Guidehouse

Multi-Family Program Impact Evaluation Report

Energy Efficiency Plan:
Plan Year 2019
(1/1/2019-12/31/2019)

Presented to
Peoples Gas and North Shore Gas

Final

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1. INTRODUCTION

This report presents the results of the impact evaluation of the Peoples Gas (PGL) and North Shore Gas (NSG) 2019 Multi-Family Program. It presents a summary of the energy impacts for the total program and broken out by relevant measure and program structure details. The appendix presents the impact analysis methodology. Program year 2019 covers January 1, 2019 through December 31, 2019.

2. PROGRAM DESCRIPTION

The PGL and NSG Multi-Family Program is designed to provide a "one-stop-shop" to multi-family property owners and managers of buildings with three or more units to achieve comprehensive improvements in energy efficiency that previously would have required accessing multiple programs. The Multi-Family Program delivery approach consists of five paths, described below.

The Direct Install (DI) and Energy Assessment "Jumpstart" path of the program provides free energy efficiency products in residential dwelling units and common areas. The energy assessment identifies additional comprehensive efficiency upgrades that allow participants to implement deeper retrofit measures through other delivery paths.

The Prescriptive Rebate path provides standardized incentives for energy efficient equipment based on the size and efficiency of the equipment installed or on a per unit basis. The Partner Trade Ally (PTA) path also provides standardized incentives for energy efficient equipment based on the size and efficiency of the equipment installed or on a per unit basis while providing higher incentives to a network of trade allies (TAs) selected, screened and registered with the Multi-Family Program. These Partner TA's in turn offer better rebates to their customers to install energy-efficient products.

The program's Custom path provides technical services and custom rebates for non-standard building improvement upgrades. The program also provides incentive opportunity for energy efficient new construction projects in multi-family buildings. Multi-family property owners and managers may also participate in the PGL and NSG Gas Optimization Study Program that provides gas optimization assessments for multi-family buildings for operation and maintenance issues that, if corrected, deliver energy and cost savings to building owners and managers supported by financial incentives. All five program paths participated in 2019.

The PGL program had 1,011 participants in 2019 and completed 5,315 projects as shown in the following table.

Table 2-1. 2019 Volumetric Summary for PGL

Participation	Direct Install	Prescriptive	PTA	Custom	Custom Optimization	Total
Participants*	290	165	551	4	1	1,011
Installed Projects†	4,436	167	705	4	3	5,315
Total Measures[1]	7,777	6,921	7,657	4	3	22,362

* Participants are defined as unique site addresses from tracking data.
† Installed Projects are defined as unique project IDs from tracking data.
Source: Peoples Gas tracking data and Guidehouse team analysis.

Table 2-2 summarizes the installed measure quantities that are the basis for verified energy savings.

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[1] If measure units were reported in the tracking system as linear feet, square feet, or MBH or the measure description was either "prescriptive change" or "custom project," Guidehouse treated each row entry of such measure as one measure quantity in this table. For "prescriptive change" and "custom project" measures, the quantity provided in the tracking data did not always reflect the number of measures installed, but rather the total net savings for the project.

Table 2-2. 2019 Installed Measure Quantities for PGL

Program Path	Measure	Quantity Unit	Installed Quantity
Direct Install	Programmable Thermostat (T-Stat)	Each	888
	Showerhead	Each	2,770
	Pipe Insulation	LN FT	5,546
	Programmable Advanced T-Stat	Each	414
	Bathroom Aerator	Each	2,086
	Kitchen Aerator	Each	1,335
	Manual Advanced T-Stat	Each	4
	Reprogram. T-Stat	Each	5
Prescriptive	Pipe Insulation	LN FT	42,238
	Pipe Steam Averaging (Avg.) Controls	Each	1,337
	Boiler Tune Up	MBH	198,022
	Boiler	MBH	60,815
	Steam Trap	Each	345
	Central Domestic Hot Water (DHW) Plant	Each	4,973
	DHW Controls	MBH	482
	Prescriptive Change, Steam Trap	Project	1
	Kitchen Ventilation Controls	Each	7
	Linkageless Controls	MBH	5,600
	Prescriptive Change	Project	2
	Boiler Reset Controls	MBH	2,394
	Furnace, Common Area (CA)	Each	12
	Advanced Thermostat	Each	52
	Furnace, In-Unit (IU)	Each	11
	Large Gas Water Heater (WH)	Each	378
	Programmable Thermostat	Each	6
	Draft Controls	Each	3,620
	High Efficiency Water Heater	Each	4
PTA	Steam Trap	Each	2,466
	Pipe Insulation	LN FT	103,262
	DHW Controls	MBH	3,345
	Pipe Steam Avg. Controls	MBH	3,398
	Boiler Tune Up	MBH	399,039
	Prescriptive Change, Steam Trap	Project	13
	Boiler	MBH	23,104
	DHW Tank Insulation	SQ FT	1,275
	Prescriptive Change	Project	2
	Condensate Tank Insulation	SQ FT	750
	Boiler Reset Controls	MBH	3,230
Custom + Custom Opt.	Custom	Project	7

Source: Peoples Gas tracking data and Guidehouse team analysis.

The NSG program had 41 participants in 2019 and completed 783 projects as shown in the following table.

Table 2-3. 2019 Volumetric Summary for NSG

Participation	Direct Install	Prescriptive	PTA	Total
Participants*	22	2	17	41
Installed Projects†	764	2	17	783
Total Measures[2]	2,785	10	30	2,825

* Participants are defined as unique site addresses from tracking data.
† Installed Projects are defined as unique project IDs from tracking data.
Source: North Shore Gas tracking data and Guidehouse team analysis.

Table 2-4 summarizes the installed measure quantities that are the basis for verified energy savings.

Table 2-4. 2019 Installed Measure Quantities for NSG

Program Path	Measure	Quantity Unit	Installed Quantity
Direct Install	Bathroom Aerator	Each	781
	Kitchen Aerator	Each	261
	Pipe Insulation	LN FT	929
	Manual Advanced T-Stat	Each	233
	Showerhead	Each	560
	Programmable T-Stat	Each	228
	Prog. Advanced T-Stat	Each	57
Prescriptive	Furnace, CA	Each	1
	Steam Trap	Each	9
PTA	Boiler Tune Up	MBH	1,464
	DHW Tank Insulation	SQ FT	1,410
	Pipe Insulation	LN FT	4,920

Source: North Shore Gas tracking data and Guidehouse team analysis.

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[2] If measure units were reported in the tracking system as linear feet, square feet, or MBH or the measure description was either "prescriptive change" or "custom project," Guidehouse treated each row entry of such measure as one measure quantity in this table. For "prescriptive change" and "custom project" measures, the quantity provided in the tracking data did not always reflect the number of measures installed, but rather the total net savings for the project.

3. SAVINGS SUMMARY

Table 3-1 summarizes the energy savings the PGL Multi-Family Program achieved by path in 2019.

Table 3-1. 2019 Annual Energy Savings Summary for PGL

Program Path	Ex Ante Gross Savings (Therms)	Verified Gross RR*	Verified Gross Savings (Therms)	NTG†	Verified Net Savings (Therms)
Direct Install	113,828	96%	109,260	0.85/1.03/NA‡	102,138
Prescriptive	796,922	84%	669,637	0.76/NA‡	509,737
PTA	2,152,004	107%	2,301,598	0.88	2,025,406
Custom	87,818	96%	84,151	0.72	60,589
Custom Optimization	25,745	46%	11,763	0.91	10,705
Total	**3,176,318**	**100%**	**3,176,409**	**NA**	**2,708,575**

* Realization Rate (RR) is the ratio of verified gross savings to ex ante gross savings, based on evaluation research findings.
† Net-to-Gross (NTG) is the ratio of verified net savings to verified gross savings. The NTG is a deemed value. Source: PGL-NSG_NTG_History_and_2019_Recommendations_2018-10-01_Final Faucet Aerator and Showerhead Correction 2019-04-12.xlsx, which is to be found on the Illinois SAG web site: http://ilsag.info/net-to-gross-framework.html.
‡The IL TRM algorithm for advanced thermostat savings calculates net savings, so no NTG adjustment is applicable
Source: Peoples Gas tracking data and Guidehouse team analysis.

Table 3-2 summarizes the energy savings the NSG Multi-Family Program achieved by path in 2019.

Table 3-2. 2019 Annual Energy Savings Summary for NSG

Program Path	Ex Ante Gross Savings (Therms)	Verified Gross RR*	Verified Gross Savings (Therms)	NTG†	Verified Net Savings (Therms)
Direct Install	35,863	99%	35,525	0.85/1.03/NA‡	34,025
Prescriptive	1,226	100%	1,228	0.76/NA‡	934
PTA	25,756	95%	24,437	0.88	21,504
Total	**62,845**	**97%**	**61,191**	**NA**	**56,463**

* Realization Rate (RR) is the ratio of verified gross savings to ex ante gross savings, based on evaluation research findings.
† Net-to-Gross (NTG) is the ratio of verified net savings to verified gross savings. The NTG is a deemed value. Source: PGL-NSG_NTG_History_and_2019_Recommendations_2018-10-01_Final Faucet Aerator and Showerhead Correction 2019-04-12.xlsx, which is to be found on the Illinois SAG web site: http://ilsag.info/net-to-gross-framework.html.
‡The IL TRM algorithm for advanced thermostat savings calculates net savings, so no NTG adjustment is applicable.
Source: North Shore Gas tracking data and Guidehouse team analysis.

4. PROGRAM SAVINGS BY MEASURE

The PGL program includes 38 measures as shown in the following table. The steam trap and pipe insulation measures contributed the most savings.

Table 4-1. 2019 Annual Energy Savings by Measure for PGL

Program Path	Research Category	Ex Ante Gross Savings (Therms)	Verified Gross RR	Verified Gross Savings (Therms)	NTG†	Verified Net Savings (Therms)
Direct Install	Programmable T-Stat	38,156	100%	38,153	0.85	32,430
	Showerhead	31,659	100%	31,656	1.03	32,605
	Pipe Insulation	21,288	79%	16,840	0.85	14,314
	Prog. Advanced T-Stat	15,152	100%	15,145	NA‡	15,145
	Bathroom Aerator	3,551	99%	3,520	1.03	3,625
	Kitchen Aerator	3,571	98%	3,495	1.03	3,600
	Manual Advanced T-Stat	230	100%	230	NA‡	230
	Reprogram. T-Stat	222	100%	222	0.85	189
Prescriptive	Pipe Insulation	263,015	111%	292,026	0.76	221,940
	Pipe Steam Avg. Controls	67,499	121%	81,675	0.76	62,168
	Boiler Tune Up	74,414	100%	74,412	0.76	56,553
	Boiler	63,372	100%	63,370	0.76	48,161
	Steam Trap	47,238	100%	47,237	0.76	35,900
	Central Domestic Hot Water Plant	217,438	21%	45,594	0.76	34,651
	DHW Controls	30,220	100%	30,221	0.76	22,968
	Prescriptive Change - Steam Trap	8,503	100%	8,503	0.76	6,462
	Kitchen Ventilation Controls	5,418	100%	5,418	0.76	4,118
	Prescriptive Change - Other	4,361	100%	4,361	0.76	3,315
	Advanced Thermostat	2,989	100%	2,989	NA‡	2,989
	Linkageless Controls	3,415	100%	3,415	0.76	2,596
	Boiler Reset Controls	3,082	100%	3,082	0.76	2,342
	Furnace, CA	2,820	101%	2,843	0.76	2,161
	Furnace, IU	1,492	100%	1,492	0.76	1,134
	Large Gas WH	204	638%	1,301	0.76	989
	Programmable Thermostat	748	101%	755	0.76	574
	Draft Controls	552	105%	581	0.76	442
	High Efficiency Water Heater	142	254%	360	0.76	274
PTA	Steam Trap	943,479	100%	943,564	0.88	830,336
	Pipe Insulation	513,304	122%	626,503	0.88	551,322
	DHW Controls	209,747	100%	209,732	0.88	184,564
	Pipe Steam Avg. Controls	171,290	121%	207,577	0.88	182,668
	Boiler Tune Up	151,376	100%	151,417	0.88	133,247
	Prescriptive Change - Steam Trap	117,899	100%	117,899	0.88	103,751
	Boiler	20,976	100%	20,975	0.88	18,458
	DHW Tank Insulation	6,831	100%	6,831	0.88	6,012
	Prescriptive Change - Other	7,168	100%	7,168	0.88	6,308
	Condensate Tank Insulation	5,776	100%	5,776	0.88	5,083
	Boiler Control	4,159	100%	4,158	0.88	3,659
Custom	Boiler Combustion & HVAC	87,818	96%	84,151	0.72	60,589
Custom Opt.	Fan VSD Adjustment	25,745	46%	11,763	0.91	10,705
	Total	**3,176,318**	**100%**	**3,176,409**	**NA**	**2,708,575**

† Net-to-Gross (NTG) ratio is a deemed value. Source: PGL-NSG_NTG_History_and_2019_Recommendations_2018-10-01_Final Faucet Aerator and Showerhead Correction 2019-04-12.xlsx, which is to be found on the Illinois SAG web site: http://ilsag.info/net-to-gross-framework.html.

‡The IL TRM algorithm for advanced thermostat savings calculates net savings, so no NTG adjustment is applicable.

Source: Peoples Gas tracking data and Guidehouse team analysis.

The NSG program includes 12 measures as shown in the following table. The pipe insulation and thermostat measures contributed the most savings.

Table 4-2. 2019 Annual Energy Savings by Measure for NSG

Program Path	Research Category	Ex Ante Gross Savings (Therms)	Verified Gross RR	Verified Gross Savings (Therms)	NTG†	Verified Net Savings (Therms)
Direct Install	Manual Advanced T-stat	13,395	100%	13,394	NA‡	13,394
	Programmable T-Stat	9,235	100%	9,234	0.85	7,849
	Showerhead	6,443	100%	6,443	1.03	6,636
	Pipe Insulation	2,749	89%	2,441	0.85	2,075
	Programmable Advanced T-Stat	2,085	100%	2,085	NA‡	2,085
	Bathroom Aerator	1,264	99%	1,252	1.03	1,290
	Kitchen Aerator	691	98%	676	1.03	696
Prescriptive	Steam Trap	991	100%	991	0.76	753
	Furnace, CA	235	101%	237	0.76	180
PTA	Pipe Insulation	17,651	93%	16,332	0.88	14,372
	DHW Tank Insulation	7,555	100%	7,555	0.88	6,648
	Boiler Tune Up	550	100%	550	0.88	484
	Total	**62,845**	**97%**	**61,191**	**NA**	**56,463**

† Net-to-Gross (NTG) ratio is a deemed value. Source: PGL-NSG_NTG_History_and_2019_Recommendations_2018-10-01_Final Faucet Aerator and Showerhead Correction 2019-04-12.xlsx, which is to be found on the Illinois SAG web site: http://ilsag.info/net-to-gross-framework.html.
‡The IL TRM algorithm for advanced thermostat savings calculates net savings, so no NTG adjustment is applicable.
Source: North Shore Gas tracking data and Guidehouse team analysis.

5. IMPACT ANALYSIS FINDINGS AND RECOMMENDATIONS

5.1 Impact Parameter Estimates

Table 5-1 shows the unit therm savings and realization rate findings by measure from our review. The realization rate is the ratio of the verified savings to the ex ante savings. Following the table, we provide findings and recommendations, including discussion of all measures with realization rates above or below 100%.

Table 5-1. Verified Gross Savings Parameters

Measure	Unit Basis	Ex Ante Gross (therms/unit)	Verified Gross (therms/unit)	Realization Rate	Data Source(s)*
Bathroom Aerator	Each	CA = 6.11	CA = 6.11	100%	TRM† Section 4.3.2
	Each	IU = 1.57	IU = 1.56	99%	TRM Section 5.4.4
Kitchen Aerator	Each	CA = 7.44	CA = 7.44	100%	TRM Section 4.3.2
	Each	IU = 2.61	IU = 2.55	98%	TRM Section 5.4.4
Prog./Reprogram T-Stat	Each	CA = 124.68	CA = 125.91	CA = 101%	TRM Section 4.4.18
	Each	IU Boiler = 59.93	IU Boiler = 59.93	100%	TRM Section 5.3.11
	Each	IU Furnace = 40.51	IU Furnace = 40.51	100%	TRM Section 5.3.11
Pipe Insulation	LN FT	Varies	Varies	varies	TRM Section 4.4.14, 5.4.1, 5.3.2
Prog. Advanced T-Stat	Each	36.58	36.58	100%	TRM Section 4.4.42, 5.3.16
Showerhead	Each	CA = 21.73	CA = 21.73	100%	TRM Section 4.3.3
	Each	IU = 11.32	IU = 11.32	100%	TRM Section 5.4.5
Manual Baseline, Advanced T-Stat	Each	57.49	57.49	100%	TRM Section 4.4.42, 5.3.16
Pipe Steam Avg. Controls	Each	50.41	61.09	121%	TRM Section 4.4.36
Boiler	MBH	HW = 1.18	HW = 1.18	100%	TRM Section 4.4.10
	MBH	Steam >=1,500 MBH = 0.93	Steam >=1,500 MBH = 0.93	100%	TRM Section 4.4.10
	MBH	Steam <1,500 MBH = 0.70	Steam <1,500 MBH = 0.70	100%	TRM Section 4.4.10
Boiler Reset Controls	MBH	1.29	1.29	100%	TRM Section 4.4.4
Boiler Tune Up	MBH	0.38	0.38	100%	TRM Section 4.4.2
Kitchen Ventilation Controls	Each	773.95	774.00	100%	TRM Section 4.2.16
Draft Controls	MBH	0.15	0.16	105%	TRM Section 4.4.23
Furnace	Each	CA = 235	CA = 236.93	101%	TRM Section 4.4.11
	Each	IU = 135.66	IU = 135.66	100%	TRM Section 5.3.7
Large Gas WH	MBH	0.54	3.44	638%	TRM Section 4.3.1
Linkageless Controls	MBH	0.61	0.61	100%	TRM Section 4.4.21
DHW Controls	MBH	62.70	62.70	100%	TRM Section 4.3.8
Steam Trap	Each	Audit Px = 408.03	Audit Px = 407.99	100%	TRM Section 4.4.16
	Each	Audit PTA = 407.95	Audit PTA = 407.99	100%	TRM Section 4.4.16
	Each	No Audit = 110.16	No Audit = 110.16	100%	TRM Section 4.4.16
Advanced Thermostat (Prescriptive)	Each	57.49	57.49	100%	TRM Section 5.3.16
High Eff. Water Heater	Each	35.43	90.12	254%	TRM Section 4.3.1
Central Domestic Hot Water Plant	Each	43.72	45.59	104%	TRM Section 4.3.7
Condensate Tank Insulation	SQ FT	7.70	7.70	100%	TRM Section 4.4.14
DHW Tank Insulation	SQ FT	5.36	5.36	100%	TRM Section 4.4.14
Custom/Gas Opt.	Project	Varies	Varies		Project File Review, Evaluation‡

* Program Tracking Data (PTD) provided by Peoples Gas and North Shore Gas, extract dated January 30, 2020.
† State of Illinois Technical Reference Manual version 7.0 from http://www.ilsag.info/technical-reference-manual.html.
‡ Project files and monthly billing data provided by Peoples Gas and North Shore Gas. Site-specific data collected by Guidehouse.

5.1.1 Cross Cutting

The measure description for the following project IDs (4636759, 4952117) in the tracking data was inconsistent with the program path. Guidehouse verified the program path for these project IDs using the application form and assigned the verified savings accordingly.

> **Recommendation 1.** Guidehouse recommends ensuring that the measure description for a project ID corresponds with the program path in which it is tracked or reported.

5.1.2 IU Bathroom Aerator and IU Kitchen Aerator

The ex ante unit therms savings in the tracking data for the IU Bathroom Aerator and IU Kitchen Aerator measures are not consistent with the ex ante values in the 2019 interim review tracking data or the MMDB[3] calculator file. The verified savings for these measures are calculated using the Section 5.4.4 of the TRM and match the savings in the MMDB file.

> **Recommendation 2.** Guidehouse recommends updating the ex ante savings in the tracking system for the in-unit faucet aerator measures to be consistent with the verified savings and the MMDB calculator file.

5.1.3 CA Programmable and Reprogramming Thermostat

The ex ante unit therm savings in the tracking data currently correspond to the proposed energy use for this measure calculated for an average of all building types in the TRM. The verified savings are calculated as an average of the difference between the baseline and proposed energy use for the following two scenarios in the TRM for all building types:

- Continuous fan mode during occupied period to intermittent fan mode during occupied period
- Intermittent fan mode during occupied period to intermittent fan mode during occupied period

> **Recommendation 3.** Guidehouse recommends updating the ex ante unit therms for common area thermostats to be calculated as an average of the difference between the baseline and proposed energy use for the aforementioned scenarios for all building types in the TRM. The savings for this measure in CY2020 will be calculated using Section 4.4.48 of the IL TRM v8.0.

5.1.4 CA Furnace

The ex ante savings for this measure are calculated using an Equivalent Full Load Hours (EFLH) value for heating of 1,595 hours. The verified savings for this measure are calculated using the EFLH value for heating of 1,609 hours, which is the average of EFLH values for all Multi-family building types in the IL TRM v7.0, to be consistent with the EFLH values used in the boiler measures.

> **Recommendation 4.** Guidehouse recommends using the average EFLH value for all Multi-family building types when calculating savings for common-area furnace measures.

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[3] The MMDB refers to the following ex ante calculators "RESIDENTIAL MMDB PY8 – Verification.xlsx", and "PG NSG MMDB PY8 - C&I, SB – Verification.xlsx"

The ex ante savings for this measure are calculated using a deemed nominal heating input capacity of 76,000 Btu/hr and a deemed custom AFUE_Efficient of 95.50% as per the ex ante calculator. Guidehouse also calculated the verified savings using these capacities and AFUE_Efficient values.

> **Recommendation 5.** Guidehouse recommends tracking the capacity and the efficient AFUE values of the installed furnace for this measure.

5.1.5 Central Domestic Hot Water Plant

The per unit savings realization rate for this measure is 104 percent, however the overall realization rate for this measure is 21 percent. The ex ante savings for this measure are calculated by multiplying the total savings (hot water savings + standby loss savings) by the total number of tenant units. The verified savings are calculated by multiplying only the hot water savings by the total number of tenant units per the IL TRM v7.0. Also, the ex ante calculations are incorrectly calculating the standby loss (SL), excluding the (Input Rating/800) factor per IL TRM v7.0. For the ex post calculations, Guidehouse assumed an input rating of 150,000 Btuh when calculating the standby loss savings for this measure per the IL TRM v7.0.

> **Recommendation 6.** Guidehouse recommends updating the ex ante savings algorithm for this measure to multiply only the hot water savings by the number of tenant units, in order to avoid claiming additional standby loss savings, and calculating the standby loss using the input rating factor per IL TRM v7.0. Guidehouse requests the default input rating value to be used for this measure and the unit of the total quantity for this measure be added to the tracking database. This recommendation is unchanged from the mid-year impact evaluation findings. Franklin Energy indicated the recommendation will be addressed for 2020 program impact.

5.1.6 Draft Controls

The ex ante savings for this measure are calculated using an average EFLH for heating value for all building types in the TRM, while verified savings are calculated using an average EFLH for heating value for the mid rise and high rise Multi-Family building types in the IL TRM v7.0.

> **Recommendation 7.** Guidehouse recommends using the average EFLH value for mid rise and high rise Multi-family building types when calculating savings for Draft Controls.

5.1.7 Pipe Steam Averaging Controls

The tracking data ex ante per unit gross savings for this measure are 50.41 therms, while the savings value in the MMDB file is 61.09 therms. The verified savings are consistent with the MMDB, 61.09 therms per unit. The tracking savings estimate used a gas heating consumption value of 1,005 therms, which was derived from an average household heating load of 834 therms for furnace heating systems divided by an 83% efficiency value. Instead, the MMDB and the verified savings used a gas boiler load of 1,218 therms (which compares to 834 therms for furnaces) and divided by 64.8% steam boiler efficiency to get 1,880 therms for the gas boiler consumption. The verified savings for boiler averaging controls is then estimated as 61.09 therms per unit. All other factors remained the same between the tracking ex ante and verified savings.

> **Recommendation 8.** Guidehouse recommends the ex ante savings for boiler averaging controls use a 1,218 therm boiler heating load divided by 64.8% boiler efficiency to achieve the gas heating consumption. The current heating consumption value of 1,005 therms is derived from

furnaces and is inconsistent with the measure description. The gross unit savings should be changed from 50.41 therms to 61.09 therms to be consistent with the MMDB and the verified savings. This recommendation is unchanged from the mid-year impact evaluation findings. Franklin Energy indicated the recommendation will be addressed for 2020 program impact.

5.1.8 Large Gas Water Heater

The ex ante savings for this measure are calculated using an average water consumption per capita for all building types in the IL TRM v7.0, a baseline Thermal Efficiency of 80 percent as per the TRM (v6.0) and an efficient thermal efficiency of 88 percent. The verified savings are calculated using the water consumption per capita value corresponding to the Multi-family building type, the baseline Uniform Energy Factor (UEF) value of 0.4352 as per the IL TRM v7.0, and the efficient UEF assumed to be 67 percent as per the Commercial Water Heater measure.

> **Recommendation 9.** The IL TRM v7.0 uses the Uniform Energy Factor (UEF) values to calculate savings for this measure. Navigant recommends calculating the savings using the corresponding baseline and efficient UEF values as per the IL TRM v7.0. Navigant also recommends using the water consumption per capita value corresponding to the Multi-family building type for this program. This recommendation is unchanged from the mid-year impact evaluation findings. Franklin Energy indicated the recommendation will be addressed for 2020 program impact.

5.1.9 High Efficiency Water Heater

The ex ante savings for this measure are calculated using an average water consumption per capita value for all building types, while the baseline UEF value is calculated as per the IL TRM v6.0. Verified savings for this measure are calculated using the water consumption per capita value corresponding to the Multi-family building type and a baseline UEF value calculated as per the IL TRM v7.0.

> **Recommendation 10.** Navigant recommends using the water consumption per capita value corresponding to the multi-family building type and calculating the baseline UEF value as per the IL TRM v7.0. This recommendation is unchanged from the mid-year impact evaluation findings. Franklin Energy indicated the recommendation will be addressed for 2020 program impact.

5.1.10 Pipe Insulation

There are three Pipe Insulation measures that claim therms savings despite the tracking data indicating electric water heat source (Project IDs: 4998293 [two measures], 3961518). Guidehouse calculated verified therms savings for these measures assuming the electric water heat source was a database error.

> **Recommendation 11.** Guidehouse recommends the implementer review the "Account: Water-Heat Source" data field in the tracking data to ensure no therms savings are claimed for hot water measures with an electric water heat source

5.1.11 IU Pipe Insulation

The ex ante savings for the Individual Unit Pipe Insulation measures are calculated using commercial section (4.5.4) of the TRM. Since the measure is installed in the in-unit space of a multi-family building,

the verified savings are calculated using the residential section 5.4.1 for DHW and 5.3.2 for Hydronic Boiler of the IL TRM v7.0. Following the savings calculation methodology for the Common Area Pipe Insulation measures, Guidehouse calculated therm savings for each quarter inch nominal pipe size and averaged the savings for the pipe sizes in the measure name.

> **Recommendation 12.** Guidehouse recommends using the residential volume of the TRM to calculate savings for pipe insulation measures installed in the in-unit spaces of the Multi-family buildings.

5.1.12 Pipe Insulation

Guidehouse found that the ex ante gross therms savings for pipe insulation measures were consistent with the MMDB values. The verified savings are different from the MMDB primarily due to inconsistencies in formulas in the MMDB file. Formulas in the same column referenced inconsistent cells for what should be the same equation. There were some references to cells in an incorrect column and other cases where certain values were double counted. In the case of Steam Small 1" to 2" and Medium 2.1" to 5" the formulas referenced condensate therm/ft instead of steam. The HW pipe insulation measures were also incorrectly referencing the calculations for DHW measures. These errors lead to realization rates different from 100 percent for some of the pipe insulation measures. Table 5-3 summarizes the savings for the pipe insulation measures at the measure level.

> **Recommendation 13.** Guidehouse recommends the implementer review the pipe insulation measures in the MMDB file to ensure that formulas in the same column do not reference different cells for what should be the same equation. Guidehouse found other cases where certain values were double counted or averaged. Ensure formulas are not referencing condensate nominal therm/ft instead of steam nominal therms/ft. For fittings and valves check the formula to avoid double averaging savings from certain sizes listed in Table 5-2 below.

> **Recommendation 14.** Guidehouse recommends the implementer update the calculations in the MMDB file for the HW pipe insulation measures to ensure that formulas are referencing the HW savings and not the DHW savings. Franklin Energy mentioned these corrections have been made for 2020.

Table 5-2. Pipe Insulation Corrections

Measure	Quantity Unit	Ex Ante Unit Therms Savings	Verified Unit Therms Savings	Gross Therms Realization Rate (RR)	Adjustment
IU - Pipe Insulation - DHW Large >2"	LN FT	7.304	3.877	53%	Used residential algorithm 5.4.1 IL TRM v7.0
IU - Pipe Insulation - DHW Medium 1.26-2"	LN FT	4.252	1.927	45%	Used residential algorithm 5.4.1 IL TRM v7.0
IU - Pipe Insulation - DHW Small <=1.25"	LN FT	2.438	0.789	32%	Used residential algorithm 5.4.1 IL TRM v7.0
IU - Pipe Insulation - Hyd. Boiler Med 1.25-2"	LN FT	3.604	1.451	40%	Used residential algorithm 5.3.2 IL TRM v7.0
Pipe Insulation - HW Large >4"	LN FT	10.672	9.041	85%	using DHW calculations instead of HW
Pipe Insulation - HW Medium 2.1" to 4"	LN FT	6.195	5.676	92%	added 3.5" nominal therms to average, using DHW calculations instead of HW
Pipe Insulation - HW Small 1" to 2"	LN FT	3.136	2.659	85%	using DHW calculations instead of HW
Pipe Insulation - Steam Large Fitting	Each	55.908	50.637	91%	Removed double averaging fitting sizes 6-8"
Pipe Insulation - Steam Med 2.1" to 5"	LN FT	12.176	15.954	131%	corrected condensate nominal therms/ft to steam
Pipe Insulation - Steam Med Fitting	Each	15.368	19.225	125%	removed double averaging size 5"
Pipe Insulation - Steam Small 1" to 2"	LN FT	3.967	7.020	177%	corrected condensate nominal therms/ft to steam
Pipe Insulation - Steam X-Large Fitting	Each	100.350	99.445	99%	removed double averaging size 8"
Pipe Insulation - DHW Medium 1.26-2"	LN FT	4.252	4.252	100%	OK
Pipe Insulation - DHW Small <=1.25"	LN FT	2.437	2.437	100%	OK
Pipe Insulation - Hyd. Boiler Large >=2"	LN FT	6.187	6.187	100%	OK
Pipe Insulation - Hyd. Boiler Med 1.25-2"	LN FT	3.603	3.603	100%	OK
Pipe Insulation - Hyd. Boiler Sm <=1.25"	LN FT	2.068	2.068	100%	OK
Pipe Insulation - Steam Large 5.1" to 8"	LN FT	31.132	31.134	100%	OK

Source: Guidehouse team analysis of MMDB pipe insulation savings inputs.

Custom Project Review Findings and Recommended Actions

5.1.13 Custom Optimization – Project 3342125 (Evaluated in Wave 1)

The project involved installation of variable speed drives (VSD) on two mixed air units (AS-2 and AS-3) and three exhaust fans. In the baseline condition, the equipment operated at constant volume and full speed, 24 hours a day, while the project proposed a 20% airflow setback at all hours.

Franklin Energy calculated the ex ante savings using the bin analysis method. Navigant calculated the verified savings using an hourly analysis method which provides a more accurate representation of the airflow setback in place at the facility post installation.

> **Recommendation 15.** Navigant recommends using an hourly analysis method rather than the bin analysis method for calculating savings for this type of project. The hourly analysis method provides a more accurate representation of the weather condition correlation to the time schedule.

5.1.14 Custom Optimization– Project 3370798 (Evaluated in Wave 1)

The project involved installation of variable speed drives (VSD) on two mixed air units (AS-2 and AS-3) and three exhaust fans. In the baseline condition, the equipment operated at constant volume and full speed, 24 hours a day, while the project proposed integrating the unit into the Building Automation System (BAS) and implementing a 70% airflow setback from 12 PM to 5 AM.

Franklin Energy calculated the ex ante savings using the bin analysis method. Navigant verified no savings for this project based on data collected during our on-site visit. During our on-site visit we were able to verify that both the mixed air units (AS-2) and (AS-3) were in occupied mode 24 hours a day, so no savings were realized from an additional unoccupied airflow setback of 70% from 12 PM to 5 AM as proposed in the project.

> **Recommendation 16** Navigant recommends that during the post installation documentation process the implementer should not only confirm that the equipment is installed, but also confirm that the equipment is operating and programmed in such a way that savings are occurring. Navigant also recommends that the implementer confirm the accuracy of the details on the post-inspection form and use an hourly analysis method rather than the bin analysis method for calculating savings for this type of project.

5.1.15 Custom Optimization– Project 3997076 (Evaluated in Wave 1)

The project involved installation of a variable speed drive (VSD) on an air handling unit (AS-1). In the baseline condition, the equipment operated at constant volume and full speed, 24 hours a day, while the project proposed a 30% airflow setback at all hours.

Franklin Energy calculated the ex ante savings using the bin analysis method. Navigant verified no savings for this project based on data collected during our on-site visit. During our on-site visit we were able to verify that the VSD on the air handling unit (AS-1) was in bypass mode, resulting in no fan speed reduction.

> **Recommendation 17.** Navigant recommends that during the post installation documentation process the implementer should not only confirm that the equipment is installed, but also confirm that the equipment is operating and programmed in such a way that savings are occurring. Navigant also recommends that the implementer confirm the accuracy of the details on the post-inspection form and the use of an hourly analysis method rather than the bin analysis method for calculating savings for this type of project.

5.1.16 Custom – Project 3378059 (Evaluated in Wave 1)

The project involved replacement of the existing burner on boiler #2 (which had limited modulation capabilities with a turndown ratio (TDR) of 3:1) with the new IC Power burner with full modulation controls,

a TDR of 10:1, linkageless controls, and fully controlled draft damper. The project was implemented in a condominium complex served by two 25.2 MMBH boilers, with the burner replacement occurring on the primary boiler for the complex.

Franklin Energy calculated the ex ante savings for the higher efficiency equipment using the boiler improvement calculation template and gas utility usage history data to estimate base load and seasonal load. The verified savings made a few minor adjustments that did not have a large impact on the savings: the stoichiometry coefficients were corrected to reflect the appropriate temperature ranges, and the measured existing combustion efficiency inputs were updated based on the combustion reading provided in the project documentation.

> **Recommendation 18.** Navigant recommends Franklin Energy update the boiler improvement calculation template to correct the temperature range errors in the stoichiometric heat capacity calculation. Navigant also recommends Franklin Energy use the combustion reports for the boiler when updating the boiler improvement calculation template.

5.1.17 Custom – Project 3699951 (Evaluated in Wave 1)

The project involved installation of a plant control system for the HVAC hot water radiant floor loop, along with sensors and a control valve for the building consisting of two zones (South Zone and North Zone). In the baseline condition, both the zones are supplied water at the same temperature and for the North Zone to stay at a comfortable temperature, the South Zone of the building is overheated by approximately 10F due to solar exposure. The proposed control system will allow for the cooler return water to be blended with the hot water supplied to the South Zone and bring it to a more reasonable temperature.

Franklin Energy calculated the ex ante savings for this project using an estimated 10F reduction in tenant space in the South Zone and utility data to establish the baseline HVAC therm consumption for the building. No savings are claimed for the North Zone of the building. Navigant verified the savings for the project using the same methodology while making a few adjustments: the gas consumption data for January 2018, December 2018, November 2017 and October 2017 was updated based on the billed volume history for the building, the adjustment factor for the building was updated from 0.50 to 0.45 to correspond to a poorly insulated building with significant other gas use or well insulated building with no other gas use, and the average winter temperature difference was updated based on TMY data for Chicago.

> **Recommendation 19.** Navigant recommends Franklin Energy ensure that the gas consumption data for the building corresponds with the billed volume history. Navigant also recommends using the default adjustment factor based on building type and gas use type for the building and providing the source for the average winter temperature difference value used in the ex ante calculations or using the average winter temperature value proposed by Navigant using TMY data for Chicago.

5.1.18 Custom – Project 3878125

The project involved installation of demand ventilation controls (DCV) to the garage ventilation system at the building. The garage has a total of 4 levels including a mezzanine garage level with a total of 144 parking spaces. In the baseline condition, the garage exhaust fan runs at constant speed year-round and the garage is heated using thirteen hydronic unit heaters, when the temperature drops below 55F. By installing a variable speed drive on the exhaust fan, the proposed system modulates the outside air intake based on Carbon Monoxide (CO) sensors and saves energy by retaining the heat in the garage.

Franklin Energy calculated the ex ante savings using bin analysis method. The length of car operation in the garage in the ex ante calculation is assumed to be an average of the average entrance time and the average exit time for level 4 of the garage. The predicted CO emission in the ex ante case is calculated assuming 40% of the time during entry and 60% of the time during exit. Guidehouse calculated the verified savings using the 8760 hourly analysis method. The length of car operation in the garage in the ex post case is calculated as an average of the average entrance time and average exit time for all 4 levels weighted by the number of parking spaces at each level. The predicted CO emission in the ex post case is also calculated as a weighted average of percent entry time and percent exit time for all four levels.

> **Recommendation 20** Navigant recommends Franklin Energy use an average value for the length of car operation in the garage and predicted CO emission parameters weighted by the number of parking spaces at each level for such projects installed in multi-level garages.

5.1.19 Custom – Project 4035730

The project involved replacement of the two existing 16,500 MBH steam boilers at the end of their useful life with five 10,000 MBH and two 5,000 MBH hot water boilers. In the existing condition, hot water obtained via steam to hot water exchangers is used to provide space heating to the building. As part of the project, the existing steam boilers along with the heat exchangers will be replaced by non-condensing hot water boilers.

Franklin Energy calculated the ex ante savings assuming the baseline boiler to be a steam boiler with a baseline efficiency consistent with the Energy Independence and Security Act (EISA) of 2007. However, since the installed boilers are hot water boilers, Guidehouse calculated the verified savings assuming the baseline boiler to be a hot water boiler with a baseline efficiency consistent with EISA requirements. As a result of this, the efficiency of the baseline boiler was updated from 79 percent in the ex ante case to 82 percent in the ex post case resulting in lower savings. Guidehouse also updated the efficiency of the installed boilers from 85 percent to 85.1 percent based on AHRI specification sheets for the installed boilers.

> **Recommendation 21.** Guidehouse recommends Franklin Energy select the baseline boiler to be of the same type as the actual installed boiler rather than the existing boiler when boilers are replaced at the end of their useful life.

5.2 Historical Realization Rates and NTG Values

Table 5-3 below shows the historical gross realization rates and NTG values for the Multi-Family Assessments Program. Beginning in GPY4, the NTG values shown are a savings weighted average from the various measures and deemed NTGs that vary by measure and program path.

Table 5-3. Historical Realization Rates and NTG Values

Program Year	PGL Verified Gross RR	NSG Verified Gross RR	PGL NTG	NSG NTG
GPY1	100%	100%	0.90	0.90
GPY2	100%	98%	0.90	0.90
GPY3	100%	100%	0.90	0.90
GPY4	100%	102%	0.95	0.92
GPY5	103%	100%	0.95	0.95
GPY6	100%	100%	0.90	0.92
2018	107%	110%	0.84	0.86
2019	100%	97%	0.85	0.92

Source: Guidehouse evaluation research.

6. APPENDIX 1. IMPACT ANALYSIS METHODOLOGY

Guidehouse determined verified gross savings for each program measure by:

1. Reviewing the savings algorithm inputs in the measure workbook for agreement with the TRM[4] or evaluation research for non-deemed measures.
2. Validating that the savings algorithm was applied correctly.
3. Cross-checking per-unit savings values in the tracking data with the verified values in the measure workbook or in Guidehouse's calculations if the workbook did not agree with the TRM.
4. Multiplying the verified per-unit savings value by the quantity reported in the tracking data.
5. Conducting engineering desk file review of a sample (census in 2019) of custom projects.

The evaluation team conducted an engineering desk file review for all seven custom projects installed in 2019, to verify project savings that were not based on measures specified in the TRM. The evaluation team also conducted site visits for three out of the seven custom projects in order to verify the ex ante assumptions and support the verified calculations.

Table 6-1 provides a summary of M&V results for the custom projects reviewed by Guidehouse.

Table 6-1. Summary of Custom M&V Results

Program	Project ID	Measure Description	Ex Ante Gross Savings (Therms)	Gross Realization Rate	Verified Gross Savings (Therms)	Summary of Adjustment
Custom Optimization	3342125	Fan VSD Adjustment	11,669	101%	11,763	8760 hourly analysis approach
Custom Optimization	3370798	Fan VSD Adjustment	6,078	0%	0	Units verified to be in occupied mode 24 hours a day during site visit
Custom Optimization	3997076	Fan VSD Adjustment	7,870	0%	0	VSD verified to be in bypass mode during site visit
Custom	3378059	Boiler Combustion Controls	16,198	103%	16,612	Stoichiometric coefficients, boiler combustion efficiency inputs
Custom	3699951	HVAC Other	7,633	143%	10,889	Gas consumption data October 2017 through January 2018, average winter temperature difference, adjustment factor
Custom	3878125	Garage Ventilation System	31,554	126%	39,912	8760 hourly analysis approach, weighted average of parameters for all 4 levels of the garage.
Custom	4035730	Boiler Replacement	32,434	52%	16,738	Baseline boiler type and efficiency, efficiency of the installed boiler

Source: Guidehouse analysis

Engineering Review of Project Files

For each selected project, an in-depth application review is performed to assess the engineering methods, parameters and assumptions used to generate all ex ante impact estimates. For each measure

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[4] Because the Illinois TRM provides multiple options for selecting input assumptions, Franklin Energy produces a "Master Measure Database" spreadsheet that documents their approach to compliance with the Illinois TRM.

in the sampled project, engineers estimated ex post gross savings based on their review of documentation and engineering analysis.

To support this review, the implementation contractor provided project documentation in electronic format for each sampled project. Documentation included some or all scanned files of hardcopy application forms and supporting documentation from the applicant (invoices, measure specification sheets, and vendor proposals), pre-inspection reports, post inspection reports, and calculation spreadsheets.

On-Site Data Collection

On-site visits were completed for a subset of three of the seven customer applications sampled.[5] During the on-site, verification of the installation and operation of the measure as intended was conducted along with supplemental data collection and verification of the parameters used in the ex ante and verified savings calculations. The data collected on-site was used to inform the verified savings estimates.

Bin Analysis versus Hourly Analysis on Projects 3342125, 3370798, 3997076

Navigant has encountered basically two ways in which the Fan VSD Adjustment measure is implemented:

Case 1   Fan Speed Reduction is applied across all hours (Example – 20% speed reduction 24 hours a day). When the fan speed reduction is applied across all hours, the bin hour analysis method produces an estimate of savings that has been very close (+/- 2%) to our verified savings calculated using the hourly analysis method.

Case 2   Fan Speed Reduction is applied only at particular times of the day (Example – 50% speed reduction from 1 AM – 6 AM). When the fan speed reduction is applied only for certain times of the day, the bin hour analysis method does not provide an accurate estimate of the savings (bin analysis savings are calculated assuming an average reduction across 24 hours) and yields results that have been much higher or lower (up to +/- 19%) than our verified savings calculated using the hourly analysis method. The hourly analysis method accounts for the actual temperatures during the time period when the fan speed is lowered and hence provides a more accurate estimate of savings.

Navigant will use and recommend the hourly approach to verify savings for the Fan VSD Adjustment measure in both cases above. If the implementer uses the bin analysis method, they may see a minor verified savings adjustment (Case 1) or possibly a larger adjustment (Case 2) depending on how the measure is implemented (Case 1 or Case 2).

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[5] On-site visits were conducted during 2019, prior to the COVID-19 restrictions in 2020.

7. APPENDIX 2. IMPACT ANALYSIS SUPPLEMENTAL INFORMATION

In Table 7-1, we show the list of projects characterized as "prescriptive change" that the implementer describes as having the ex ante savings capped at 20 percent of the customer annual gas usage. Based on our review of installed quantity and the reported savings for a sample of these projects, Guidehouse determined that the assumptions used to calculate the reported savings for these projects were reasonable.

Table 7-1. Projects with Capped Percentage Savings ("Prescriptive Change")

Project ID	Type of Measure	Ex Ante Gross Therms (capped savings)	Verified Gross Therms
3802554	Prescriptive Change Steam Trap - Savings - PG MF PTA 2019	33,452	33,452
3802335	Prescriptive Change Steam Trap - Savings - PG MF PTA 2019	30,189	30,189
3841015	Prescriptive Change Steam Trap - Savings - PG MF PTA 2019	13,870	13,870
3801095	Prescriptive Change Steam Trap - Savings - PG MF PTA 2019	9,383	9,383
3311771	Prescriptive Change Steam Trap - Savings - PG MF P 2019	8,503	8,503
3829295	Prescriptive Change Steam Trap - Savings - PG MF PTA 2019	6,935	6,935
3791361	Prescriptive Change Steam Trap - Savings - PG MF PTA 2019	6,119	6,119
3489766	Prescriptive Change Other - Savings - PG MF PTA 2019	5,001	5,001
3801589	Prescriptive Change Steam Trap - Savings - PG MF PTA 2019	3,264	3,264
3801883	Prescriptive Change Steam Trap - Savings - PG MF PTA 2019	3,264	3,264
3850604	Prescriptive Change Steam Trap - Savings - PG MF PTA 2019	3,264	3,264
3734591	Prescriptive Change Steam Trap - Savings - PG MF PTA 2019	2,856	2,856
3734204	Prescriptive Change Steam Trap - Savings - PG MF PTA 2019	2,448	2,448
3576367	Prescriptive Change Other - Savings - PG MF P 2019	2,416	2,416
4500225	Prescriptive Change Other - Savings - PG MF PTA 2019	2,168	2,168
3802228	Prescriptive Change Steam Trap - Savings - PG MF PTA 2019	2,040	2,040
3929106	Prescriptive Change Other - Savings - PG MF P 2019	1,945	1,945
3802266	Prescriptive Change Steam Trap - Savings - PG MF PTA 2019	816	816

Source: PGL and NSG tracking data and Guidehouse team analysis.

8. APPENDIX 3. PROGRAM-SPECIFIC INPUTS FOR THE ILLINOIS TRC

Table 8-1 and Table 8-2, the Total Resource Cost (TRC) variable tables, only include cost-effectiveness analysis inputs available at the time of finalizing the 2019 Multi-Family Assessment Program impact evaluation report. Additional required cost data (e.g., measure costs, program level incentive and non-incentive costs) are not included in the tables and will be provided to the evaluation team later. Detail in the TRC tables (e.g., EULs), other than final 2019 savings and program data, are subject to change and are not final.

Table 8-1. TRC Inputs for PGL

Program Path	Measure Category	Unit Basis	Quantity	EUL	Ex Ante Gross Savings (Therms)	Verified Gross Savings (Therms)	Verified Net Savings (Therms)
Direct Install	Programmable T-Stat	Each	888	8	38,156	38,153	32,430
	Showerhead	Each	2,770	10	31,659	31,656	32,605
	Pipe Insulation	LN FT	5,546	15	21,288	16,840	14,314
	Advanced T-Stat Programmable Baseline	Each	414	11	15,152	15,145	15,145
	Bathroom Aerator	Each	2,086	10	3,551	3,520	3,625
	Kitchen Aerator	Each	1,335	10	3,571	3,495	3,600
	Advanced T-Stat Manual Baseline	Each	4	11	230	230	230
	Reprogram T-Stat	Each	5	2	222	222	189
Prescriptive	Pipe Insulation	LN FT	42,238	20	263,015	292,026	221,940
	Pipe Steam Avg. Controls	Each	1,337	20	67,499	81,675	62,168
	Boiler Tune Up	MBH	198,932	3	74,414	74,412	56,553
	Boiler	MBH	60,815	20	63,372	63,370	48,161
	Steam Trap	Each	345	6	47,238	47,237	35,900
	Central Domestic Hot Water Plant	Each	4,973	15	217,438	45,594	34,651
	DHW Controls	MBH	482	15	30,220	30,221	22,968
	Prescriptive Change, Steam Trap	Project	1	6	8,503	8,503	6,462
	Kitchen Ventilation Controls	Each	7	15	5,418	5,418	4,118
	Linkageless Controls	MBH	5,600	16	3,415	3,415	2,596
	Prescriptive Change	Project	2	3	4,361	4,361	3,314
	Advanced Thermostat	Each	52	11	2,989	2,989	2,989
	Boiler Reset Controls	MBH	2,394	20	3,082	3,082	2,342
	Furnace, CA	Each	12	17	2,820	2,843	2,161
	Furnace, IU	Each	11	20	1,492	1,492	1,134
	Large Gas WH	Each	378	15	204	1,301	989
	Programmable Thermostat	Each	6	8	748	755	574
	Draft Controls	Each	3,620	15	552	581	442
	High Efficiency Water Heater	Each	4	15	142	360	274
PTA	Steam Trap	Each	2,466	6	943,479	943,564	830,336
	Pipe Insulation	LN FT	103,262	20	513,304	626,503	551,322
	DHW Controls	MBH	3,345	15	209,747	209,732	184,564
	Pipe Steam Avg. Controls	MBH	3,411	20	171,290	207,577	182,668
	Boiler Tune Up	MBH	398,129	3	151,376	151,417	133,247
	Prescriptive Change, Steam Trap	Project	13	6	117,899	117,899	103,751
	Boiler	MBH	23,104	20	20,976	20,975	18,458
	DHW Tank Insulation	SQ FT	1,275	15	6,831	6,831	6,012
	Prescriptive Change	Project	2	3	7,168	7,168	6,308
	Condensate Tank Insulation	SQ FT	750	15	5,776	5,776	5,083
	Boiler Control	MBH	3,230	20	4,159	4,158	3,659
Custom	Custom	Project	4	17	87,818	84,151	60,589
	Custom Optimization	Project	3	15	25,745	11,763	10,705
	Total		**NA**		**3,176,318**	**3,176,409**	**2,708,575**

Source: PGL tracking data and Guidehouse team analysis.

Table 8-2. TRC Inputs for NSG

Program Path	Measure Category	Unit Basis	Quantity	EUL	Ex Ante Gross Savings (Therms)	Verified Gross Savings (Therms)	Verified Net Savings (Therms)
Direct Install	Advanced T-Stat Manual Baseline	Each	233	11	13,395	13,394	13,394
	Programmable T-Stat	Each	228	8	9,235	9,234	7,849
	Showerhead	Each	560	10	6,443	6,443	6,636
	Pipe Insulation	LN FT	929	15	2,749	2,441	2,075
	Advanced T-Stat Programmable Baseline	Each	57	11	2,085	2,085	2,085
	Bathroom Aerator	Each	781	10	1,264	1,252	1,290
	Kitchen Aerator	Each	261	10	691	676	696
Prescriptive	Steam Trap	Each	9	6	991	991	753
	Furnace, CA	Each	1	16.5	235	237	180
PTA	Pipe Insulation	LN FT	4,920	15	17,651	16,332	14,372
	DHW Tank Insulation	SQ FT	1,410	15	7,555	7,555	6,648
	Boiler Tune Up	MBH	1,464	3	550	550	484
	Total		**NA**		**62,845**	**61,191**	**56,463**

Source: NSG tracking data and Guidehouse team analysis.