Guidehouse

Residential Education and Outreach Program Impact Evaluation Report

Home Energy Reports

Energy Efficiency Plan Year 2020
(1/1/2020 - 12/31/2020)

Prepared for:

Peoples Gas and North Shore Gas

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PGL and NSG Home Energy Reports Impact Evaluation Report

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E. EXECUTIVE SUMMARY

This report summarizes Guidehouse's findings and results from the impact evaluation of Calendar Year 2020 (CY2020)[1] of the Peoples Gas (PGL) and North Shore Gas (NSG) Home Energy Reports (HER) program. Based on guidance from the Illinois Stakeholder Advisory Group (SAG), Guidehouse normalized CY2020 program savings for the effect of the coronavirus pandemic.[2] Initially launched in 2013, the program is designed to generate energy savings by providing residential customers with information about their energy use and energy conservation suggestions and tips. Program participants receive information in the form of paper and email home energy reports, and via the customer's energy management portal online.

An important feature of the PGL and NSG HER program is that it is designed as a randomized controlled trial (RCT).[3] Customers in the target group of residential customers from each utility are randomly assigned to either the recipient group or the control (non-recipient) group to estimate changes in energy use due to the program. Customers may opt *out* of the program at any time, but cannot opt *in* due to the RCT design. An implication of the RCT design is that the savings estimates are intrinsically net of free-ridership and most spillover bias. Unless otherwise noted, reported "savings" in this report refer to *normalized net savings*.[4]

In CY2020, the program included three waves of customers: one for PGL and two for NSG. Each utility launched one wave in October 2013 and then restructured its HER program during 2017 to drop many of the treatment customers. Many of the dropped customers were added back into the program throughout 2019 and 2020, with NSG reaching its pre-reduction size (less attrition) in March 2019, and PGL in September 2020.[5] NSG also launched a new wave in September 2019. Each treated customer was included in the evaluation only for the period after it (re)started getting reports. Treated customer counts for each of these waves throughout the year are summarized in Table E-1.

Table E-1. CY2020 Peoples Gas and North Shore Gas HER Program Customer Counts

Wave	Treated Customer Counts*	
	2020-01-01	2020-09-01
PGL	78,000	91,000
NSG	56,000	-
NSG – Sept 2019 Wave	18,000	-

Source: Guidehouse analysis of PGL and NSG customer billing data.
* Customer counts are rounded to the nearest 1,000.

[1] CY2020 began January 1, 2020 and ended December 31, 2020.

[2] This decision is documented in meeting notes from the June 11 and August 24, 2020 SAG meetings (available at https://www.ilsag.info/events/list).

[3] In selecting each wave, the program implementer, Oracle, randomly allocated targeted PGL and NSG residential customers between participant and control groups. As each wave was added, Guidehouse confirmed that the usage data was consistent with an RCT design.

[4] In some instances, the word "net" appears in column headings and summary sentences for added clarity. For CY2020 specifically, the reported savings are normalized savings.

[5] Since these added customers were part of the original RCT design, adding them back into their original program waves does not disrupt the statistical validity of the evaluation.

E.1 Program Savings

Table E-2 summarizes the HER Program's CY2020 natural gas savings. The savings values in the table represent savings normalized for the effects of COVID-19 using an approach agreed upon by Guidehouse, the utilities, and the implementer, which leverages historical savings trends. These savings reflect adjustments for uplift,[6] as well as CY2018 and CY2019 persisting savings.[7] The normalized savings methodology is described in Section 2.1.

For the original PGL and NSG waves, the CY2020 evaluation reflects savings from January 1 to December 31, 2020, as usual. For the NSG September 2019 wave, the CY2020 savings reflect savings from the wave launch (September 1, 2019) to December 31, 2020. Savings were not claimed for this wave in CY2019 as the savings from September 1, 2019 to December 31, 2019 were not statistically different from zero. Guidehouse, the utilities, the implementer, and Illinois Commerce Commission (ICC) staff agreed that these savings can be counted with the next program year to avoid penalizing the gas companies for the heating season starting so late in the program year. Persistence from 2019 into 2020 is subtracted from the CY2020 savings estimate.

Guidehouse verified net savings of 1,031,533 therms for PGL and 614,415 therms for NSG, respectively. The persistence adjustment reduced savings by approximately one-third and also is accounted for by the implementer in its *ex ante* savings estimates. However, the implementer's *ex ante* savings reflect actual, rather than normalized savings for CY2020, leading to the large difference. A comparison of actual savings gives realization rates of 136% for PGL and 173% for NSG. The remaining difference is partially caused by the fact that the implementer does not account for uplift, which reduced savings by approximately 3%, and potentially differences in the way the implementer and the evaluation team calculate persistence, particularly in the calculation of retention rates.

[6] Uplift refers to the impact of the HER program on enrollment in *other* PGL and NSG EE programs. In the normalized savings, uplift is already accounted for in the historic data used to produce savings. To avoid double-counting the savings from this indirect effect, Guidehouse subtracts the estimated uplift savings from the total HER program savings, including legacy uplift from prior years (see Section 2.2.4 for details). The fact that uplift savings is subtracted from the HER programs' total energy savings does not indicate that the uplift savings was not *caused by* the HER programs, or that the HER programs shouldn't be credited for its occurrence. It is an accounting adjustment to avoid double-counting when aggregating savings over multiple EE programs. Indeed, the existence of uplift is an indicator of successful cross-marketing by the HER programs, and thus should be seen as an added program benefit.

[7] This adjustment is prescribed in the *Adjustments to Behavior Savings to Account for Persistence* measure in the Illinois Technical Reference Manual (TRM). See TRM, Measure 6.1.1, Volume 4, Version 8.0. See Section 2.2.3 for details.

Table E-2. CY2020 Peoples Gas and North Shore Gas HER Program Net Savings

Wave	*Ex Ante* Savings (Therms)*	Verified Unadjusted Savings (Therms)†	Persistence Adjustment (Therms)‡	Final Verified Savings (Therms)	Verified Realization Rate§
PGL	656,325	1,466,209	434,676	1,031,533	157%
NSG	297,590	896,189	387,483	508,706	206%
NSG – Sept 2019 Wave#		112,284	6,575	105,709	

Source: Guidehouse analysis of PGL and NSG customer billing data.
* Note that these values represent ex ante savings prior normalization for COVID-19. Comparing these to Guidehouse's actual savings (without normalizing) results in net realization rates of 136% for PGL and 173% for NSG.
† Verified unadjusted savings account for uplift (which is inherently accounted for in the normalization method) but not persistence.
‡ This adjustment reduces savings reduces the savings by the amount attributable to sending reports in CY2018 and CY2019 and is prescribed in the *Adjustments to Behavior Savings to Account for Persistence* measure in the Illinois Technical Reference Manual (TRM). See TRM, Measure 6.1.1, Volume 4, Version 8.0.
§ The verified realization rate compares final verified savings with *ex ante* savings.
# Savings reflect September 2019 to December 2020. Persistence from September to December 2019 into 2020 are removed from the estimate.

E.2. Program Volumetric Detail

Table E-3 presents participation details for the CY2020 PGL and NSG HER programs. The PGL wave had normalized savings of 0.045 therms per day (1.04%) in CY2020, while the original NSG wave had 0.045 therms per day (1.28%) and the NSG September 2019 wave had 0.014 therms per day (0.40%).

Table E-3. CY2020 Peoples Gas and North Shore Gas HER Program Participation Detail

Utility	Number of Participants	Number of Controls	Average Participant Net Savings per Day (Therms)	Average Annual Participant Net Savings (Therms)	Implied Percentage Savings*
PGL	91,163	12,729	0.045	16.43	1.04%
NSG	55,670	12,988	0.045	16.43	1.28%
NSG – Sept 2019 Wave*	17,932	14,494	0.014†	5.11	0.40%

Source: Guidehouse analysis of PGL and NSG customer billing data.
* The implied percentage savings are equal to the normalized savings per day divided by the actual baseline usage per day.
†This value represents a weighted average of the 0.007 therms per day assumed for 2019 and 0.016 assumed for 2020.

E.3 Findings and Recommendations

For PGL's HER program, Guidehouse verified CY2020 impacts of 1,031,533 therms; and for NSG, the corresponding figure was 614,415 therms.

Finding 1. CY2020 marked the third year since the program measure life was revised from 1 to 5 years, with savings decay in the TRM associated with each year. Continuous treatment of customers required adjustment of the current year's savings for the persisting savings claimed as part of the previous years'

impacts. In CY2020, the evaluation team reduced total savings by 33% to account for persisting savings from CY2018 and CY2019 interventions.

Finding 2. The pandemic overshadowed CY2020, which led to stay at home orders, social distancing, and sustained work-from-home behaviors from March and through much of 2020. Program verified net savings in CY2020 were normalized to adjust for the effects of the pandemic using historical savings data. Alongside normalized savings, the evaluation team modeled actual savings from CY2020 to offer a point of comparison. Normalized savings were on average 11% higher than actual savings when adjusted for uplift, and 17% higher when adjusted for persisting savings along with uplift. Should pandemic-induced behaviors persist and translate into the new normal, misalignment of persisting normalized savings with actual customer behaviors can result in steeper than warranted reductions in future years' verified savings, presenting a source of uncertainty and risk for the program.

Recommendation 1. The evaluation team, PGL and NSG, and the implementer should monitor future longer-term market trends and customer behaviors caused by the pandemic to assess and anticipate the risk associated with savings claims.

Finding 3. The program realization rate was 157% for PGL and 206% for NSG, although comparing to actual savings gives realization rates of 136% and 173%, respectively. High realization rates have been a trend for this program for several years, as shown in Table 4-1, although the CY2020 rates are particularly high. Discussions with the implementer for other Illinois evaluations revealed differences in the way the implementer calculated persistence, and particularly retrospective retention rates, compared to the evaluation team. This is a possible cause of the high realization rates.

Recommendation 2. Prior to the start of the 2021 heating season, the implementer and the evaluation team should work together to identify drivers of the high realization rates and work to more closely align any discrepancies for CY2021.

1. INTRODUCTION

This report presents a summary of the findings and results from the impact evaluation of calendar year 2020 (CY2020) for the Peoples Gas (PGL) and North Shore Gas (NSG) Home Energy Reports (HER) program. Based on guidance from the Illinois Stakeholder Advisory Group (SAG), Guidehouse normalized CY2020 program savings for the effect of the coronavirus pandemic.[8] This program is designed to generate energy savings by providing residential customers with information about their energy use and energy conservation suggestions and tips. Program participants receive information in the form of home energy reports that give customers various types of information, including:

- Assessments of how their recent energy use compares to their own energy use in the past
- Tips on how to reduce energy consumption, some of which are tailored to their own circumstances
- Information on how their energy use compares to that of neighbors with similar homes

Recipient customers received reports by mail and were also invited to log onto a dedicated program website that offers suggestions of additional opportunities to save energy and allows participants to fine-tune their profiles and report energy conservation steps that they have taken. Other studies have shown that receiving reports containing this type of information can stimulate customers to reduce their energy use, creating average energy savings in the one percent to three percent range, depending on local energy use patterns.

An important feature of the PGL and NSG HER programs is that both programs were designed as randomized controlled trials (RCTs).[9] Customers in the target group of residential customers from each utility were randomly assigned to either the recipient group or the control (non-recipient) group to estimate changes in energy use due to the program. Having an RCT experimental design makes the process of verifying energy savings simpler and more robust. Among other things, it effectively eliminates free-ridership bias, and thus the need for net-to-gross research. Customers may opt *out* of the program at any time, but they cannot opt *in* due to the RCT design.

In CY2020, the program included three waves of customers: one for PGL and two for NSG. Each utility launched one wave in October 2013 and then restructured their HER programs during 2017 to drop many of the treatment customers from the program. Many of these dropped customers were added back into the program throughout 2019 and 2020, with NSG reaching its pre-reduction size in September 2019 and PGL in September 2020.[10] NSG also launched a new wave in September 2019. Each treated customer was included in the evaluation only for the period after they (re)started getting reports. Treated customer counts for each of these waves throughout the year are summarized in Table 1-1.

[8] This decision is documented in meeting notes from the June 11 and August 24, 2020 SAG meetings (available at https://www.ilsag.info/events/list).

[9] Guidehouse has verified the RCT design of each of these waves as they were launched into the program.

[10] Since these added customers were part of the original RCT design, adding them back into their original program waves does not disrupt the statistical validity of the evaluation.

Table 1-1. CY2020 Peoples Gas and North Shore Gas HER Program Customer Counts

Wave	Treated Customer Counts*	
	2020-01-01	2020-09-01
PGL	78,000	91,000
NSG	56,000	-
NSG – Sept 2019 Wave	18,000	-

Source: Guidehouse analysis of PGL and NSG customer billing data.
* Customer counts are rounded to the nearest 1000.

Table 1-2 provides an overview of the number of accounts who received HERs or served as controls along with their average use during the program period. The table shows that the PGL HER recipients used about 20% more natural gas than the NSG participants.

Table 1-2. Synopsis of CY2020 PGL and NSG HER Program Waves

Utility	Number of Participants	Number of Controls	Participant Baseline Average Daily Usage in Post Period (Therms)
PGL	91,163	12,729	4.31
NSG	55,670	12,988	3.51
NSG Sept 2019 Wave	17,932	14,494	3.46

Source: Guidehouse analysis of PGL and NSG customer billing data.

2. EVALUATION APPROACH

The evaluation approach used to produce the results presented in this report follows the SAG's direction to normalize savings for the effects of the coronavirus pandemic. In addition, the evaluation team estimated actual CY2020 savings using an approach consistent with the previous program year, and with evaluations of similar programs in other utilities' territories, relying on statistical analysis appropriate for measuring the impacts of RCTs. Notably, these actual savings were not used by the evaluation team to develop claimable savings for CY2020, but were developed for robustness purposes to allow a comparison to the normalized savings used for claimable savings, and for future use when the program transitions away from using normalized savings estimates.

2.1 Impact Evaluation Methodology – Normalized Savings

Stay at home orders, social distancing, and sustained work-from-home behaviors across Illinois as a result of the coronavirus pandemic likely led to a change in usage patterns for CY2020 starting in March.[11] Notably, pandemic-related impacts may have limited the program's ability to influence energy efficiency behaviors that participants are willing and able to take. While the program RCT design should produce an unbiased estimate of program savings given the pandemic, it does not normalize the savings that occur under the pandemic. For CY2020, SAG directed evaluation teams to normalize claimable savings for pandemic-related changes across the utilities' energy efficiency programs, including the HER Program.

The evaluation team developed a normalization approach that builds upon historical program data, is wave-specific, and incorporates available history for each wave. For each wave, the evaluation team developed per household, per day savings adjusted for current year and legacy uplift, but before subtracting persisting savings from previous years. It is important to use savings estimates adjusted for uplift because suspensions in other program operations (as well as changes to the HER program's cross-promotion of other programs) likely resulted in different than normal uplift in CY2020. Using historic data to adjust for uplift ensures the use of normalized program uplift in our calculations. Additionally, we use absolute (therm) savings rather than percentage savings, as usage patterns and levels likely differed from normal in CY2020. The description of accounting for savings persistence can be found in Section 2.2.3.

The normalized savings per household per day are summarized in Table 2-1, and a description of the method for each wave follows.

Table 2-1. Normalized Per Household Per Day Savings for CY2020

Wave	Per Household Per Day Savings (Therms)	
	September – December 2019	January – December 2020
PGL	-	0.045
NSG	-	0.045
NSG - Sept 2019 Wave	0.007	0.016

Source: Guidehouse analysis of historic PGL-NSG HER Program data

[11] Phase 1 of Illinois' pandemic response began the week of March 16, 2020.

2.1.1 Original 2013 Waves

For the original PGL and NSG waves launched in GPY3 (2013)[12], the evaluation team recommends using CY2019 per household per day savings, after adjusting for both current year and legacy uplift to create normalized savings. These two waves have been restructured over the last 3 years, with a reduction in customers during GPY6 (2016 to 2017) and the addition of some of those customers back into the program in CY2019 and CY2020. Given this restructuring, the evaluation team, the utilities, and the implementer agreed CY2019 could be expected to be most reflective of CY2020.

2.1.2 NSG September 2019 Wave

The NSG wave launched in September 2019 has only four months of program history, meaning we need to look to other program data to determine an appropriate normalized value. As discussed above, savings for this wave are being claimed from September 2019 to December 2020. To determine a per household per day normalized savings value to apply to this 16 month period, the evaluation team reviewed pre-period usage[13] and found this new wave had usage between the original PGL and NSG waves.

In discussion with the utilities and the implementer, the evaluation team recommends using the per household per day savings from the CY2019 evaluation for the period of September to December 2019. Although these savings were not statistically significant, and thus were not claimed, these still represent the best estimate of savings during that time. Additionally, that time was not affected by the coronavirus pandemic.

For the period from January to December 2020, the evaluation team recommends averaging GPY6 savings across those two waves, which was the year with the lowest absolute per customer per day savings. Guidehouse considered averaging first-year savings (from GPY3) across those two waves for this wave, but found that this resulted in considerably higher absolute savings for CY2020 than for the two more mature waves. Therefore, in discussion with the utilities and the implementer, we opted for a more conservative recommendation.

2.2 Impact Evaluation Methodology – Actual Savings Modeling

2.2.1 Data Used in Impact Analysis

In preparation for the impact evaluation, Guidehouse combined and cleaned the data provided by the implementer. Guidehouse performed the following data cleaning steps:

[12] The program was first offered in Gas Program Year 3 (GPY3), which began June 1, 2013 and ended May 31, 2014. Program years GPY3 through GPY5 began June 1 and ended May 31. GPY6 began June 1, 2016 and ended December 31, 2017. Beginning January 1, 2018, program year (PY) coincides with calendar year (CY).

[13] Evaluations both from Guidehouse and others nationwide have consistently shown that pre-period is one of the key factors driving savings.

- Filtered data to the pre-period[14] and post period[15] for each wave
- Removed exact duplicate observations
- Aggregated bills that ended in the same month
- Excluded outlier observations, defined as observations with average daily usage outside plus or minus one order of magnitude from the median usage
- Excluded observations with a bill length greater than 90 days

Detailed accounts of the customers and observations removed by each cleaning step for each wave are included in Section 5.1 of the Appendix.

2.2.2 Statistical Models Used in the Impact Evaluation

Guidehouse estimated actual program impacts using two approaches: 1) a lagged dependent variable regression (LDV) analysis with lagged individual controls, and 2) a linear fixed-effects regression (LFER) analysis, both applied to monthly billing data. Both approaches should, in principle, produce unbiased estimates of program savings under a wide range of conditions, however, Guidehouse prefers the LDV results for two reasons. First, savings estimates produced by the LDV model tend to be more accurate and more precisely estimated than those from the LFER model[16], based on past experience analyzing similar HER programs' impacts and findings from the academic literature.[17] Second, the implementer uses a similar model for its evaluation, which makes the two sets of results comparable. Although the LDV and LFER models are structurally very different, the models should generate similar program savings estimates, assuming the RCT is well balanced with respect to the drivers of energy use.

The savings estimates coming out of the LDV regression model are referred to as the modeled savings throughout this report. For final actual savings, the modeled savings must be adjusted for savings persistence (see Section 2.2.3) and uplift (see Section 2.2.4). However, the actual savings are not claimed in CY2020, rather, the normalized savings are used to produce final verified savings.

The LFER model combines cross-sectional and time-series data in a single panel dataset. The regression essentially compares pre- and post-program billing data for participants and controls to identify the effect of the program on usage. The customer-specific fixed effect is a key feature of the LFER analysis and captures all customer-specific factors affecting natural gas usage that do not change over time, including those that are unobservable. Examples of the latter include the construction and square footage of the premise, the number of occupants, the amount of seasonal sun exposure, and the thermostat settings. The fixed effect represents an attempt to control for any small, systematic differences between the treatment and control customers that might occur due to chance.

[14] The pre-period differed by wave and in whether the customer was in one of the expansion groups. For the original waves, the pre-period was between October 2012 and September 2013 and for expansion customers encompassed only the months of the pre-period also included in the post period. For the NSG September 2019 Wave the pre-period was September to December 2018.

[15] Calendar year 2020 for the original waves and September 2019 through 2020 for the NSG September 2019 Wave.

[16] One likely reason for this is that the LDV model embodies more flexibility than the LFER model, in that the former allows the individual customer control variable to vary seasonally, while the latter does not – a particularly attractive feature given the highly seasonal nature of natural gas usage. The LFER model treats all unobserved inter-household heterogeneity affecting households' energy usage as time-invariant, while the LDV model uses lagged individual controls that can vary over time. These aspects are discussed in more detail in Section 5.2 of the Appendix.

[17] Allcott, Hunt and Todd Rogers, 2014. "The Short-Run and Long-Run Effects of Behavioral Intervention: Experimental Evidence from Energy Conservation." *American Economic Review*, 104(10): 3003-37.

Like the LFER model, the LDV model also combines cross-sectional and time-series data in a panel dataset. Unlike the LFER model, however, the LDV model uses only the post-program data in the dependent variable, and includes the customer's lagged energy usage for the same calendar month of the pre-program period to serve as the control for any small, systematic differences between the treatment and control customers, in that sense serving the same purpose as the customer fixed effect included in the LFER model. Section 5.2 of the Appendix presents the details of the LDV and LFER models used in the analysis.

2.2.3 Accounting for Savings Persistence

Continued implementation of HER programs in Illinois and across the country has demonstrated persistence of savings beyond the first year, leading Illinois to adopt a measure persistence framework in Version 8.0 of the TRM. This framework assumes that savings persist over five years, but the persistence decays in each year. The TRM recommends using the persistence factors presented in Table 2-2 over the five-year life to estimate lifetime gas savings for the program. In CY2020, the original PGL and NSG waves are in Year 3, while the NSG September 2019 wave is in Year 2.[18]

Table 2-2. HER Gas Savings Persistence Factors

Year	Gas Persistence Factor
Year 1	100%
Year 2	45%
Year 3	20%
Year 4	9%
Year 5	4%

Source: TRM, Measure 6.1.1, Volume 4, Version 8.0

Per the TRM, the adjustment for persistence also accounts for the program retention rate.[19] The retention rate was based on the treatment customers who were also in the program in CY2019 (i.e., not the treatment customers added into the program in the PGL September expansion) or CY2018 (i.e., not the treatment customers added into the program in the expansions in 2019).

2.2.4 Accounting for Uplift in Other Energy Efficiency Programs

The home energy reports sent to participating households included energy-saving tips, some of which encouraged participants to enroll in other PGL and NSG energy efficiency (EE) programs. If participation rates in other EE programs were the same for HER participant and control groups, the savings estimates from the regression analysis are already "net" of savings from the other programs, as this indicates the HER Program had no net effect on participation in the other EE programs. However, if the receipt of reports increased participation rates of recipients relative to controls in other EE programs, then the combined savings across all programs would be lower than indicated by the simple summation of savings in the HER and the other EE programs. For instance, if the HER Program increases participation

[18] Note, 16 months of savings are being claimed for the NSG September 2019 Wave in CY2020 (from September 2019 to December 2020). Persistence from the last four months of 2019 are subtracted from the savings estimate.

[19] Retention is calculated separately for CY2020 compared to CY2019 and CY2020 compared to CY2018.

in another EE program, the resulting increase ("uplift") in savings may be allocated to either the HER Program or the EE program, but cannot be allocated to both programs simultaneously.[20]

As data permitted, Guidehouse used a difference-in-difference (DID) statistic to estimate uplift in other EE programs. To calculate the DID statistic, Guidehouse calculated the difference between the HER treatment and control groups in average EE program savings per customer in the post period,[21] and subtracted the same difference from the pre-period. For instance, if the EE program savings during CY2020 is five therms for the treatment group and three therms for the control group, and the savings during the year before the start of the HER Program is two therms for the treatment group and one therm for the control group, then the DID statistic is one therm, as reflected the following calculation:

(CY2020 treatment group savings – CY2020 control group savings) – (pre-year treatment group savings - pre-year control group savings) = DID statistic

$$(5 - 3) - (2 - 1) = 1$$

The DID statistic generates an unbiased estimate of uplift when the baseline average savings is the same for the treatment and control groups, or when these values are different due only to differences between the two groups in time-invariant factors, such as the square footage of the residence.

An alternative statistic that generates an unbiased estimate of uplift when the baseline average savings in the EE program is the same for the treatment and control groups, is a simple difference in savings during CY2020. Guidehouse uses this alternative statistic –the "post-only difference" (POD) statistic – in cases where the EE program did not exist for the entire pre-program year.

Guidehouse examined the uplift associated with seven other PGL and NSG EE programs: Home Energy Jumpstart (HEJ), Home Energy Rebate (HEReb), Multifamily Energy Savings (MF),[22] Income-Eligible Single-Family (SFIE),[23] Income-Eligible Weatherization (WXIE), and Income-Eligible Multi-Family (MFIE).[24,25] For each EE program, uplift savings were calculated separately for each utility. In addition, legacy uplift (uplift from GPY3 – CY2019) was also calculated.[26]

2.3 Process Evaluation

Guidehouse's CY2020 PGL and NSG HER process evaluation included interviews with the program implementer to update our information about the program, such as plans for additional waves. The evaluation did not include any participant surveys or interviews.

[20] It is not possible to avoid double-counting of the savings generated by programs for which tracking data are not available, such as upstream lighting programs.

[21] Where the averages are calculated over all treatment and control group customers, not just those who participated in other EE programs.

[22] MF includes direct install, custom, partner trade ally, and prescriptive.

[23] SFIE includes Chicago Bungalow Association (CBA) and Illinois Home Weatherization Assistance Program (IHWAP).

[24] MFIE includes IHWAP and Income-Eligible Multifamily Savings (IEMS).

[25] Guidehouse also looked at the Public Housing Energy Savings program, but found no overlap with HER. Additionally, double counting between the Affordable Housing New Construction Programs and HER is not possible due to the requirement that HER participants have sufficient historical usage data.

[26] Legacy uplift refers to uplift from prior years for which the measure life of the applicable program has not yet passed. These savings are also de-rated by the average move out rate to account for savings which no longer get captured in our HER analysis. Guidehouse used a move out rate of 6%.

3. NET IMPACT EVALUATION

A key feature of the RCT design of the HER program is that the analysis inherently estimates net savings because there are no participants who would have received the individualized reports in the absence of the program. While some customers receiving reports may have taken energy-conserving actions or purchased high-efficiency equipment anyway, the random selection of program participants (as opposed to voluntary participation) implies that the control group of customers not receiving reports would be expected to exhibit the same degree of energy-conserving behavior and purchases. Therefore, this method estimates net savings, and no further net-to-gross (NTG) adjustment is necessary.

Table 3-1 summarizes total program savings, before and after adjusting for persisting savings from CY2018 and CY2019. *Note that these values reflect the normalized savings*. Savings from the regressions described in Section 2.2 which reflect actual CY2020 savings are shown in Appendix Section 6. Relative to the implementer's *ex ante* estimates, Guidehouse verified higher savings for both PGL and NSG.[27]

Table 3-1. CY2020 Peoples Gas and North Shore Gas HER Program Net Savings

Wave	*Ex Ante* Savings (Therms)	Verified Unadjusted Savings (Therms)*	Persistence Adjustment (Therms)†	Final Verified Savings (Therms)	Verified Realization Rate‡
PGL	656,325	1,466,209	434,676	1,031,533	157%
NSG	297,590	896,189	387,483	508,706	206%
NSG – Sept 2019 Wave§		112,284	6,575	105,709	

Source: Guidehouse analysis of PGL and NSG customer billing data.

* Verified unadjusted savings account for uplift (which is inherently accounted for in the normalization method) but not persistence.

† This adjustment reduces savings reduces the savings by the amount attributable to sending reports in CY2018 and CY2019 and is prescribed in the *Adjustments to Behavior Savings to Account for Persistence* measure in the Illinois Technical Reference Manual (TRM). See TRM, Measure 6.1.1, Volume 4, Version 8.0.

‡ The verified realization rate compares final verified savings with *ex ante* savings.

§ Savings reflect September 2019 to December 2020. Persistence from September to December 2019 into 2020 are removed from the estimate.

[27] Discussions with the implementer for other IL evaluations revealed differences in the way the implementer calculated persistence, and particularly retrospective retention rates, compared to the evaluation team. This is the most likely cause of the high realization rates.

4. FINDINGS AND RECOMMENDATIONS

For PGL's HER program, Guidehouse verified CY2020 impacts of 1,031,533 therms and for NSG, the corresponding figure was 614,415 therms.

Finding 1. CY2020 marked the third year since the program measure life was revised from 1 to 5 years, with savings decay in the TRM associated with each year. Continuous treatment of customers required adjustment of the current year's savings for the persisting savings claimed as part of the previous years' impacts. In CY2020, the evaluation team reduced total savings by 33% to account for persisting savings from CY2018 and CY2019 interventions.

Finding 2. The pandemic overshadowed CY2020, which led to stay at home orders, social distancing, and sustained work-from-home behaviors from March and through much of 2020. Program verified net savings in CY2020 were normalized to adjust for the effects of the pandemic using historical savings data. Alongside normalized savings, the evaluation team modeled actual savings from CY2020 to offer a point of comparison. Normalized savings were on average 11% higher than actual savings when adjusted for uplift, and 17% higher when adjusted for persisting savings along with uplift. Should pandemic-induced behaviors persist and translate into the new normal, misalignment of persisting normalized savings with actual customer behaviors can result in steeper than warranted reductions in future years' verified savings, presenting a source of uncertainty and risk for the program.

Recommendation 1. The evaluation team, PGL and NSG, and the implementer should monitor future longer-term market trends and customer behaviors caused by the pandemic to assess and anticipate risk associated with savings claims.

Finding 3. The program realization rate was 157% for PGL and 206% for NSG, although comparing the actual savings gives realization rates of 136% and 173%, respectively. High realization rates have been a trend for this program for several years, as shown in Table 4-1, although the CY202 rates are particularly high. Discussions with the implementer for other IL evaluations revealed differences in the way the implementer calculated persistence, and particularly retrospective retention rates, compared to the evaluation team. This is a possible cause of the high realization rates.

Recommendation 2. Prior to the start of the 2021 heating season, the implementer and the evaluation team should work together to identify drivers of the high realization rates and work to more closely align any discrepancies for CY2021.

Historical Results

Table 4-1 shows the historical net savings realization rates for the HER Program. The impact analysis method provides net savings directly. Gross savings are not estimated, and there is no NTG ratio.

Table 4-1. Historical Realization Rates and NTG Values

Program Year *	PGL Verified Net Savings RR	NSG Verified Net Savings RR	PGL NTG	NSG NTG
GPY1	No Program	No Program	-	-
GPY2	No Program	No Program	-	-
GPY3 (2013-14)	105%	98%	NA	NA
GPY4 (2014-15)	110%	125%	NA	NA
GPY5 (2015-16)	98%	101%	NA	NA
GPY6 (2016-17)	92%	116%	NA	NA
2018	106%	129%	NA	NA
2019	112%	153%	NA	NA
2020 (Normalized)	157%	206%	NA	NA
2020 (Actual)	136%	173%	NA	NA

Source: Guidehouse evaluation research. Analysis method provides net savings directly.
* The program was first offered in GPY3, which began June 1, 2013 and ended May 31, 2014. Program years GPY3 through GPY5 began June 1 and ended May 31. GPY6 began June 1, 2016 and ended December 31, 2017. Beginning January 1, 2018, program year coincides with calendar year.

5. APPENDIX 1. IMPACT METHODOLOGY ACTUAL SAVINGS DETAIL

This section details the methodology employed for developing actual savings estimates for CY2020. Notably, these savings were not used by the evaluation team to develop claimable savings for CY2020, but were developed for robustness purposes to allow a comparison to the normalized savings used for claimable savings, and for future use when the program transitions away from using normalized savings estimates.

5.1 Detailed Data Cleaning

Guidehouse performed the following data cleaning steps:

- Excluded post-period data from outside of the period of examination (calendar year 2020 for the original waves and September 2019 through 2020 for the NSG September 2019 Wave)
- Filtered to relevant pre-period data for each wave
- Removed exact duplicate observations
- Aggregated bills that ended in the same month
- Excluded outlier observations, defined as observations with average daily usage outside plus or minus one order of magnitude from the median
- Excluded observations with a bill length greater than 90 days
- For the LDV model, removed observations that did not have a usage value in the same month of the pre-period

Table 5-1, Table 5-2, and Table 5-3 give counts of customers and observations removed for the data cleaning steps identified above. Each data cleaning step removed a similar percentage of treatment and control customers for each wave. This approach suggests that non-random biases were not introduced into the data by the cleaning steps.

Table 5-1. NSG CY2020 Data Cleaning Results

Cleaning Step	Customers		Observations	
	Treatment	Control	Treatment	Control
Raw Data	55,670	12,988	5,636,519	1,314,747
Subset to pre/post periods	55,670	12,988	1,308,093	305,354
Remove exact duplicate observations	55,670	12,988	1,308,093	305,354
Bill Flattening	55,670	12,988	1,261,517	294,394
Exclude outliers	55,670	12,988	1,260,057	293,970
Remove pre-period data (for LDV analysis)	54,880	12,808	618,257	144,257
Remove observations without a monthly pre-use value (for LDV analysis)	54,862	12,802	594,181	138,659

Source: Guidehouse analysis of PGL and NSG customer billing data.

Table 5-2. NSG September 2019 Wave CY2020 Data Cleaning Results

Cleaning Step	Customers		Observations	
	Treatment	Control	Treatment	Control
Raw Data	17,932	14,494	536,984	433,850
Subset to pre/post periods	17,927	14,486	482,736	390,017
Remove exact duplicate observations	17,927	14,486	482,736	390,017
Bill Flattening	17,927	14,486	465,647	376,058
Exclude outliers	17,927	14,486	464,871	375,477
Remove pre-period data (for LDV analysis)	17,927	14,486	464,862	375,472
Remove observations without a monthly pre-use value (for LDV analysis)	17,772	14,351	247,915	200,128

Source: Guidehouse analysis of PGL and NSG customer billing data.

Table 5-3. PGL CY2020 Data Cleaning Results

Cleaning Step	Customers		Observations	
	Treatment	Control	Treatment	Control
Raw Data	91,163	12,729	9,017,030	1,271,928
Subset to pre/post periods	91,162	12,729	2,019,717	295,527
Remove exact duplicate observations	91,162	12,729	2,019,717	295,527
Bill Flattening	91,162	12,729	1,975,368	288,831
Exclude outliers	91,162	12,729	1,975,317	288,825
Remove pre-period data (for LDV analysis)	91,162	12,729	1,975,276	288,822
Remove observations without a monthly pre-use value (for LDV analysis)	86,927	12,164	886,784	136,570

Source: Guidehouse analysis of PGL and NSG customer billing data.

5.2 Detailed Impact Methodology

Guidehouse used two regression models to estimate impacts: 1) an LDV model, and 2) an LFER model. The following sections present each model. Neither of these results were used for claiming savings in CY2020, as normalized savings were claimed based on the method described in Section 2.1. The following sections present the specifications for each model.

5.2.1 LDV Model

The LDV model controls for non-program differences in energy use between the treatment and control groups using each customer's lagged energy usage as an explanatory variable. In particular, the model frames energy use in calendar month *t* of the post-program period as a function of both the treatment variable and energy use in the same calendar month of the pre-program period. The underlying logic is that systematic differences between control and treatment customers will be reflected in differences in their past energy use, which is highly correlated with their current energy use. Formally, the model is shown in Equation 5-1.

Equation 5-1. Lagged Dependent Variable Regression Model

$$ADU_{kt} = \beta_1 Treatment_k + \sum_J \beta_{2j} Month_{jt} + \sum_J \beta_{3j} Month_{jt} \cdot ADUlag_{kt} + \varepsilon_{kt}$$

where:

ADU_{kt}	is average daily consumption of therms by household k in bill period t
$Treatment_k$	is a binary variable taking a value of 0 if household k is assigned to the control group, and 1 if assigned to the treatment group
$ADUlag_{kt}$	is household k's energy use in the same calendar month of the pre-program year as the calendar month of month t
$Month_{jt}$	is a binary variable taking a value of 1 when $j = t$ and 0 otherwise[28]
ε_{kt}	is the cluster-robust error term for household k during billing cycle t; cluster-robust errors account for heteroscedasticity and autocorrelation at the household level.[29]

The coefficient β_1 is the estimate of the average daily therms energy savings due to the program.

[28] In other words, if there are *T* post-program months, there are *T* monthly dummy variables in the model, with the dummy variable $Month_{it}$ the only one to take a value of 1 at time t. These are, in other words, monthly fixed effects.

[29] Ordinary Least Squares (OLS) regression models assume that the data are homoscedastic and not autocorrelated. If either of these assumptions is violated, the resulting standard errors of the parameter estimates are incorrect (usually underestimated). A random variable is heteroskedastic when the variance is not constant. A random variable is autocorrelated when the error term in one period is correlated with the error terms in at least some of the previous periods.

5.2.2 LFER Model

The LFER model used by Guidehouse is one in which average daily consumption of therms by household k in bill period t, denoted by ADU_{kt}, is a function of the following three terms:

1. The binary variable $Treatment_k$
2. The binary variable $Post_t$, taking a value of 0 if month t is in the pre-treatment period, and 1 if in the post-treatment period.
3. The interaction between these variables, $Treatment_k \cdot Post_t$

Formally, the LFER model is shown in Equation 5-2.

Equation 5-2. Linear Fixed Effects Regression Model

$$ADU_{kt} = \alpha_{0k} + \alpha_1 Post_t + \alpha_2 Treatment_k \cdot Post_t + \varepsilon_{kt}$$

In this model, the coefficient α_{0k} captures all household-specific effects on energy use that do not change over time, including those that are unobservable, the coefficient α_2 captures the average effect *across all households* of being in the post-treatment period, and the effect of being both in the treatment group and in the post period (i.e., the effect directly attributable to the program) is captured by the coefficient α_2. In other words, while the coefficient α_1 captures the change in average daily therms use across the pre- and post-treatment for the *control* group, the sum α_1 + α_2 captures this change for the treatment group, and so α_2 is the estimate of average daily therms energy savings due to the program.

6. APPENDIX 2. CY2020 ACTUAL SAVINGS DETAIL

6.1 LDV and LFER Model Parameter Estimates

The LDV and LFER models generated very similar results for program savings estimates for all waves.

6.2 Uplift Analysis Results

This section summarizes CY2020 uplift results. These results were not used for claiming savings in CY2020 as normalized savings were claimed based on the method described in Section 2.1.

The LDV estimates include savings that resulted from participation in other EE programs caused by the HER program. To avoid double-counting when aggregating savings across the portfolio, Guidehouse removes from HER impacts uplift in other EE programs. Legacy uplift captures energy savings from previous program years (GPY3 through CY2019) for measures that have multi-year measure lives. CY2020 uplift captures savings from other EE programs that occurred in 2020. Table 6-1 shows uplift figures for PGL and NSG, and how the adjustment affected total savings.

Table 6-1. CY2020 PGL and NSG Uplift Results

	PGL Savings (Therms)	NSG Savings (Therms)	NSG Sept 2019 Wave Savings (Therms)
Modelled Savings	1,375,684	837,314	90,374
Persistence Adjustment	434,676	387,483	6,575
Net Savings, Prior to Uplift Adjustment	941,008	449,832	83,799
CY2020 Uplift Adjustment*	588	2,691	809
Legacy Uplift Adjustment*	49,651	15,148	-
Final Actual Net Savings†	890,768	431,993	82,989

Source: Guidehouse analysis of PGL and NSG program tracking and customer billing data.

* For the NSG September 2019 wave, the CY2020 uplift captured the full 16 months of uplift and thus legacy uplift was not calculated.

† Note that these are not the final verified savings which are based on normalized rather than actual savings.

The following subsections present detailed calculations of CY2020 and legacy uplift for each of the EE programs considered in the analysis: HEJ, HEReb, MF, SFIE, WXIE, and MFIE.

6.2.1 CY2020 Uplift

Table 6-2, Table 6-3, and Table 6-4 present program savings due to participation in other EE programs in CY2020. Each table provides the uplift for a single program group in each of six EE Programs for which estimates for deemed savings are available.[30] If a particular EE program does not show up in the table for a given wave, it means that HER wave had no participation in that EE program. While these tables show estimates of both positive and negative uplift, only positive values were used to adjust program savings for double-counting. For all cases where the EE program did not exist in the pre-program year, the estimate is based on a probability of detection (POD) statistic; otherwise it is based on a DID statistic.[31]

Table 6-2. CY2020 PGL HER Uplift Adjustment Details

Program	HEJ	HEReb	MF	MFIE	SFIE	WXIE
Median program savings (annual therm per EE participant)	47.00	276.00	28.59	419.68	17.58	35.83
Number of treatment customers	151,189	151,189	151,189	151,189	151,189	151,189
Number of control customer	20,999	20,999	20,999	20,999	20,999	20,999
Avg. therm savings per HER treatment customer, CY2020	0.05	0.08	0.00	0.00	0.21	0.18
Avg. therm savings per HER control customer, CY2020	0.06	0.07	0.00	0.00	0.25	0.19
CY2020 savings difference (therms)	-0.01	0.01	0.00	0.00	-0.04	-0.01
Avg. therm savings per HER treatment customer, pre	0.50	2.06	0.01	0.00	0.00	0.00
Avg. therm savings per HER control customer, pre	0.43	2.01	0.01	0.00	0.00	0.00
Pre savings difference (therms)	0.07	0.05	0.00	0.00	0.00	0.00
DID or POD statistic	-0.09	-0.04	0.00	0.00	-0.04	-0.01
Savings attributable to other programs (therms)	-13,463	-6,123	322	266	-6,626	-1,734
Implied change in participation	-286.5	-22.2	11.3	0.6	-376.8	-48.4

Source: Guidehouse analysis of PGL program tracking and customer billing data.

[30] See Section 2.2.4 for more information about the programs considered.

[31] See Section 2.2.4 for more information on POD and DID statistics.

Table 6-3. CY2020 NSG HER Uplift Adjustment Details

Program	HEJ	HEReb	MF	SFIE	WXIE
Median program savings (annual therm per EE participant)	40.28	272.00	31.31	462.16	35.83
Number of treatment customers	91,350	91,350	91,350	91,350	91,350
Number of control customer	21,000	21,000	21,000	21,000	21,000
Avg. therm savings per HER treatment customer, CY2020	0.04	0.26	0.00	0.01	0.05
Avg. therm savings per HER control customer, CY2020	0.03	0.29	0.00	0.02	0.05
CY2020 savings difference (therms)	0.01	-0.03	0.00	-0.01	0.00
Avg. therm savings per HER treatment customer, pre	0.08	2.55	0.02	0.00	0.00
Avg. therm savings per HER control customer, pre	0.09	2.34	0.02	0.00	0.00
Pre savings difference (therms)	-0.02	0.21	-0.01	0.00	0.00
DID or POD statistic	0.02	-0.24	0.01	-0.01	0.00
Savings attributable to other programs (therms)	2,144	-21,941	490	-851	58
Implied change in participation	53.2	-80.7	15.6	-1.8	1.6

Source: Guidehouse analysis of NSG program tracking and customer billing data.

Table 6-4. CY2020 NSG September 2019 Wave HER Uplift Adjustment Details

Program	HEJ	HEReb	MFIE	SFIE	WXIE
Median program savings (annual therm per EE participant)	24.16	131.50	175.89	266.05	35.83
Number of treatment customers	17,970	17,970	17,970	17,970	17,970
Number of control customer	14,528	14,528	14,528	14,528	14,528
Avg. therm savings per HER treatment customer, CY2020	0.04	0.32	0.00	0.01	0.02
Avg. therm savings per HER control customer, CY2020	0.08	0.37	0.00	0.00	0.02
CY2020 savings difference (therms)	-0.04	-0.05	0.00	0.00	0.00
Avg. therm savings per HER treatment customer, pre	0.08	0.53	0.03	0.03	0.00
Avg. therm savings per HER control customer, pre	0.06	0.50	0.05	0.05	0.00
Pre savings difference (therms)	0.01	0.03	-0.02	-0.02	0.00
DID or POD statistic	-0.05	-0.08	0.02	0.03	0.00
Savings attributable to other programs (therms)	-969	-1,359	356	453	-1
Implied change in participation	-40.1	-10.3	2.0	1.7	0.0

Source: Guidehouse analysis of NSG program tracking and customer billing data.

6.2.2 Legacy Uplift

To determine legacy uplift, Guidehouse utilized uplift in other PGL-NSG EE programs from previous evaluations. The total resource cost report provided program weighted average measure lives.[32] Total legacy uplift for CY2020 is 64,799 therms, or approximately 3% of the program's modelled savings.[33]

6.3 Actual Program Impact Results

Table 6-5 summarizes estimated, actual program savings by participant wave, including CY2020 and legacy uplift adjustments. In CY2018 and CY2019, the program claimed 828,734 therms for CY2020 as part of the decay framework. These savings need to be subtracted from the CY2020 savings of 2,303,372 therms, resulting in final actual savings of 1,102,133 therms this program year. The table also includes the number of participants, controls, and average savings rates. Both modeled savings and average savings rates include standard error figures. Note that this table does not reflect claimable savings which are based on the normalized, rather than actual, results.

Table 6-5. PGL and NSG CY2020 HER Program Savings

Savings Category	PGL	NSG	NSG – Sept 2019 Wave
Number of Participants	91,163	55,670	17,932
Number of Controls	12,729	12,988	14,494
Modeled Savings, therms	1,375,684	837,314	90,374
(Standard Error)	297,962	165,990	48,576
Average Savings Rate (%)	0.98%	1.20%	0.32%
(Standard Error)	0.21%	0.24%	0.17%
Net Savings Prior to Uplift Adjustment, therms	941,008	449,832	83,799
CY2020 Uplift Adjustment, therms	588	2,691	809
Legacy Uplift, therms	49,651	15,148	-
Total Uplift Adjustment, therms	50,239	17,839	809
Actual Net Savings After Uplift Adjustment, therms*	890,768	431,993	82,989

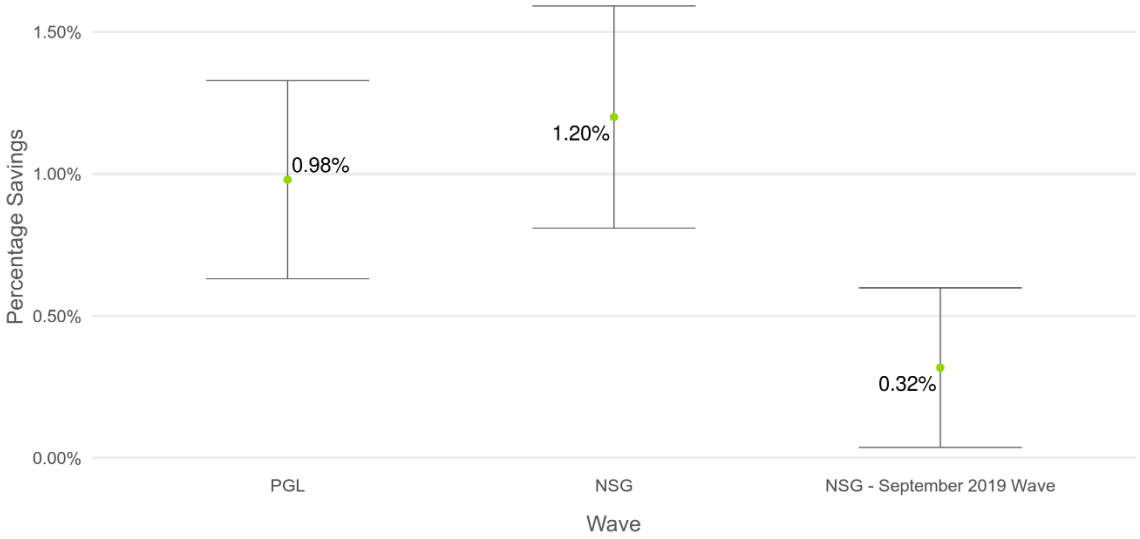
Source: Guidehouse analysis of PGL and NSG program tracking and customer billing data.
*Note that these are not the final verified savings which are based on normalized rather than actual savings.

Figure 6-1 shows actual energy savings for each wave with 90% confidence intervals.

[32] Navigant Consulting, 2016. *Plan Year 1 through 3 Total Resource Cost Test Results and Impact Summary Evaluation Report.* Presented to Peoples Gas.

[33] Legacy uplift results by program and year are available upon request.

Figure 6-1. CY2020 Percent Savings and 90% Confidence Interval, by Wave



Source: Guidehouse analysis of PGL and NSG customer billing data.

6.4 Comparison of Normalized and Actual Savings

This section compares normalized and actual savings for CY2020. Table 6-6 compares two sets of savings values: 1) savings adjusted for uplift but not for persisting savings and 2) savings adjusted for uplift and persisting savings. Both comparisons are useful, the first offers insight into the magnitude of difference in savings estimates, while the second offers insight into the additional difference caused by the persisting savings adjustment. As Table 6-6 shows, normalized savings adjusted for uplift but not for persisting savings are overall 28% higher than equivalently adjusted actual savings. Depending on the wave, normalized savings range from 115% to 157% of actual savings. After adjusting for persisting savings, normalized savings are overall 49% higher than actual savings (between 23% and 179% higher depending on the wave).

Table 6-6. Normalized and Actual Savings Comparison

Wave	Treatment Customer Count	Control Customer Count	Savings Adjusted for Uplift and Prior to Adjusting for Persisting Savings					Savings Adjusted for Uplift and Persisting Savings		
			Per Participant Per Day Savings (Normalized), Therms	Per Participant Per Day Savings (Actual), Therms	Total Normalized Savings, Therms	Total Actual Savings, Therms	Normalized Savings/Actual Savings	Total Normalized Savings, Therms	Total Actual Savings, Therms	Normalized Savings/Actual Savings
PGL	91,163	12,729	0.045	0.042	1,466,209	1,325,444	111%	1,031,533	890,768	116%
NSG	55,670	12,988	0.045	0.042	896,189	819,475	109%	508,706	431,993	118%
NSG Sept 2019 Wave	17,932	14,494	0.014	0.011	112,284	89,565	125%	105,709	82,989	127%
Total or Weighted Average	**164,765**	**40,211**	**0.042**	**0.039**	**2,474,683**	**2,234,484**	**111%**	**1,645,949**	**1,405,750**	**117%**

Source: Guidehouse analysis of PGL and NSG program tracking and customer billing data.

7. APPENDIX 3. TOTAL RESOURCE COST DETAIL

Table 7-1, the Total Resource Cost savings table for PGL and NSG, includes cost-effectiveness analysis inputs available at the time of finalizing the CY2020 HER impact evaluation report. Additional required cost data (e.g., measure costs, program level incentive and non-incentive costs) are not included in this table and will be provided to evaluation later. Detail in this table (e.g., EULs), other than final CY2020 savings and program data, are subject to change and are not final.

Table 7-1. Total Resource Cost Savings Summary for PGL and NSG

Savings Category	PGL	NSG	NSG Sept 2019 Wave
Number of Participants	91,163	55,670	17,932
Effective Useful Life (Years)	5	5	5
Ex Ante Savings, therms	656,325	297,590	
Verified Net Savings After Uplift Adjust., therms	1,031,533	508,706	105,709

Source: Guidehouse analysis of PGL and NSG program tracking and customer billing data.