

Statewide Evaluation: Residential HEHE Program Impact Evaluation Summary

Evaluation Conducted by: Opinion Dynamics, West Hill Energy and Computing, and Analytical Evaluation Consultants, LLC – August 2014

1. PROGRAM SUMMARY

The New York State Public Service Commission (PSC) approved certain utility Residential Gas High-Efficiency Heating programs (HEHE Programs) for implementation between 2009 and 2011 (Cycle 1). The following utilities in New York State administer these programs:

- Consolidated Edison Company of New York, Inc. (Con Edison)
- Orange and Rockland Utilities, Inc. (O&R)
- National Grid (The Brooklyn Union Gas Company (KEDNY), Keyspan Gas East Corporation (KEDLI), and Niagara Mohawk Power Corporation (NiMo))
- Corning Natural Gas Corporation (Corning Gas)
- Central Hudson Gas & Electric (Central Hudson)
- National Fuel Gas Distribution Corporation (National Fuel)
- Enbridge St. Lawrence Gas (Enbridge)

The HEHE Programs are open to all residential customers and are funded by those customers' System Benefit Charges (SBC) (i.e., they pay the SBC on their natural gas utility bill). The HEHE programs promote the purchase and installation of energy-efficient heating and water heating equipment. Rebates are available to qualifying customers to offset the upfront incremental costs associated with the purchase of high-efficiency equipment. Qualifying equipment is largely the same across PAs and includes natural gas furnaces, boilers, indirect water heaters, and related add-on measures such as programmable thermostats, boiler reset controls (in some cases), and air sealing (in some cases).

The HEHE Programs had approximately 57,000 participants between 2009 and 2011. The majority of statewide ex ante savings are associated with high-efficiency furnaces (59%), programmable thermostats (22%) and boilers (15%).

2. EVALUATION OBJECTIVE AND HIGH LEVEL FINDINGS

The overall objective of the statewide evaluation was to develop gas and associated ancillary electric savings impacts based on measures installed through the HEHE Programs for all participating PAs in New York State. More specifically, through the research activities conducted, the evaluation accomplishes the following:

- Reviewed savings assumptions and proposed recommendations for revisions to the *New York Standard Approach for Estimating Energy Savings from Energy Efficiency Programs* Technical Manual (NYTM)¹
- Developed and applied gross savings realization rates
- Developed estimates of free ridership and spillover for an overall estimate of net-to-gross ratios (NTGR)
- Developed measure-specific incremental cost estimates

The evaluation resulted in statistically valid gross and net impacts, with segmentation by measure category and PA where reliable estimates proved feasible given the sample size. To the degree possible, we used the impact evaluation to derive insights and provide actionable recommendations that can help improve program design, implementation, savings estimation, and data tracking.

The evaluation complies with the requirements of the Evaluation Guidelines issued by the DPS (established August 7, 2008, and updated in November 2012) to support rigorous and transparent evaluation. Per the Evaluation Guidelines, the impact evaluation methods used in this report followed the recommendations provided in the Regional EM&V Methods Guidelines, developed by the NEEP EM&V Forum.

Gross Impacts

The estimated statewide gross realization rate for the HEHE Programs is 53%. The rate ranges from 50% for National Fuel to 68% for Corning. Applying the realization rate to total ex ante therm savings yields total ex post savings of almost 8 million therms.

Table 1. Summary of Gross Savings (2009-2011)

PA	Ex Ante Program Savings (Therms)	RR	Ex Post Program Savings (Therms)
Central Hudson	194,782	57%	111,406
Con Edison	863,985	52%	448,550
Corning	119,180	68%	81,531
Enbridge	91,348	61%	55,675
National Fuel	6,560,295	50%	3,264,486
KEDLI	955,067	61%	582,657
KEDNY	668,990	62%	416,473
NiMo	5,224,681	54%	2,797,021
O&R	325,988	63%	204,486
Statewide	15,004,317	53%	7,962,286

¹ New York Department of Public Service's *New York Standard Approach for Estimating Energy Savings from Energy Efficiency Programs*, October 15, 2010, (a.k.a. the New York Technical Manual or NYTM). <http://www.dps.ny.gov/TechManualNYRevised10-15-10.pdf>. This review included revisions to the NYTM through November 23, 2013.

Statewide realization rates for measures incented by the residential HEHE Programs range from 22% for thermostats to 93% for sealing. Realization rates for heating systems range from 60% to 69%. Thermostats have the biggest impact on overall realization rates. While they have relatively small per unit ex ante savings, they are the most frequently installed measure and have by far the lowest realization rate. Heating systems have the second biggest impact on overall ex post savings.

Other findings are detailed below:

- **Data Collection and Program Tracking.** Some PAs used default values for necessary inputs to savings calculations (such as equipment capacity). Further, not all PAs were applying NYTM algorithms in the same manner. For example, each PA could choose FLH assumptions based on vintage and home type, and therefore each PA may have had different criteria for assigning these values. Some PAs used default values as inputs instead of household-specific values. These tracking differences have implications for realization rates.
- **Savings Assumptions for Heating System Replacement.** Full-load hours (FLH) for heating system replacement estimated through this evaluation indicate that assumptions in the NYTM (for an average single-family home) may be overstated by as little as 16% to as much as 41%. If the FLH values estimated in this evaluation were applied to 2009-2011 ex ante savings, realization rates would be between 59-81%, depending on the program administrator.
- **Savings Assumptions for Programmable Thermostats.** This evaluation showed that the current energy savings factor of 6.8%, stipulated by the NYTM, is not realistic among HEHE program participants. The realization rate for thermostat savings was 22%, and programmable thermostats appeared to save about 2% of average annual pre-installation natural gas consumption, based on billing analysis.
- **Savings Assumptions for Boiler Reset Controls.** While the realization rate for boiler reset controls was 63%, the pre/post billing analysis showed that actual percent savings are in line with the energy savings factor (ESF) in the NYTM.
- **Savings Assumptions for Indirect Water Heaters.** The current NYTM algorithm does not currently account for a reduction in operating efficiency during summer months. The decrease in efficiency would be applicable to households that switch from a standard natural gas-fired water heater to a large boiler with an indirect hot water heater. In addition, the NYTM also uses an algorithm to calculate the heat loss coefficient for the baseline water tank, but not all values in the algorithm are documented. The resulting heat loss coefficient is higher than most other sources and higher than the deemed heat loss coefficient for standard hot water heaters in other areas of the NYTM.

Net Impacts

The estimated statewide NTGR for the evaluation period (2009-2011) is 61.8%. We estimate free-ridership to be 38.5% and participant spillover 0.3%. The NTGR ranges from 71.0% for KEDLI to 48.2% for Orange & Rockland (O&R). Free-ridership ranges from just under 30% for KEDLI to approximately 50% for O&R, Corning, and Enbridge. Participant spillover is uniformly low across PAs, ranging from no spillover for Enbridge and O&R to 1.5% for Corning. Table 2 summarizes the program-level FR, participant SO, and NTGRs.

Table 2. Program Level NTGRs

PA	Program Free-Ridership	Program Spillover	Program NTGR
Central Hudson	31.8%	0.5%	68.8%
Con Edison	36.5%	0.5%	64.1%
Corning	50.4%	1.5%	51.1%
Enbridge	47.8%	0.0%	52.2%
National Fuel	36.9%	0.3%	63.4%
KEDLI	29.6%	0.6%	71.0%
KEDNY	37.5%	0.4%	62.9%
NiMo	41.5%	0.3%	58.8%
O&R	51.8%	0.0%	48.2%
Statewide	38.5%	0.3%	61.8%

Table 3 below presents ex post net impacts for 2009 to 2011, by PA and statewide, calculated by multiplying ex-post gross impact results by the NTGR.

Table 3. Program Level Net Impacts (2009-2011)

PA	Ex-Post Gross Impacts (Therms)	Program Level NTGR	Ex-Post Net Impacts (Therms)
Central Hudson	111,406	68.8%	76,596
Con Edison	448,550	64.1%	287,313
Corning	81,531	51.1%	41,673
Enbridge	55,675	52.2%	29,057
National Fuel	3,264,486	63.4%	2,070,017
KEDLI	582,657	71.0%	413,603
KEDNY	416,473	62.9%	261,855
NiMo	2,797,021	58.8%	1,644,122
O&R	204,486	48.2%	98,639
Statewide	7,962,286	61.8%	4,922,876

Incremental Cost

This evaluation included estimation of incremental costs for the four major measures incented through the Programs: furnaces, water boilers, steam boilers, and indirect water heaters. We estimated incremental costs for various efficiency levels, corresponding to efficiency levels rebated by the PAs through the Programs. Table 4 provides mean and median incremental cost estimates. Results are presented for two analytical approaches developed as part of this evaluation. Except for steam boilers (82% AFUE), the results of the two approaches are nearly identical. Further discussion of the differences between these two approaches can be found in the evaluation report.

Table 4. Weighted Incremental Cost Estimates

Measure	Approach #1			Approach #2		
	n	Mean	Median	n	Mean	Median
Furnace – 90% AFUE	46	\$835	\$700	31	\$889	\$650
Furnace – 92% AFUE	41	\$1,062	\$900	27	\$1,022	\$800
Furnace – 94% AFUE	35	\$1,317	\$1,200	25	\$1,169	\$1,000
Furnace – 95% AFUE	56	\$1,295	\$1,200	35	\$1,349	\$1,100
Water Boiler – 85% AFUE	25	\$669	\$500	24	\$679	\$500
Water Boiler – 90% AFUE	22	\$2,073	\$2,000	21	\$2,072	\$1,800
Steam Boiler – 82% AFUE	35	\$130	\$500	24	\$442	\$500
Indirect Water Heater	33	\$955	\$1,105	32	\$944	\$950

NYTM Review

This evaluation also included a measure-level engineering review of the current algorithms and deemed savings values from the NYTM for eight measures installed through the HEHE Programs. The following are findings by measure (in alphabetical order).

- **Air Sealing.** The NYTM contains two algorithms for this measure. The algorithm using blower door test information is well specified. Our billing analysis found a realization rate of 93% for this measure, indicating that the savings algorithms and assumptions used by the PAs provide a good estimate of actual savings.
- **Boilers & Furnaces.** We find the algorithm to be reasonable and comparable to those used elsewhere, but our billing analysis indicates that, if using NYTM default assumptions, the engineering algorithm overestimates savings. This overstatement can be attributed to NYTM default FLH values considerably higher than those produced in our billing analysis.
- **Boiler Reset Controls.** We find the algorithm for boiler reset controls to be well specified, with one exception: the algorithm assumes that multiple controls would increase the savings of a single boiler² While different controls in commercial

² During the DPS review process, the TecMarket team clarified that the “units” term in the boiler reset control algorithm refers to the number of controllers installed by the program. The evaluation team has added a recommendation that this be clarified in future versions of the NYTM.

applications can control different systems, it is unclear how additional controls would provide additional savings for residential applications when the customer has only one boiler. Inputs to the algorithm are simple and well defined, and default values suggested for heating unit capacity (when customer-specific data are not available) are reasonable, with the exception of overstated FLH values.

- **Duct Sealing.** The NYTM algorithm is relatively similar to those used in other TRMs. However, it does not include a factor accounting for furnace efficiency, and therefore excludes interactive effects.
- **EC Motors.** The Wisconsin study upon which the deemed savings value is based includes savings in the summer and was conducted in an area of the country that, based on the 2009 Residential Energy Consumption Survey,³ has a greater penetration of central air conditioning than New York. As such, the overall savings may be overstated.
- **Indirect Water Heaters (IWH).** The NYTM includes an algorithm input called UA_{base} that can cause large changes in estimated savings, yet two of the specific inputs to the algorithm are not documented. UA_{base} values for seemingly similar baseline water heaters in different NYTM sections vary substantially. In addition, the algorithm does not consider summer losses associated with IWHs that replace standard water heaters.
- **Programmable Thermostats.** This measure uses good engineering inputs, but may not accurately reflect how customers use their thermostats. We found the NYTM algorithm is simple and well defined, and default values suggested for heating unit capacity (when customer-specific data are not available) are reasonable. However, multiple recent evaluations^{4,5} – as well as the billing analysis conducted in this current evaluation – have found lower-than-expected programmable thermostat savings, calling the 6.8% ESF used in the NYTM into question.

3. EVALUATION RECOMMENDATIONS AND PROGRAM ADMINISTRATOR RESPONSE

The recommendations for the program and the NYTM resulting from the analyses and conclusions of this evaluation are presented below. Program administrator responses follow each program and NYTM recommendation.

Program Recommendations

1. **Improve Data Collection and Program Tracking.** We recommend that PAs continue to improve data collection and program tracking practices.

³ Residential Energy Consumption Survey (RECS). U.S. Energy Information Administration (August, 2011).

⁴ NYSERDA 2007-2008 *EmPower New YorkSM Program Impact Evaluation Final Report*, prepared for the New York Energy and Research Development Authority by Megdal and Associates. April 2012. Page ES-8.

⁵ NYSERDA 2007-2008 *Home Performance with Energy Star[®] Program Impact Evaluation Final Report*, prepared for the New York Energy and Research Development Authority by Megdal and Associates. September 2012. Page 4-7.

Response to Program Recommendation 1:

National Fuel accepts this recommendation. The Company will continue its data collection efforts and will continue assembling program tracking information that is useable for evaluations and program reporting.

National Grid accepts this recommendation. The Company will continue its data collection efforts and will continue assembling program tracking information that is useable for evaluations and program reporting.

Enbridge St. Lawrence Gas has no response.

Con Edison accepts this recommendation. We continue to improve our data collection and program tracking practices to minimize any data errors.

- 2. Track Data to Determine if Installation Was Replacement on Failure or Early Replacement.** We recommend that PAs track the efficiency and/or age of the replaced equipment and whether the equipment was still functioning at the time of replacement, if feasible. This would provide additional information on the extent to which early replacement is taking place.⁶

Responses to Program Recommendation 2:

National Fuel accepts this recommendation. The Company will add additional fields of data to its rebate application form and will utilize upcoming trade ally training sessions to educate contractors about the rebate application form changes. Generally, National Fuel believes that PA's should take reasonable efforts to educate contractors participating in their program to track the efficiency level of and working condition of replaced equipment. It is important not to over burden customers in attempting to gather hard to find information on aging equipment. Contractors, however, have the capability, through their familiarity with HVAC equipment, to identify model numbers, working condition and efficiency levels.

National Grid accepts this recommendation. The Company will look to add additional fields of data to its rebate application form. Generally, it is important not to over burden customers in attempting to gather hard to find information on aging equipment. Contractors, however, might have the capability, through their familiarity with HVAC equipment, to identify model numbers, working condition and efficiency levels.

Enbridge St. Lawrence Gas has no response.

Con Edison accepts this recommendation. We have revised our Residential applications to include questions that would indicate a reason for the new equipment (i.e. Replace on Fail or Early Replacement). In order to minimize any additional burden on the customer and unnecessary delays in rebates, the questions are kept high-level and as an optional field.

⁶ If PAs choose to base savings on early replacement, Appendix M, Section 5 of the NYTM specifies the additional variables that the TecMarket team recommends be tracked in program databases.

3. **Collect Additional Data on Indirect Water Heaters.** We recommend incorporating data on existing system type (i.e., indirect water heater, individual natural gas boiler and storage water heater, etc.) in future evaluations to help understand the market and better characterize units being replaced. Additional information on units being replaced will also aid New York stakeholders in determining if a term incorporating summer losses into future impacts calculations for indirect water heaters is necessary.

Responses to Program Recommendation 3:

National Fuel accepts this recommendation. The Company will take this under advisement when future evaluation study scopes are being prepared for the Company's Residential Rebate Program. In addition, the Company will continue its active participation in the E2 Working Group and the Technical Manual Subcommittee. Evaluating the variables within a technical manual formula is appropriately considered in those venues. The Company does note that indirect water heaters make up 3% of the savings covered in this evaluation, and this measure is not a major contributor to the entire portfolio of savings being evaluated. This should be considered in prioritizing the review of this savings algorithm.

National Grid accepts this recommendation. The Company will take this under advisement when future evaluation study scopes are being prepared for the Company's Residential Rebate Program. The Company will continue its active participation in the E2 Working Group and the Technical Manual Subcommittee. The Company does note that indirect water heaters are not a major contributor to the entire portfolio of savings being evaluated and this should be considered in prioritizing the review of this savings algorithm.

Enbridge St. Lawrence Gas has no response.

Con Edison accepts this recommendation. We have revised our Residential applications to include questions that collect information on units being replaced (i.e. Model, Size). In order to minimize any additional burden on the customer and unnecessary delays in rebates, the questions are kept high-level and as an optional field.

Recommendations for the New York Technical Manual

Based on our measure-level engineering review of the NYTM and our gross impact analysis, we recommend dialogue among New York stakeholders (i.e., the PAs, the NYTM Review Committee, the DPS, and the TecMarket team) about the following potential updates to the NYTM:

1. **Air Sealing.** We suggest revisions to the NYTM text to clarify the meaning of the term incorporating heating and distribution system efficiency.

Responses to NYTM Recommendation 1:

National Fuel accepts this recommendation. The Company will continue its active participation in the E2 Working Group and the Technical Manual Subcommittee, where revisions to the NYTM are appropriately considered. It is important to note that program savings targets are based on legacy Technical Manual algorithms, and

adjustments to targets should be considered in conjunction with making prospective modifications to algorithms.

National Grid accepts this recommendation. The Company will continue its active participation in the E2 Working Group and the Technical Manual Subcommittee, where revisions to the NYTM are appropriately considered. It is important to note that program savings targets are based on legacy Technical Manual algorithms, and adjustments to targets should be considered in conjunction with making prospective modifications to algorithms.

Enbridge St. Lawrence Gas has no response.

Con Edison notes this recommendation and will work with the E2 Working Group and the Technical Manual Subcommittee to continue its efforts to maintain up-to-date algorithms based on the latest available data.

- 2. Boilers & Furnaces.** We recommend additional dialogue among New York stakeholders about potential updates to residential heating equipment FLH assumptions in the NYTM. If stakeholders wish to modify FLH assumptions for planning purposes, we would recommend applying an adjustment factor to FLH assumptions in the NYTM (see page 431 of the October 15, 2010 NYTM) based on the average difference between FLH assumptions in the NYTM and evaluated Ex Post FLH.

Response to NYTM Recommendation 2: National Fuel accepts this recommendation. The Company will continue its active participation in the E2 Working Group and the Technical Manual Subcommittee, where revisions to the NYTM are appropriately considered. It is important to note that program savings targets are based on legacy Technical Manual algorithms, and adjustments to targets should be considered in conjunction with making prospective modifications to algorithms.

National Grid accepts this recommendation. The Company will continue its active participation in the E2 Working Group and the Technical Manual Subcommittee, where revisions to the NYTM are appropriately considered. It is important to note that program savings targets are based on legacy Technical Manual algorithms, and adjustments to targets should be considered in conjunction with making prospective modifications to algorithms.

Enbridge St. Lawrence Gas has no response.

Con Edison notes this recommendation and will work with the E2 Working Group and the Technical Manual Subcommittee to continue its efforts to maintain up-to-date algorithms based on the latest available data. Con Edison notes that TRM revisions to the heating Equivalent Full Load Hours (EFLH) were made in March 2014. Revisions made include redefining building vintages, and refining NYC EFLH to reflect values based on Con Edison customer data.

- 3. Boiler Reset Controls.** We recommend clarifying the “units” variable in the NYTM algorithm for boiler reset controls to reflect that savings for only one control can be claimed for each boiler in the residential sector. Additionally, to better align future estimates of savings with actual values, we suggest the NYTM estimates of FLH be updated in accordance with this study, which will reduce expected savings to better

align with the results of this billing analysis. However, if FLH values are not updated, we suggest additional research to verify ESF values could be valuable.

Response to NYTM Recommendation 3: National Fuel accepts this recommendation. The Company will continue its active participation in the E2 Working Group and the Technical Manual Subcommittee, where revisions to the NYTM are appropriately considered. It is important to note that program savings targets are based on legacy Technical Manual algorithms, and adjustments to targets should be considered in conjunction with making prospective modifications to algorithms.

National Grid accepts this recommendation. The Company will continue its active participation in the E2 Working Group and the Technical Manual Subcommittee, where revisions to the NYTM are appropriately considered. It is important to note that program savings targets are based on legacy Technical Manual algorithms, and adjustments to targets should be considered in conjunction with making prospective modifications to algorithms.

Enbridge St. Lawrence Gas has no response.

Con Edison notes this recommendation and will work with the E2 Working Group and the Technical Manual Subcommittee to continue its efforts to maintain up-to-date algorithms based on the latest available data. Con Edison notes that TRM revisions to the heating Equivalent Full Load Hours (EFLH) were made in March 2014. Revisions made include redefining building vintages, and refining NYC EFLH to reflect values based on Con Edison customer data.

4. **Duct Sealing.** We suggest revising the NYTM algorithm to include a term accounting for furnace efficiency, and therefore interactive effects.

Response to NYTM Recommendation 4: National Fuel accepts this recommendation. The Company will continue its active participation in the E2 Working Group and the Technical Manual Subcommittee, where revisions to the NYTM are appropriately considered. It is important to note that program savings targets are based on legacy Technical Manual algorithms, and adjustments to targets should be considered in conjunction with making prospective modifications to algorithms.

National Grid accepts this recommendation. The Company will continue its active participation in the E2 Working Group and the Technical Manual Subcommittee, where revisions to the NYTM are appropriately considered. It is important to note that program savings targets are based on legacy Technical Manual algorithms, and adjustments to targets should be considered in conjunction with making prospective modifications to algorithms.

Enbridge St. Lawrence Gas has no response.

Con Edison notes this recommendation and will work with the E2 Working Group and the Technical Manual Subcommittee to continue its efforts to maintain up-to-date algorithms based on the latest available data.

5. **EC Motors.** We recommend performing additional New York-specific research into the parameters in the Wisconsin algorithm to more accurately quantify savings for the state of New York.

Response to NYTM Recommendation 5: National Fuel accepts this recommendation. The Company will continue its active participation in the E2 Working Group and the Technical Manual Subcommittee, where revisions to the NYTM are appropriately considered. It is important to note that program savings targets are based on legacy Technical Manual algorithms, and adjustments to targets should be considered in conjunction with making prospective modifications to algorithms.

National Grid accepts this recommendation. The Company will continue its active participation in the E2 Working Group and the Technical Manual Subcommittee, where revisions to the NYTM are appropriately considered. It is important to note that program savings targets are based on legacy Technical Manual algorithms, and adjustments to targets should be considered in conjunction with making prospective modifications to algorithms.

Enbridge St. Lawrence Gas has no response.

Con Edison notes this recommendation and will work with the E2 Working Group and the Technical Manual Subcommittee to continue its efforts to maintain up-to-date algorithms based on the latest available data.

6. **Indirect Water Heaters.** We suggest revising the information listed in the NYTM to specify more clearly the source of its assumptions. Alternatively, for larger-sized water heaters where stand-by loss data is available, more standardized estimates of UA_{base} could be used, such as the formula suggested by ASHRAE. We also suggest to consider inclusion of a term to cover summer losses in the NYTM algorithm for indirect water heaters. Finally, we recommend updates to the NYTM to more clearly explain the variation in UA_{base} values for seemingly similar baseline water heaters in different NYTM sections or, if necessary, to make values more consistent.

Response to NYTM Recommendation 6: National Fuel accepts this recommendation. The Company will continue its active participation in the E2 Working Group and the Technical Manual Subcommittee, where revisions to the NYTM are appropriately considered. It is important to note that program savings targets are based on legacy Technical Manual algorithms, and adjustments to targets should be considered in conjunction with making prospective modifications to algorithms.

National Grid accepts this recommendation. The Company will continue its active participation in the E2 Working Group and the Technical Manual Subcommittee, where revisions to the NYTM are appropriately considered. It is important to note that program savings targets are based on legacy Technical Manual algorithms, and adjustments to targets should be considered in conjunction with making prospective modifications to algorithms.

Enbridge St. Lawrence Gas has no response.

Con Edison notes this recommendation and will work with the E2 Working Group and the Technical Manual Subcommittee to continue its efforts to maintain up-to-date algorithms based on the latest available data.

7. **Programmable Thermostats.** We suggest further research into the appropriate choice of ESF for programmable thermostats in New York. If further research aligns with recent findings, a change in the ESF specified may be necessary.

Response to NYTM Recommendation 7: National Fuel accepts this recommendation. The Company will continue its active participation in the E2 Working Group and the Technical Manual Subcommittee, where revisions to the NYTM are appropriately considered. It is important to note that program savings targets are based on legacy Technical Manual algorithms, and adjustments to targets should be considered in conjunction with making prospective modifications to algorithms.

National Grid accepts this recommendation. The Company will continue its active participation in the E2 Working Group and the Technical Manual Subcommittee, where revisions to the NYTM are appropriately considered. It is important to note that program savings targets are based on legacy Technical Manual algorithms, and adjustments to targets should be considered in conjunction with making prospective modifications to algorithms.

Enbridge St. Lawrence Gas has no response.

Con Edison notes this recommendation and will work with the E2 Working Group and the Technical Manual Subcommittee to continue its efforts to maintain up-to-date algorithms based on the latest available data.

Evaluation Recommendations

Based on the evaluation team's experience conducting this study, the first statewide evaluation in New York, we provide the following recommendations to inform and support further statewide evaluation efforts:

1. **Improve Data Management and Aggregation Procedures for Future Statewide Evaluations.** The evaluation team notes that the complexity of aggregating program tracking data from many disparate sources presents significantly more problems than anticipated. Future evaluations should explore ways to handle disparate data sources more easily.

Response to Evaluation Recommendation 1 National Fuel accepts this recommendation. The Company will take this under advisement when future evaluation study scopes are being prepared for the Company's Residential Rebate Program.

National Grid accepts this recommendation. The Company will take this under advisement when future evaluation study scopes are being prepared for the Company's residential rebate programs.

Enbridge St. Lawrence Gas has no response.

Con Edison is in agreement with the recommendations to inform and support future statewide evaluations.

2. **Build in a "Data Check" Task for Future Evaluations.** As part of a typical evaluation leveraging program administrator data, evaluation teams typically perform ad-hoc checking and modifications to databases, identifying issues such as use of an incorrect algorithm to produce savings that could interfere with evaluation assumptions, even when review of PA tracking and choices is not a task specifically defined in the evaluation's scope. This task is usually relatively straightforward, but when conducting it simultaneously for multiple PAs, the effort required increases

exponentially and can grind parts of the analysis to a halt. Future evaluations should understand this as a crucial, and often substantial, task to accomplish thoroughly as early in the evaluation process as possible.

Response to Evaluation Recommendation 2 National Fuel accepts this recommendation. The Company has an existing data check task currently in place and conducts compliance reviews of its implementation of the NYTM with its evaluation contractor. The data check task is substantially completed. On a going-forward basis, the Company will take this under advisement when future evaluation study scopes are being prepared for the Company's Residential Rebate Program.

National Grid accepts this recommendation. The Company will take this under advisement when future evaluation study scopes are being prepared for the Company's residential rebate programs.

Enbridge St. Lawrence Gas has no response.

Con Edison is in agreement with the recommendations to inform and support future statewide evaluations.

- 3. Weigh Relative Needs and Desires of Small and Large Program Administrators Against Evaluation Requirements.** Especially in the context of a statewide impact evaluation, evaluation requirements may, at times, conflict with desires of PAs. For example, in the context of this evaluation, while PAs originally desired net-to-gross ratios at the measure level for each PA, evaluation resources, sample sizes, and relative impacts of each measure-PA combination led to the understanding that defining these numbers was an irrational use of resources in the context of each measure-PA's contribution to overall statewide savings. As a result, National Fuel received NTGR numbers specific to their program at the measure level, while other PAs were grouped together. While these tradeoffs are unavoidable due to evaluation constraints, open and consistent dialogue with stakeholders is extremely important in the evaluation process to address the needs and desires of PAs of various sizes as equitably as possible.

Response to Evaluation Recommendation 3: National Fuel accepts this recommendation. The Company will take this under advisement when future evaluation study scopes are being prepared for the Company's Residential Rebate Program.

National grid accepts this recommendation. The Company will take this under advisement when future evaluation study scopes are being prepared for the Company's residential rebate Programs.

Enbridge St. Lawrence Gas has no response.

Con Edison is in agreement with the recommendations to inform and support future statewide evaluations.

- 4. Minimize Changes to Evaluation Frameworks and Desired Comparisons and Contextualizations to the Extent Possible.** In the process of an evaluation, we firmly believe that the evaluation plan should be a living document, open to revision and change initiated by the stakeholders or evaluation team. That being said, revisions or requests for additional comparisons necessarily add additional time and effort to an

evaluation. In the context of a statewide evaluation, this becomes additionally troublesome due to the multiple programs being evaluated, as well as the multiple stakeholders who may wish to make changes or request additional outside information be brought into the analysis. While we by no means suggest that all decisions must be locked into stone, efforts on the parts of all parties to minimize changes will aid in producing high quality final products on schedule and within the available budget.

Response to Evaluation Recommendation 4: National Fuel accepts this recommendation. The Company will take this under advisement when future evaluation study scopes are being prepared for the Company's Residential Rebate Program.

National Grid accepts this recommendation. The Company will take this under advisement when future evaluation study scopes are being prepared for the Company's residential rebate programs.

Enbridge St. Lawrence Gas has no response.

Con Edison is in agreement with the recommendations to inform and support future statewide evaluations.

We also present a few recommendations for future research.

1. **Selection of Baseline.** For this study, we defined the baseline as the federal standard. However, we note that definition of the baseline can significantly influence savings results. If the standard market practice baseline exceeds federal standards, our estimated ex post savings would be overstated. Determining the most appropriate baseline for each measure was outside the scope of this study. However, given the sensitivity of results to the selection of the baseline, we recommend future research into this issue.

Response to Further Research Recommendation 1 National Fuel accepts this recommendation. The Company will take this under advisement when future evaluation study scopes are being prepared for the Company's Residential Rebate Program.

National Grid accepts this recommendation. The Company will take this under advisement when future evaluation study scopes are being prepared for the Company's residential rebate programs.

Enbridge St. Lawrence Gas has no response.

Con Edison is in agreement with the future research recommendations, and will support changes that are within its jurisdiction.

2. **Savings Assumptions for Programmable Thermostats.** We understand that programmable thermostats may be installed through other delivery channels, and that savings may differ depending on the program population or delivery approach. As such, we recommend reviewing ex post savings observed in this and other evaluations or conducting additional research across multiple program designs (including this one) to determine if and how assumptions could be modified. For example, the results of this evaluation could be used to inform a revision for the HEHE Programs, while the results of other evaluation efforts could be used to update

assumptions for other programs (e.g., home energy assessment) where programmable thermostats are installed.

Response to Further Research Recommendation 2: National Fuel accepts this recommendation. The Company will take this under advisement when future evaluation study scopes are being prepared for the Company's Residential Rebate Program.

National Grid accepts this recommendation. The Company will take this under advisement when future evaluation study scopes are being prepared for the Company's residential rebate programs.

Enbridge St. Lawrence Gas has no response.

Con Edison is in agreement with the future research recommendations, and will support changes that are within its jurisdiction.

4. Evaluation Methods and Sampling

The Evaluation Team used a combination of telephone surveys, in-depth interviews, customer billing data analysis, and engineering analysis in this evaluation.

Analysis of gross natural gas impacts relied on three complementary approaches:

1. Customer-level regression analysis to develop FLH values for heating equipment
2. A pre/post billing analysis using a fixed-effects regression model to estimate retrofit savings for measure installation
3. Supplementary engineering analysis to characterize savings from indirect water heaters

This three-fold approach provided internal cross-checking and robust savings estimation. Based on these analyses, we developed and applied gross savings realization rates.

The net impact analysis is based on a telephone survey of 1,363 participating customers and 54 participating contractors and includes estimation of free-ridership and participant spillover. Non-participant spillover was outside the scope of this evaluation.⁷

Consistent with established industry practices, we used self-reported answers to survey questions to estimate free-ridership and participant spillover. We relied on the participant survey as the primary source for deriving free-ridership estimates, and supplemented them with information from the participating contractor interviews. The participant survey was also the source of participant spillover estimates.

Incremental cost estimates are based on a telephone survey of 110 participating contractors.

⁷ A future comprehensive statewide effort is planned to address non-participant spillover.