIMA (North American Insulation Manufacturer Association).

**Table 7-1. Steam Pipe Insulation Savings Parameters**

Parameter	Value	Data Source
R value of pipe insulation	5.0 (1.5 inches of insulation with K of 0.27)	IECC 2009
DI-R value of pipe insulation	3.0 (1.5 inches of insulation with K of 0.28)	IECC 2009
Linear feet of pipe	1	Standard value
Pipe temperature	225 F	Engineering assumption
Ambient temperature	75F	Engineering assumption
Combustion Efficiency	80.7%	Engineering assumption
Nominal Pipe Size	Varies	Engineering assumption
BTU loss/hr, uninsulated	Varies	Calculation using 3E Plus
BTU loss/hr, insulated	Varies	Using 3E Plus
BTU loss/hr, savings	Varies	Using 3E Plus
Hours of Operation/year	4,963	TMY3 Weather Data from O'Hare Int'l Airport
Heat Loss Correction Factor	0.67	Engineering Assumption
BTU/therm Conversion Factor	100,000	Standard value
Therms/year saved	Varies	Calculation
DI-Therms/year saved	Varies	Calculation
Nominal Therms/year saved	Varies (Average of all pipe sizes)	Calculation
DI-Nominal Therms/year saved	Varies (Average of all pipe sizes)	Calculation

Source: Navigant analysis of Integrys\_Master\_Measure\_Document 010213.xlsx

**7.2.1.2 Thermostatically Initiated Shower Restriction Valve**

Navigant conducted research to identify possible energy savings associated with installing a thermostatically initiated shower restriction valve on a showerhead.<sup>33</sup> The specific device with shower restriction valve technology available in the retail market is under the trademarked name “ShowerStart™.” Navigant’s research indicates that installing ShowerStart devices can potentially save an additional 4.2 therms/yr or 84 kWh/yr in multi-family homes. Presuming that the installation of a 1.5 GPM water efficient showerhead provides a baseline case for the ShowerStart device, Navigant’s estimates in the table below do not include water/energy savings from installing a 1.5 GPM water efficient showerhead at the water source.

<sup>33</sup> Navigant’s evaluation research was distributed to interested parties in a separate memorandum dated September 6, 2013. The memorandum includes research into both electric and natural gas savings associated with the measure. The entire memorandum is replicated in this section.

**To: Interested Parties in Illinois**  
**From: Multi-Family Program Evaluation Team**  
**Date: September 6, 2013**  
**Subject: Research Energy Savings From Thermostatic Shower Restriction Valves**

**Executive Summary**

The purpose of this memo is to present research on potential energy and water savings from installing a thermostatically initiated shower restriction valve on a showerhead. Navigant’s research focused on a unique and patented shower restriction valve technology available in the retail market called ShowerStart™ [1]. This device has been tested to provide energy and water savings in other jurisdictions, and thus serves as a basis for preliminary research on the device’s operation and potential savings for Illinois utility energy efficiency programs.

The Table 7-2 below presents a summary of potential savings from installing ShowerStart on a previously installed 1.5 gallons per minute (GPM) water efficient showerhead. Presuming that the installation of a 1.5 GPM water efficient showerhead provides a baseline case for the ShowerStart device, Navigant’s estimates in the table below do not include water/energy savings from installing a 1.5 GPM water efficient showerhead at the water source. Navigant’s research indicates that installing ShowerStart devices can potentially save an additional 3.2 therms/yr or 75 kWh/yr in single family homes and 4.2 therms/yr or 84 kWh/yr in multi-family homes. These additional savings can result in a 2.3 year simple payback for electric water heat and a 4.6 year simple payback for gas water heat in multi-family homes.

**Table 7-2. Potential Savings from Installing ShowerStart on 1.5 GPM Showerhead**

ShowerStart Savings Calculations	Single Family	Multi-Family
Water savings (gallons/yr/ShowerStart)	588	664
Electric Energy Savings (kWh/yr/ShowerStart)	75	84
Peak Demand savings (kW/yr/ShowerStart)	0.005	0.007
Gas energy savings (therms/yr/ShowerStart)	3.2	4.2
Simple Payback Period	2.3 years electric water heater 4.6 years gas water heater	

*Source: Navigant*

**ShowerStart™ Technology Description**

As illustrated in Figure 7-2below, the ShowerStart device is described by the manufacturer as a “compact, thermostatic valve that automatically pauses a shower’s water flow once it reaches bathing temperature” [2]. The thermostatic valve can be installed in-between the shower arm and existing showerhead, and it is expected to detect when near-bathing-temperature water (95F/35C) arrives at the shower head.

**Figure 7-2. Depiction of ShowerStart Device**



Source: [www.showerstart.com](http://www.showerstart.com)

Once installed and operational, the device is expected to automatically reduce the showerhead’s flow to a trickle, and as a result prevent hot water from unintentionally running down the drain while the user is away. When ready to begin showering, the user can pull the thermostatic valve’s fob to resume normal showerhead flow [3].

**Water Savings Potential and Calculation**

The potential to reduce hot water waste and produce energy savings from a shower restriction device depends primarily on accurate estimation of the time hot water arrives at the shower and the time an individual enters the shower. Limited information exists on how much hot water is avoided or wasted before a user gets into the shower after installing the device, and accordingly how long the wasted hot water is left to run. From a few available surveys and research studies on the functions of shower restriction devices, we can estimate the total time that passes between turning on the shower and entering the shower (pre-retrofit warm up wait time out of the shower spent on bathroom activities), and how much time it takes before the hot water arrives at the shower (cold water warm-up time). The difference between these two estimates represents the hot water wait time that could be prevented due to installation of the shower restriction device.

Table 7-3 below provides average estimates of the hot water wait time deduced from residential shower behavior studies. ShowerStart LLC estimates that total warm-up wait activities will take about 106 seconds to complete, while it takes 46 seconds for warm water to arrive at the shower, resulting in 60 seconds of hot water waste time that could have been prevented with the use of the ShowerStart device. Based on the results from a pilot study conducted by California’s City of San Diego Water Department, an average of 52 seconds of hot water waste time can be deduced [4]. The Pacific Gas and Electric Company (PG&E) relied on what they considered to be a conservative value of 34 seconds hot water waste time to calculate the potential savings from shower restriction devices in their service territory [5].

**Table 7-3. Estimates of Avoided Shower Hot Water Waste Time**

Study Type	Hot Water Waste Time (sec)	Sources (See reference section for study reports)
Survey	60	ShowerStart LLC
Survey	52	City of San Diego Water Department
Work Paper PGECODHW113	34	Pacific Gas and Electric Company (PG&E)

Sources: please see reference section

ShowerStart LLC estimated each ShowerStart installed in a typical single family home with 3 persons could yield up to 2700 gallons of water savings annually (assuming a 2.5 GPM showerhead). The City of San Diego estimated 2400 gallons annual savings for a similar household size. The PG&E conducted a more in depth analysis and came up with estimates for low flow 1.6 GPM showerheads, and estimated 296 gallons annual water savings for single family homes, and 435 gallons for multi-family homes.

It is important to note that it is possible the ShowerStart device may not realize any savings. A typical example would be a situation where an individual has a habit of opening the bath faucet during the warm up time, such that the showerhead is used immediately when the water temperature is deemed warm enough to start shower.

**Engineering Estimate of Water Savings from Using ShowerStart**

Using the Illinois TRM section 5.4.5, Navigant applied savings assumptions and algorithm for the showerhead replacement measure to estimate potential water and energy savings from installing a ShowerStart device. As shown in Table 7-4 below, savings estimates have been provided for both 2.67 GPM base flow showerheads and 1.5 GPM low flow efficient showerheads in single family and multi-family homes [6].

**Calculations:**

Annual Water Savings from ShowerStart = Avoided annual water use from showerhead

$$\text{Water savings for 2.67gpm showerhead installed with ShowerStart} = [((\text{GPM\_base\_SS} * \text{L\_showerstart}) * \text{Household} * \text{SPCD} * 365.25 / \text{SPH}) * \text{ISR\_ss}]$$

$$\text{Avoided water savings for 1.5gpm low flow showerhead installed with ShowerStart} = [((\text{GPM\_low\_SS} * \text{L\_showerstart}) * \text{Household} * \text{SPCD} * 365.25 / \text{SPH}) * \text{ISR\_ss}]$$

Where:

*GPM\_base\_SS= Flow rate of the base case showerhead with ShowerStart (2.67 for direct install)*

*GPM\_low\_SS= As-used flow rate of the low-flow showerhead with ShowerStart (used 1.5GPM)*

*Household= Average number of people per household (2.56 for single family, and 2.1 for multi-family)*

SPCD= Showers Per Capita Per Day (0.75)

365.25= Days per year, on average.

SPH= Showerheads Per Household (1.79 for single family, and 1.3 for multi-family)

ISR<sub>ss</sub>= In Service Rate of ShowerStart device (assumed 100%)

L<sub>showerstart</sub>= Hot water waste time avoided due to ShowerStart (60 seconds) per shower

For the purpose of this engineering estimate, we assumed on average 60 seconds of hot water waste time is avoided for installing thermostatic shower restriction device. This value is subject to review upon further detailed studies conducted within Illinois residential facilities to understand household shower behavior and the amount of water and energy that can be saved by installing shower restriction devices. This water savings estimate is applied for both electric water heaters and natural gas water heaters.

From Table 7-4, a ShowerStart device installed on a 1.5GPM low flow showerhead could save additional 588 gallons annually in a typical single family home and 664 gallons annually in a multi-family home in Illinois. These savings represent additional 16% and 17% increase respectively, given that the TRM estimated annual savings for installing low flow showerhead is 3,684 gallons for single family, and 3,948 gallons for multi-family home.

**Table 7-4. Potential Water Savings for ShowerStart Device in Illinois**

Water Savings Calculations	Single Family	Multi-Family
Water savings from installing ShowerStart on 2.67 GPM base showerhead (gallons/yr/ShowerStart)	1,046	1,182
Water savings from installing ShowerStart on 1.5 GPM low flow showerhead (gallons/yr/ShowerStart)	588	664
Percent increase in water savings on a 1.5 GPM low flow showerhead retrofit	16%	17%

Source: Navigant analysis

**Energy Savings Potential and Calculation**

Navigant estimated energy savings potential for both 2.67 GPM base flow showerheads and 1.5 GPM low flow showerheads installed with a ShowerStart device in a single family and multi-family homes.

**Engineering Estimate of Electric Energy Savings from ShowerStart**

As shown in Table 7-5 below, a ShowerStart device installed on a 2.67 GPM base flow showerhead could save an additional 133 kWh annually in a typical single family home and 150 kWh annually in a multi-family home in Illinois. A ShowerStart device installed on a 1.5 GPM low flow showerhead could save an additional 75 kWh annually in a typical single family home and 84 kWh annually in a multi-family home in Illinois. These savings represent additional 16% and 16% increase respectively, given that the TRM estimated annual energy savings for installing a 1.5 GPM low flow showerhead is 468 kWh for single family, and 528 kWh for a multi-family home.

**Calculations:**

Annual Electric Energy Savings from ShowerStart = Avoided annual electrical energy use from showerhead

Avoided electrical energy savings for 1.5 GPM low flow showerhead installed with ShowerStart =

$$\%ElectricDHW * (GPM\_low\_SS * L\_showerstart) * Household * SPCD * 365.25 / SPH) * EPG\_electric] * ISR\_ss$$

Where:

- %ElectricDHW = proportion of water heating supplied by electric resistance heating (100%)
- EPG\_electric = Energy per gallon of hot water supplied by electric (0.127 kWh/gallon)
- Other variables as defined above.

**Table 7-5. Potential Electric Energy Savings for ShowerStart Device in Illinois**

Electric Energy Savings Calculations	Single Family	Multi-Family
Electric Water Heater savings from installing ShowerStart on 2.67 GPM base showerhead (kWh/yr/ShowerStart))	133	150
Electric Water Heater savings from installing ShowerStart on 1.5 GPM low flow showerhead (kWh/yr/ShowerStart)	75	84
Percent increase in electrical energy savings on a 1.5 GPM low flow showerhead retrofit	16%	16%

Source: Navigant analysis

**Engineering Estimate of Electrical Demand Savings**

As shown in Table 7-6 below, annual peak demand savings for ShowerStart device installed on a 2.67 GPM base flow showerhead could be 0.009 KW in a typical single family home and 0.012 KW in a multi-family home in Illinois. Annual peak demand savings for ShowerStart device installed on a 1.5 GPM low flow showerhead could be 0.005 KW in a typical single family home and 0.007 KW in a multi-family home in Illinois.

**Calculations:**

Annual Peak Demand Savings from ShowerStart = Avoided annual peak demand from showerhead

$$\Delta kW = \Delta kWh/Hours * CF$$

Where:

- $\Delta kWh$  = calculated kWh value in Table-3 above
- Hours = Annual electric DHW recovery hours for showerhead use (431 for SF DI; 354 for MF DI)
- CF = Coincidence Factor for electric load reduction (=0.0278)



**Table 7-6. Potential Demand Savings for ShowerStart Device in Illinois**

Electric Demand Savings Calculations	Single Family	Multi-Family
Electric Water Heater savings from installing Peak Demand savings from installing ShowerStart on 2.67GPM base showerhead (KW/yr/ShowerStart)	0.009	0.012
Peak Demand savings from installing ShowerStart on 1.5GPM low flow showerhead (KW/yr/ShowerStart)	0.005	0.007

Source: Navigant analysis

**Engineering Estimate of Natural Gas Energy Savings**

As shown in Table 7-7 below, a ShowerStart device installed on a 2.67 GPM base flow showerhead could save an additional 5.6 therms annually in a typical single family home and 7.4 therms annually in a multi-family home in Illinois. A ShowerStart device installed on a 1.5 GPM low flow showerhead could save an additional 3.2 therms annually in a typical single family home and 4.2 therms annually in a multi-family home in Illinois. These savings represent additional 16% and 17% increase respectively, given that the TRM estimated annual energy savings for installing a 1.5 GPM low flow showerhead is 19.9 therms for single family, and 24.9 therms for a multi-family home.

**Calculations:**

Natural gas energy savings from ShowerStart = Avoided annual therms energy use from showerhead

$$\text{Avoided therms energy savings for 1.5gpm low flow showerhead installed with ShowerStart} = \%FossilDHW * ((GPM\_low\_SS * L\_showerstart) * Household * SPCD * 365.25 / SPH) * EPG\_gas * ISR\_ss$$

Where:

- %FossilDHW = proportion of water heating supplied by natural gas heating (100%)
- EPG\_gas = Energy per gallon of hot water supplied by gas (0.0054 therm/gal SF, 0.0063 Therm/gal MF)
- Other variables as defined above.

**Table 7-7. Potential Gas Therms Savings for ShowerStart Device in Illinois**

Gas Therm Savings Calculations	Single Family	Multi-Family
Natural gas energy savings from installing ShowerStart on 2.67 GPM base showerhead (therms/yr/ShowerStart)	5.6	7.4
Natural gas energy savings from installing ShowerStart on 1.5 GPM low flow showerhead (therms/yr/ShowerStart)	3.2	4.2
Percent increase in natural gas therms savings on a 1.5 GPM low flow showerhead retrofit	16%	17%

Source: Navigant analysis

### Cost Savings

The national average cost of water is approximately \$0.002/gallon, according to the United States Environmental Protection Agency [7]. The average cost to heat water from a standard gas water heater is estimated as \$0.008/gallon, and \$0.017 for an electric water heater [8]. Assuming that users typically turn their mixing valve all the way to the hot position in the warm-up process, and the average hot water cost savings for an electric water heater is \$0.02/gallon, gas water heating is \$0.01 per gallon, and the unit cost of ShowerStart is \$29.95, we can estimate the net savings in utility bills for each ShowerStart installed. Table 7-8 and Table 7-9 below illustrate potential cost savings for installing thermostatic shower restriction valves in multi-family and single family residences.

**Table 7-8. Potential Cost Savings from Installed ShowerStart device (Multi-family)**

Cost Savings for Multi-family	ShowerStart with 2.67 GPM base showerhead	ShowerStart with 1.5 GPM low flow showerhead
Water Savings (gallons/yr/ShowerStart)	1,182 gallons	664 gallons
Utility Bill Savings (\$/yr/ShowerStart)	\$23.64 Electric WH \$11.82 Gas WH	\$13.28 Electric WH \$6.64 Gas WH
Net Savings (bill savings - unit cost)	(\$6.31) Electric WH (\$18.13) Gas WH	(\$16.67) Electric WH (\$23.31) Gas WH
Simple Payback	1.3 years (Elec.) 2.6 years (Gas)	2.3 years (Elec.) 4.6 years (Gas)

Source: Navigant analysis

**Table 7-9. Potential Cost Savings from Installed ShowerStart device (Single Family)**

Cost Savings for Single Family	ShowerStart with 2.67 GPM base showerhead	ShowerStart with 1.5 GPM low flow showerhead
Water Savings (gallons/yr/ShowerStart)	1,046 gallons	588 gallons
Utility Bill Savings (\$/yr/ShowerStart)	\$20.92 Electric WH \$10.46 Gas WH	\$11.76 Electric WH \$5.88 Gas WH
Net Savings (bill savings - unit cost)	(\$9.03) Electric WH (\$19.49) Gas WH	(\$18.19) Electric WH (\$24.07) Gas WH
Customer Payback Period	1.4 years (Elec.) 2.9 years (Gas)	2.5 years (Elec.) 5.1 years (Gas)

Source: Navigant analysis

### Conclusion

As discussed above, additional 16 percent of water and energy savings may be realized from installing a ShowerStart device on a 1.5 GPM efficient showerhead. Additional cost savings ranging from an estimated \$6.00 to \$24.00 may be accrued from installing a ShowerStart device in single family and multi-family homes.

### Suggested Additional Research

- Further studies are required to understand users' shower behavior, and to enable accurate determination of the pre-shower hot water wait time in the State of Illinois.
- Further research is necessary to investigate the showerhead flow rate during trickling due to operation of the shower restriction valve.
- Further research is necessary to investigate how much hot water is wasted before a user enters into the shower when a shower restriction valve is installed, and how long this wasted hot water is left to run.
- Further studies could focus on investigating whether shower restriction valves interfere with the flow rate and consequently affect the energy savings from a low flow showerhead, causing savings estimates to be revised for one or both devices.
- Research on shower behaviors should include the impact of situations where users normally open the faucet tap during the warm up time. Such discussion was lacking in the reference materials, but the possibility could render the thermostatic restriction valve virtually non-operational, and thus produce zero savings. Alternatively, if the pre-retrofit scenario involved hot water waste through the faucet and post-retrofit behavior changed to using the showerhead for warm up time, savings could be greater.

### References

- [1] ShowerStart LLC ([www.showerstart.com](http://www.showerstart.com))
- [2] "Simply & Cost Effectively Reducing Shower Based Warm-Up Waste: Increasing Convenience & Conservation by Attaching ShowerStart to Existing Showerheads" (ShowerStart LLC, 2008).
- [3] "Identifying, Quantifying and Reducing Behavioral Waste in the Shower: Exploring the Savings Potential of ShowerStart" (ShowerStart LLC, May 2013).
- [4] "Water Conservation Program: ShowerStart Pilot Project White Paper", (City of San Diego, CA, August 2008).
- [5] Pacific Gas and Electric Company (Work Paper PGECODHW113, Low Flow Showerhead and Thermostatic Shower Restriction Valve, Revision # 4, August 2012).
- [6] Illinois Statewide Technical Reference Manual for Energy Efficiency (June 2013, Version 2.0, section 5.4.5).
- [7] [www.epa.gov/safewater](http://www.epa.gov/safewater), "Water on Tap, What You Need to Know", 2009.
- [8] Smart Energy Design Assistance Center, University of Illinois, Urbana, Champaign; Newsletter Vol. 6, No. 6, June 2010, ([www.sedac.org](http://www.sedac.org)).

### 7.2.2 Net Program Impact Results

In GPY2, the Net-to-Gross Ratio (NTGR) estimates used to calculate the Net Verified Savings were deemed through a negotiation process by the Illinois Stakeholder Advisory Group (SAG)<sup>34</sup> based on GPY1 evaluation research. The Net-to-Gross Ratio for gas measures installed in residential dwelling units was 0.96 and for measures installed in common areas was 0.93. Navigant applied the deemed program NTGR to obtain verified net savings for each program component. The program-level NTGR is verified net savings/verified gross savings based on evaluation research findings. As noted in Section 2.1.4, the GPY2 evaluation plan did not include new free-ridership or spillover research.

### 7.3 Detailed Process Results

Process research related to the EPY5/GPY2 evaluation report was limited to interviews with program staff and the implementation contractor staff to verify information about the Multi-Family program’s measures, tracking system and quality assurance /quality control procedures.

The program evaluation plan for GPY2 included a review or development of a program logic model and program theory for the new program component implemented in GPY2,<sup>35</sup> as well as a review of multi-family program best practices. Navigant’s multi-family program best practices research is presently underway and will be reported on separately in a memo and incorporated into the GPY3 evaluation report.

### 7.4 TRM Recommendations

As detailed in Section 7.2.1 above, Navigant conducted evaluation research into two measures that may assist the Illinois TRM Technical Advisory Committee annual updating process.

Steam Pipe Insulation Measures – Heat Loss Correction Factor

Please see Section 7.2.1.1 of this report.

Thermostatically Initiated Shower Restriction Valve

Please see Section 7.2.1.2 of this report.

### 7.5 Data Collection Instruments

The GPY2 evaluation plan did not include developing new data collection instruments for this program evaluation.

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<sup>34</sup> [http://ilsagfiles.org/SAG\\_files/Meeting\\_Materials/2013/August 5-6, 2013 Meeting/Nicor Gas Net-to-Gross Results and Application GPY1-3.pdf](http://ilsagfiles.org/SAG_files/Meeting_Materials/2013/August 5-6, 2013 Meeting/Nicor Gas Net-to-Gross Results and Application GPY1-3.pdf), which is to be found on the IL SAG web site here: <http://ilsag.info/net-to-gross-framework-1.html>.

<sup>35</sup> ComEd developed a program logic model and program theory for the new ComEd-Nicor Gas MCEEP program component implemented in GPY2.

## 7.6 EPY6-GPY3 Program Logic Model – Preliminary Program Document

The EPY6-GPY3 program logic model below was developed by ComEd for the jointly implemented MCEEP program and provided to Navigant in June 2013. This program logic model is a preliminary program document from ComEd program staff. Navigant has not reviewed this EPY6-GPY3 logic model.

