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From: Christy Zook, Peter Vigilante, Mike Freed, Navigant

CC: Kevin Grabner, Laura Agapay-Read, Randy Gunn, Navigant

Date: September 6, 2018 (Interim Update, September 13, 2018)

Re: Net-to-Gross Research Results from GPY6 and CY2018 for the Nicor Gas Home Energy Savings Program

This memo presents our free ridership and spillover research results for the GPY6 and CY2018 Nicor Gas Home Energy Savings (HES) Program using the Illinois TRM version 6.0 methodologies.¹ The net-to-gross (NTG) surveys were fielded in Summer 2018. Navigant conducted telephone surveys with 100 GPY6 participants that participated in the program between June 2016 and July 2017 to assess spillover as well as 213 GPY6 and CY2018 participants that participated in the program between August 2017 and June 2018 to assess free ridership. The GPY6 and CY2018 participant free ridership and spillover results provide updated findings relative to prior NTG research for this program which was conducted in GPY1 and GPY2.

Table 1 below provides a summary of the Home Energy Savings Program GPY6 and CY2018 participant free ridership and GPY6 spillover research findings. Navigant estimated free ridership for each program measure, excluding advanced thermostats². Together the researched measures comprise almost 90 percent of the GPY6 evaluated program savings. In total, 313 interviews were completed with GPY6 and CY2018 Nicor Gas participants. Participant free ridership scores were averaged to yield a measure-level free ridership estimate, and the measure-level estimates were weighted by GPY6 verified gross therms to the program level. Navigant estimated population participant spillover and various program subcomponent free ridership rates are provided in the Appendix to reflect different scenarios for applying the measure-level findings.

¹ Illinois Statewide Technical Reference Manual for Energy Efficiency, Version 6.0, Volume 4: Cross-Cutting Measures and Attachments, effective January 1st, 2018.

² Advanced thermostats were excluded from this NTG research as the TRM-derived savings estimates for advanced thermostats installed through the program are net savings and do not require NTG adjustment.

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Table 1. Participant Free Ridership and Spillover Results (GPY6 and CY2018 Participants)

Program Path	Measure	Population Weights FR	Participant Average FR Score	Relative Precision @ 90% CI	Participant SO
Direct Install (DI)	Showerhead	0.22	0.12	31%	
	Kitchen Aerator	0.02	0.22	23%	
	Bathroom Aerator	0.01	0.10	35%	
	Programmable Thermostat	0.13	0.26	21%	
	Re-Programming Thermostat	0.11	0.44	13%	
	Hot Water Pipe Insulation	0.02	0.08	35%	
	Water Heater Temperature Setback	0.01	0.09	31%	
Air Sealing & Insulation (ASI)	Attic Insulation	0.19	0.31	12%	
	Wall Insulation	0.01	0.25	NA	
	Basement/Sidewall Insulation	0.01	0.25	0%	
	Air Sealing	0.24	0.25	15%	
	Duct Sealing	0.03	0.35	NA	
Population		1.00			0.07

Source: Navigant analysis of data from a CATI surveys conducted with Nicor Gas GPY6 and CY2018 Home Energy Savings Program participants.

FR = Free Ridership; SO = Spillover

For comparison, the GPY6 deemed net to gross value is presented below.

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Table 2. GPY6 Deemed NTG Values

Measure Category	FR	SO	NTG
Overall HES Program	0.09	0.14	1.05

Source: Nicor Gas Energy Efficiency Programs Summary of Deemed NTG Values for GPY1 through GPY7 Updated to include Final NTG Values for GPY7. March 1, 2017.

These values are based on evaluation research conducted in GPY1 and GPY2. Statewide NTG protocols were not established when the research was conducted in GPY1 and GPY2.

Free Ridership and Spillover Research Data Collection

The free ridership research was conducted using a customer self-report approach through a computer-assisted telephone interviewing (CATI) survey with 213 participants from a census of 3,582 Nicor Gas GPY6 and CY2018 participants. The spillover research was also conducted using a customer self-report approach through a CATI survey with 100 participants from a random sample of 4,643 GPY6 participants. The counts for the completed participant interviews and sample design are outlined in Table 3. Participants that installed multiple measures were interviewed for up to two measures, and the 213 free ridership interviews covered 362 installed measures. After reviewing the response data, Navigant excluded 35 measure installations from the free ridership sample because of failed consistency checks or lack of required data to conduct the free ridership analysis. The free ridership was estimated from the remaining 327 measure installation responses. A detailed discussion of Navigant’s analysis of responses that triggered the free ridership consistency checks as well as survey sample disposition are provided in the Appendix at the end of this memo. All 100 spillover interviews were included in the spillover analysis.

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Table 3. Free Ridership and Spillover Research Decision Maker Survey Disposition

NTG Component	Measure	Number of Usable Contacts	Target Completes	Measure Installations Covered by Completed Interviews*	Excluded from the Analysis	Analyzed Completes†
Free Ridership						
	Showerhead	655	70	90	7	83
	Kitchen Aerator	294	70	23	2	21
	Bathroom Aerator	547	70	67	4	63
	Programmable Thermostat	395	70	31	2	29
	Re-Programming Thermostat	257	70	16	4	12
	Hot Water Pipe Insulation	354	70	24	5	19
	Water Heater Temperature Setback	241	70	18	0	18
	Attic Insulation	380	70	45	3	42
	Wall Insulation	42	42	1	0	1
	Basement/Sidewall Insulation	17	17	3	1	2
	Air Sealing	356	70	42	6	36
	Duct Sealing	44	44	2	1	1
	Overall Population	3,582	733	362	35	327
Spillover		4,643	100			100

Source: Navigant analysis of data from CATI surveys conducted with GPY6 and CY2018 Nicor Gas Home Energy Savings program participants.

*The call center completed free ridership interviews 213 participants. Participants that installed multiple measures were interviewed for up to two measures, and each measure installation is counted in the 362 total.

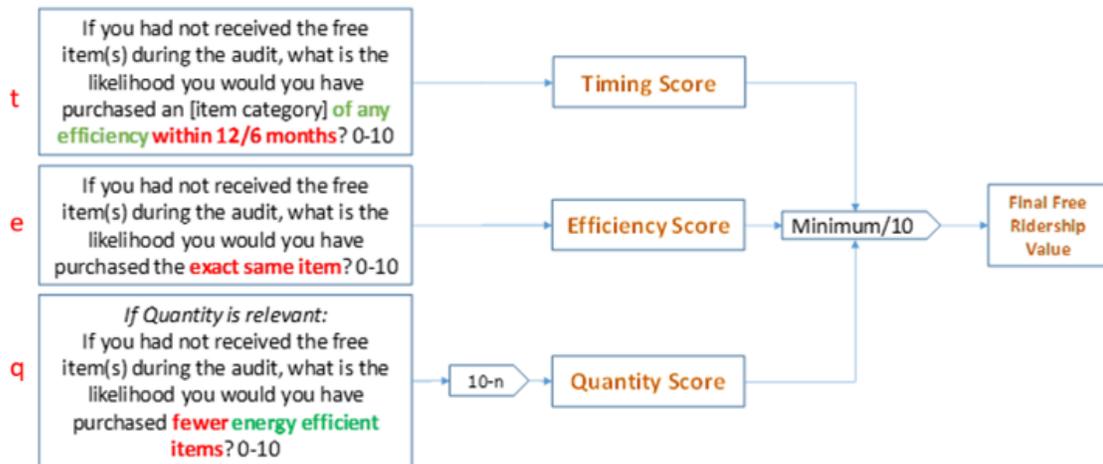
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† Analyzed Completes provides the interview count used to develop the free ridership and spillover estimates. Analyzed Completes excludes responses that failed consistency checks or lacked required data (discussed in the Appendix below).

Free Ridership Estimates Using Algorithms in the TRM Version 6.0

The following diagrams describes the IL TRM v6.0 free ridership algorithms for residential single-family home energy audit programs (protocol 4.5) and residential prescriptive rebate with no audit programs (protocol 4.4).

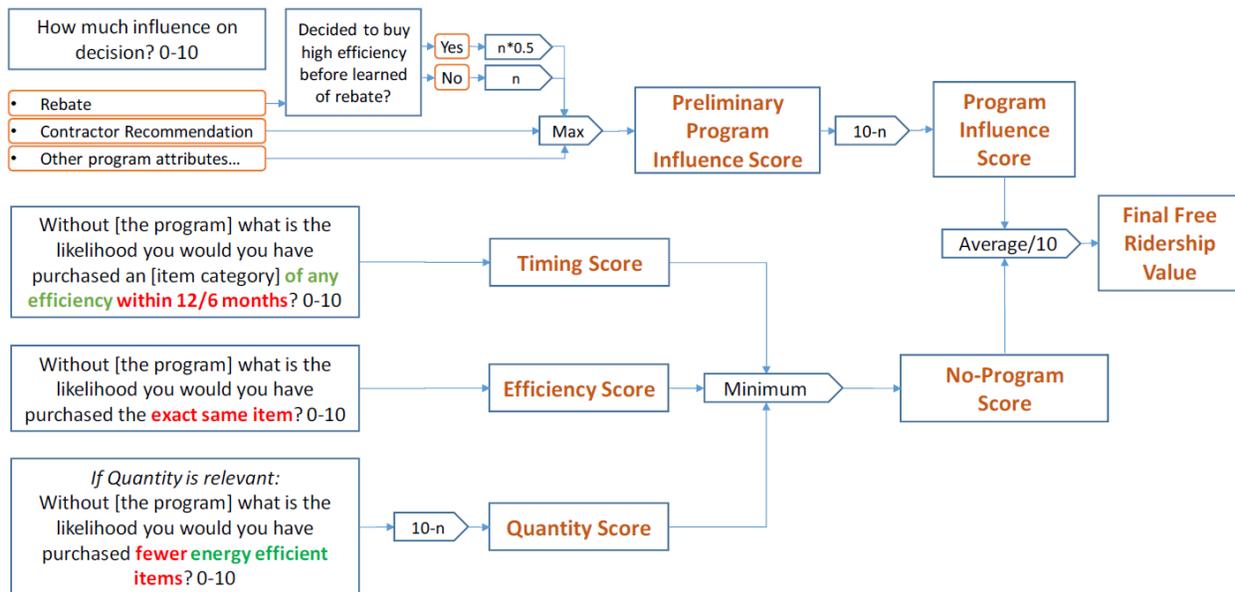
Figure 1. Residential Single-Family Home Energy Audit Free Ridership – No Cost Measures



Source: Illinois TRM Version 6, Volume 4. Cross-Cutting Measures and Attachments, final February 8, 2017, effective January 1st, 2018.

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Figure 2. Residential Prescriptive Rebate (With No Audit) Free Ridership



Source: Illinois TRM Version 6, Volume 4. Cross-Cutting Measures and Attachments, final February 8, 2017, effective January 1st, 2018.

Navigant applied the free ridership algorithms from the Prescriptive Rebate (With No Audit) Protocol and the Single-Family Home Energy Audit Protocol in the IL TRM version 6.0 document.³ Free ridership estimates for the direct install measures were calculated using the algorithm for no cost measures shown in Figure 1 above, and free ridership estimates for air sealing and insulation measures were calculated using the algorithm for prescriptive measures shown in Figure 2 above.

Participant Spillover Estimation

The respondents were asked in the telephone survey if they had installed any additional natural gas saving measures to reduce energy consumption since participating in the Home Energy Savings Program. Navigant included 19 questions to identify spillover candidates and estimate savings.⁴ These questions addressed three general aspects, paraphrased below:

³ The referenced TRM document can be accessed here: http://ilsagfiles.org/SAG_files/Technical_Reference_Manual/Version_6/Final/IL-TRM_Effective_010118_v6.0_Vol_4_X-Cutting_Measures_and_Attach_020817_Final.pdf.

⁴ Respondents do not answer all 19 questions – follow-up questions are skipped depending on earlier responses.

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1. Since participating in the program, did you make additional energy efficiency improvements that were not rebated by a utility program?
2. How much influence did your participation in the program have on your making additional energy efficiency improvements?
 - a. On a zero to ten scale, where zero is not at all important and ten is extremely important, how important was your participation in the Home Energy Savings program on your decision to make additional energy efficiency improvements outside of a utility program? [Attribution Score 1.]
 - b. If you had not participated in the Home Energy Savings program, how likely is that you would have made additional energy efficiency improvements? Please use a zero to ten scale, where zero means that you definitely would not have made additional energy efficiency improvements and ten means that you definitely would have made them? [Attribution Score 2.]
3. What were details of the energy efficiency improvements (equipment, efficiency level, quantity, etc.)?

The evaluation attributed spillover to the Home Energy Savings Program if the following condition is met: the average of Attribution Score 1 and (10 minus Attribution Score 2) must exceed 5.0.⁵ Of the 100 survey respondents, 33 reported that they installed additional energy efficient equipment, and 21 of them indicated that participating in the Home Energy Savings Program influenced them to make these additional purchases. Navigant determined that 17 of those 21 had spillover averaged attribution scores greater than five. Five of those 17 installed natural gas measures, but only four installed equipment with quantifiable natural gas savings,⁶ which included an advanced thermostat, programmable thermostat, high efficiency gas water heater, and high efficiency furnace as shown in Table 4 below.

⁵ The spillover methodology is guided by NTG protocols in the Illinois TRM Version 6, Volume 4. Cross-Cutting Measures and Attachments, final February 8, 2017, effective January 1st, 2018.

⁶ Electric-saving spillover actions are not credited to the natural gas spillover.

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Table 4. Distribution of Reported Energy Savings by Respondent

Participant	Measure Installed	Spillover therms	Proportion of Total Spillover therms
Respondent 1	Advanced Thermostat	74.37	24%
Respondent 2	Programmable Thermostat	62.31	20%
Respondent 3	High Efficiency Gas Water Heater	12.99	4%
Respondent 4	High Efficiency Furnace	158.37	51%
Overall Population		308.04	100%

Source: Navigant analysis of data from CATI spillover telephone surveys conducted with GPY6 Home Energy Savings Program participants

Together, the therm savings from these improvements amounted to seven percent of program savings for the 100 respondents. Because the 100 were selected as a simple random sample, their spillover savings rate is representative of the population of GPY6 program participants.

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APPENDIX

Free Ridership Sample Disposition and Consistency Check Analysis

Of the 362 measure installations captured in the raw interview data, 25 measure installations were excluded from the free ridership calculation due to non-response on required free ridership scoring data.

Of the remaining responses, 62 (41 direct install and 21 air sealing and insulation) triggered consistency checks. These respondents answered questions indicating that the program was both highly influential and inconsequential to their decision to install a measure through the program. The consistency check methodology involved having two independent reviewers examine these respondents' numeric responses and their responses to open-ended probing questions which were triggered by their inconsistent numeric responses. Responses were excluded from the free ridership calculation if both reviewers found that the open-ended response was inconsistent with the numeric responses. This resulted in a total of 10 (six direct install and four air sealing and insulation) measure installations excluded due to inconclusive influence explanations (10 exclusions total out of 62 consistency checks).

As summarized in the tables below, Navigant's survey of 213 free ridership participants covered 362 measure installations (269 direct install and 93 air sealing and insulation measures), of which 35 (24 direct install and 11 air sealing and insulation measures) were excluded for missing or inconsistent data. Navigant's recommended free ridership estimates are based on the remaining 327 responses (362 minus 35).

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Table 5. Free Ridership Survey Disposition for Direct Install Measures

Measure Response Disposition	Showerhead	Kitchen Aerator	Bathroom Aerator	Pgm. T-stat	RePgm. T-stat	Pipe Insulation	Water Heater Temp. Setback	Total
Measure installations covered by interviews	90	23	67	31	16	24	18	269
Excluded: Non-response	4	2	4	1	4	3	0	18
Excluded: Triggered and Failed Consistency Check	3	0	0	1	0	2	0	6
Total of Excluded Responses	7	2	4	2	4	5	0	24
Analyzed Sample	83	21	63	29	12	19	18	245
Included in Analyzed Sample: Triggered and Passed Consistency Check	14	2	5	8	4	2	0	35

Source: Navigant analysis of data from CATI surveys conducted with GPY6 and CY2018 Nicor Gas Home Energy Savings Program participants.

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Table 6. Free Ridership Survey Disposition for Air Sealing and Insulation Measures

Measure Response Disposition	Attic Insulation	Wall Insulation	Basement Insulation	Air Sealing	Duct Sealing	Total
Measure installations covered by interviews	45	1	3	42	2	93
Excluded: Non-response	0	0	1	5	1	7
Excluded: Triggered and Failed Consistency Check	3	0	0	1	0	4
Total of Excluded Responses	3	0	1	6	1	11
Analyzed Sample	42	1	2	36	1	82
Included in Analyzed Sample: Triggered and Passed Consistency Check	8	0	0	8	1	17

Source: Navigant analysis of data from CATI surveys conducted with GPY6 and CY2018 Nicor Gas Home Energy Savings Program participants.

Table 7 below shows free ridership results for each measure with and without excluded responses from the consistency check analysis.

Table 7. Free Ridership with and without Consistency Check Exclusions

Program Path	Measure	Participant Average FR Score	Participant Average FR Score
		(with Consistency Check Exclusions)	(without Consistency Check Exclusions)
Direct Install (DI)	Showerhead	0.12	0.15
	Kitchen Aerator	0.22	0.22
	Bathroom Aerator	0.10	0.10
	Programmable Thermostat	0.26	0.26
	Re-Programming Thermostat	0.44	0.44
	Hot Water Pipe Insulation	0.08	0.14
	Water Heater Temperature Setback	0.09	0.09
Air Sealing & Insulation (ASI)	Attic Insulation	0.31	0.33
	Wall Insulation	0.25	0.25
	Basement/Sidewall Insulation	0.25	0.25
	Air Sealing	0.25	0.25
	Duct Sealing	0.35	0.35

Source: Navigant analysis of data from CATI surveys conducted with GPY6 and CY2018 Nicor Gas Home Energy Savings Program participants.

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Free Ridership Component Scores

To estimate free ridership for direct install measures according to the TRM, the evaluation team took the minimum of three component scores (timing, efficiency, and quantity) and divided it by 10, as shown in

Figure 1. Table 8 below shows the average for each component score as well as the average FR score, for each direct install measure.

Table 8. Free Ridership Component Scores for Direct Install Measures

Measure	Participant Average timing (t) score	Participant Average efficiency (e) score	Participant Average quantity (10-q) score	Participant Average FR Score
Showerhead	2.4	1.8	3.8	0.12
Kitchen Aerator	3.3	2.2	3.0	0.22
Bathroom Aerator	1.8	1.5	2.9	0.10
Programmable Thermostat	3.9	3.3	0.0	0.26
Re-Programming Thermostat	6.0	4.9	NA	0.44
Hot Water Pipe Insulation	1.0	2.3	NA	0.08
Water Heater Temperature Setback	2.3	1.4	NA	0.09

Source: Navigant analysis of data from CATI surveys conducted with GPY6 and CY2018 Nicor Gas Home Energy Savings Program participants.

To estimate free ridership for air sealing and insulation measures according to the TRM, the evaluation took the average of the Program Influence score and the No Program score and divided by 10, as shown in Figure 2. Table 9 below shows the average Program Influence and No Program scores as well as the average free ridership score for each air sealing and insulation measure.

Table 9. Free Ridership Component Scores for Air Sealing and Insulation Measures

Measure	Participant Average No Program (NP) Score	Participant Average Program Influence (PI) Score	Participant Average FR Score
Attic Insulation	4.5	1.7	0.31
Wall Insulation	3.0	2.0	0.25
Basement/Sidewall Insulation	4.0	1.0	0.25
Air Sealing	3.7	1.2	0.25
Duct Sealing	7.0	0.0	0.35

Source: Navigant analysis of data from CATI surveys conducted with GPY6 and CY2018 Nicor Gas Home Energy Savings Program participants.

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Applying Free Ridership and Spillover Component Scores to the HES Program

Navigant estimated population participant spillover and various program subcomponent free ridership rates to reflect different scenarios for applying the measure-level findings from this research study. Air sealing installed with attic insulation is a separate NTG scenario defined by the Illinois TRM version 7.0 and does not use the results of this HES survey research. Following is the air sealing plus attic insulation NTG approach and three valid approaches for applying the findings of this HES NTG research to set program NTG values.

All scenarios of Air Sealing plus Attic Insulation Installed in the Same Project (with or without additional measures installed in the same project)

Applies only in scenarios where air sealing and attic insulation are installed at the same time, and only if the savings for natural gas heating are estimated using the Illinois TRM Version 7.0, Section 5.6.1 (Air Sealing) and Section 5.6.5 (Ceiling/Attic Insulation) adjustment factor of 72% that was derived from air sealing and insulation research by Navigant (2018). See Navigant (2018) ComEd and Nicor Gas Air Sealing and Insulation Research Report. The 72% adjustment factor was derived from a gas consumption data regression analysis with an experimental design that does not require further net savings adjustment.

NTG Application Approach 1: Include Programmable Tstats as a Direct Install Measure, use separate NTGs for DI and weatherization measures

- a. Direct Installation measures (Values shown cover all DI measures INCLUDING programmable thermostats as direct install measures)
 - NTG 0.84
 - Free ridership 23%
 - Spillover 7%
- b. All scenarios of Air Sealing plus Attic Insulation Installed in the Same Project (with or without additional measures installed in the same project)
 - NTG: Use 72% TRM savings adjustment factor and no further NTG adjustment
- c. Weatherization measures: Duct Sealing and Insulation Measures (excluding attic insulation) applied as single measures or combined, alone or in combination with DI measures or air sealing plus attic insulation. Air sealing applied without attic insulation, alone or in combination with other measures:
 - NTG 0.81
 - Free ridership 26%
 - Spillover 7%

NTG Application Approach 2: Exclude Programmable Tstats as a Direct Install Measure, use separate NTGs for DI and weatherization measures

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- a. Direct Installation measures (Values shown cover all DI measures EXCLUDING programmable thermostats as direct install measures)
 - NTG 0.86
 - Free ridership 21%
 - Spillover 7%

- b. All scenarios of Air Sealing plus Attic Insulation Installed in the Same Project (with or without additional measures installed in the same project)
 - NTG: Use 72% TRM savings adjustment factor and no further NTG adjustment

- c. Weatherization measures: Duct Sealing and Insulation Measures (excluding attic insulation) applied as single measures or combined, alone or in combination with DI measures or air sealing plus attic insulation. Air sealing applied without attic insulation, alone or in combination with other measures:
 - NTG 0.81
 - Free ridership 26%
 - Spillover 7%

NTG Application Approach 3: Exclude Programmable Tstats as a Direct Install Measure, use a combined NTG for DI and weatherization measures

- a. All scenarios of Air Sealing plus Attic Insulation Installed in the Same Project (with or without additional measures installed in the same project)
 - NTG: Use 72% TRM savings adjustment factor and no further NTG adjustment

- b. DI and Weatherization measures: All DI measures (excluding programmable Tstats) and all weatherization measures (excluding air sealing plus attic insulation) applied as single measures or combined, alone or in combination with air sealing plus attic insulation. Air sealing applied without attic insulation, alone or in combination with other measures:
 - NTG 0.85
 - Free ridership 22%
 - Spillover 7%