Multifamily Performance Program Impact Evaluation (2009–2011)

Final Report

Prepared for:

The New York State
Energy Research and Development Authority

Judeen Byrne
Jonathon Steiner
Project Managers

Prepared by:

ERS
120 Water Street, Suite 350
North Andover, MA 01845
Phone: 978-521-2550

Principal Investigators:
ERS
Itron, Inc.
West Hill Energy and Computing, Inc.

NYSERDA Contract 26397 February 2015

NOTICE

This report was prepared by ERS and its subcontractors Itron and West Hill Energy, in the course of performing work contracted for and sponsored by the New York State Energy Research and Development Authority (hereinafter the "NYSERDA"). The opinions expressed in this report do not necessarily reflect those of NYSERDA or the State of New York, and reference to any specific product, service, process, or method does not constitute an implied or expressed recommendation or endorsement of it. Further, NYSERDA, the State of New York, and the contractor make no warranties or representations, expressed or implied, as to the fitness for particular purpose or merchantability of any product, apparatus, or service, or the usefulness, completeness, or accuracy of any processes, methods, or other information contained, described, disclosed, or referred to in this report. NYSERDA, the State of New York, and the contractor make no representation that the use of any product, apparatus, process, method, or other information will not infringe privately owned rights and will assume no liability for any loss, injury, or damage resulting from, or occurring in connection with, the use of information constrained, described, disclosed, or referred to in this report.

ABSTRACT

This report describes the impact evaluation of the Multifamily Performance Program (the MPP or, the Program). NYSERDA established the MPP in 2006 by consolidating the multifamily components of predecessor programs to simplify customer interactions with NYSERDA. As such, this study represents the first impact evaluation of the MPP in its current form.

The Impact Evaluation Team assessed the energy savings attributable to Program-funded projects completed between 2009 and 2011 using two main methods: 1) measurement-based engineering analysis on a sample of completed projects to quantify the evaluated gross energy savings by project, and 2) telephone surveys among participating and nonparticipating customers to quantify program influence in the form of a net-to-gross ratio. The Program electric realization rate and net-to-gross ratio are 0.79 and 0.58, respectively; the Program realized 60% of reported fossil fuel savings with a net-to-gross ratio of 0.55.

The Impact Evaluation Team concludes that the MPP is effective in identifying and acquiring substantial energy savings that otherwise would not have been realized without the Program, and that MPP projects, on average, lead to a 17% energy reduction at participating facilities. The MPP's tiered incentive structure and network of qualified performance partners successfully guide multifamily customers through comprehensive, time- and capital-intensive projects. Nonetheless, the multifamily market in New York State is complex, with several motivations and funding sources that might not focus on energy savings alone. This report outlines recommendations from both engineering and attribution perspectives to improve Program effectiveness in the market.

ACKNOWLEDGMENTS

This report was prepared by the Impact Evaluation Team led by ERS with Patrick Hewlett as the project manager and Susan Haselhorst as the director in charge. ERS is the lead for the on-site engineering measurement and verification (M&V) effort. Kathryn Parlin of West Hill Energy is the sample design lead and Jennifer Fagan of Itron is the lead for program attribution. The Impact Evaluation Team wishes to acknowledge the significant contribution of NYSERDA project managers Judeen Byrne and Jonathon Steiner, other members of the NYSERDA Performance Management and Evaluation Systems group, and Multifamily Performance Program staff Michael Colgrove, Edward Morrison, and Lindsay Robbins. Additionally, the Impact Evaluation Team acknowledges the valuable suggestions provided by Bill Saxonis of the Department of Public Service and its consultants, Ralph Prahl and Rick Ridge of TecMarket Works.

CONTENTS

LIST OF TABLES

LIST OF FIGURES

SECTION 1: EXECUTIVE SUMMARY

This report describes the impact evaluation of the NYSERDA Multifamily Performance Program (the MPP or, the Program). The MPP was developed in 2006 by consolidating the multifamily components of a number of diverse NYSERDA programs to better serve the market by simplifying interactions with NYSERDA and providing building owners and developers with a single portal of energy efficiency solutions. The Program promotes energy efficiency to multifamily facility owners of existing buildings and developers of new construction for both market rate[1] and low-income properties. This is accomplished by offering incentives for the installation of energy efficiency measures that comprehensively reduce energy use among a variety of multifamily systems. For all projects included in the evaluation population, participation in the MPP required an energy reduction plan[2] (ERP) that demonstrated a 20% or greater source energy reduction target[3]. During the evaluation time frame of January 2009 through December 2011, the Program awarded more than $63 million in incentives to 388 installed projects and reported 80,426 MWh of electric savings[4]. These installed projects and total savings constitute the population that was evaluated.

1.1 APPROACH

The primary purpose of this impact evaluation is to establish rigorous and defensible estimates of the energy savings that can be attributed to the Program. The impact evaluation involved two distinct methodologies to determine program net savings:

1. **On-site measurement and verification (M&V) to determine evaluated gross savings** – The evaluators applied a comprehensive M&V approach to assess the whole-facility savings for a sample of 117 projects over the evaluation time frame. Each sampled project received an on-site visit from engineers who collected post-project utility bills, noted detailed information on facility operating characteristics, and deployed metering equipment on affected systems in order to calibrate a whole-building model.

2. **Telephone surveys to determine program attribution** – The Impact Evaluation Team relied on a series of telephone interviews with participating owners/managers to assess self-reported

[1] Market rate facilities receive no subsidies and lease apartment spaces at full market value.

[2] The Program initially funds an energy reduction plan (ERP), a technical assistance study that reviews the feasibility of a comprehensive suite of multifamily measures at the participating facility. The ERP involves whole-building analysis, which quantifies each measure's contributions to facility-wide energy savings.

[3] The MPP's minimum percentage reduction varied by program year. The M&V evaluation sample includes only projects with a 20% energy reduction target; therefore, the 20% objective is indicated throughout this report.

[4] The Program was primarily funded by System Benefits Charges (SBC) during this time frame. Regional Greenhouse Gas Initiative (RGGI) funding led to 183,875 MMBtu of total source energy savings.

free ridership (FR), inside spillover (ISO), and outside spillover (OSO).[5] The assessment of nonparticipant spillover (NPSO) relied on telephone surveys with nonparticipants including both owners/managers and key market actors.[6]

The methods utilized in this evaluation comport with the current New York Department of Public Service (DPS) Energy Efficiency Portfolio Standard (EEPS) evaluation guidelines.[7]

1.2 RESULTS

Results of the impact evaluation study are presented below by funding classification.

1.2.1 Systems Benefit Charge and EEPS I Savings

For most projects in the evaluation population, the Program primarily received System Benefits Charge (SBC) funding, which targeted electric savings only. Table 1-1 presents the impact evaluation results for the electricity-saving projects completed between 2009 and 2011.

Table 1-1. MPP Impact Evaluation Electric Energy and Peak Demand Results, 2009–2011

Metric	Electric Energy (MWh)	Electric Peak Demand (kW)
A – Reported savings	80,426	7,695
B – Realization rate	0.79	0.77
C – Evaluated gross savings (A × B)	63,537	5,925
D – Net-to-gross ratio[1, 2]	0.58	0.58
E – Evaluated net savings (C × D)	36,851	3,437
F – Relative precision of evaluated net savings at 90% confidence	8%	10%

[1] Net-to-gross (NTG) ratio is the relationship between net energy and/or demand savings – where net is measured as what would have occurred without the Program or what would have occurred naturally – and evaluated gross savings. The NTG ratio is a factor represented as the ratio of net savings actually attributable to the Program divided by the program-evaluated gross savings. For NYSERDA programs the NTG ratio is defined as 1 minus FR plus SO.

[2] NYSERDA's activity in the multifamily market may undergo changes per the New York State Public Service Commission's Clean Energy Fund (CEF) proceeding[8]. As the extent or details of these changes are not yet known, the Impact Evaluation Team recommends that careful consideration is exercised when assessing the applicability of this study's results to future multifamily programs in New York State.

[5] Free ridership refers to program participants who would have implemented the Program measure or practice in the absence of the Program. Additional energy efficiency actions that program participants take inside the dwelling or facility served by the Program are referred to as inside spillover, while actions participants take or influence at other facilities not directly served by the Program are considered outside spillover. An eligible nonparticipant who adopted a particular efficiency measure or practice as a result of the Program or its partners leads to savings referred to as nonparticipant spillover.

[6] Key market actors include contractors, architect/engineering firms, and construction firms.

[7] *Evaluation Plan Guidance for EEPS Program Administrators*, November, 2012, http://www3.dps.ny.gov/W/PSCWeb.nsf/96f0fec0b45a3c6485257688006a701a/766a83dce56eca35852576da006d79a7/$FILE/NY_Eval_Guidance_Aug_2013.pdf

[8] "Proceeding on Motion of the Commission to Consider a Clean Energy Fund," Case 14-M-0094, NYSERDA, September 2014. http://documents.dps.ny.gov/public/Common/ViewDoc.aspx?DocRefId={DABF6A8A-17A5-441F-AC44-48587105CF6D}

To meet the 20% source[9] energy reduction goal, the Program also encourages reduction of other fuel savings, such as natural gas, various grades of fuel oil, and district steam, henceforth referred to as "fossil fuels." Table 1-2 presents the impact evaluation results for fossil fuel-saving projects that received SBC and EEPS funding and were completed during the evaluation time frame.

Table 1-2. MPP Impact Evaluation Fossil Fuel Results – SBC and EEPS Funding, 2009–2011

Metric	Fossil Fuel Energy (MMBtu)
A – Reported savings	995,146
B – Performance factor[1]	0.60
C – Evaluated gross savings (A × B)	597,088
D – Net-to-gross ratio[2]	0.55
E – Evaluated net savings (C × D)	328,398
F – Relative precision of evaluated net savings at 90% confidence	11%

[1] Since projects completed between 2009 and 2011 were primarily SBC-funded and targeted electric savings only, this table uses the term "performance factor" to distinguish from a "realization rate." Careful consideration must be taken when applying this impact evaluation's results to natural gas savings of later EEPS-funded projects.

[2] NYSERDA's activity in the multifamily market may undergo changes per the New York State Public Service Commission's Clean Energy Fund (CEF) proceeding. As the extent or details of these changes are not yet known, the Impact Evaluation Team recommends that careful consideration is exercised when assessing the applicability of this study's results to future multifamily programs in New York State.

After assessing all fuel savings in the M&V sample, the Impact Evaluation Team determined that 2009–2011 MPP projects reduced source energy use at multifamily facilities by 17% on average.

The evaluators assessed the key contributors to the electric energy realization rate (RR) of 79% and the fossil fuel performance factor of 60%. Table 1-3 outlines these key drivers, which apply to both SBC/EEPS- and RGGI-funded projects. A more detailed analysis of the key contributors, along with examples from actual MPP projects, can be found in Section 4.1 and in Appendix G.

Table 1-3. MPP Key Differences Influencing Electric and Fossil Fuel Measure Performance

Reason for RR Other Than One[1]	Number of Observations	Overall Electric RR % Change	Overall Fossil Fuel Performance Factor % Change
Difference in quantity installed	84	−12%	−5%
Difference in equipment operating efficiency	77	+2%	−6%
Difference in equipment loading profile	55	+2%	−7%
Difference in installed control strategy	31	−2%	+1%
Inaccurate pre-project characterization	26	−4%	−4%
Difference in equipment hours of operation	26	−3%	−1%

[9] Program goals reflect electric savings at the power plant, and the term *source* is therefore used throughout this report. Source MMBtu savings is the sum of the fossil fuel energy savings plus the site-reported electric savings converted to source MMBtu. The source electric MMBtu savings is the product of the following: site electric kWh savings x 3.142 MBtu/kWh x 0.001 MMBtu/MBtu x 2.98 Btu input/Btu output (per NYSERDA guidance, to account for power plant and distribution inefficiencies).

Reason for RR Other Than One[1]	Number of Observations	Overall Electric RR % Change	Overall Fossil Fuel Performance Factor % Change
Difference in installed equipment technology	18	−3%	−1%
Baseline adjustment to reflect code	15	−2%	−2%
Difference in installed equipment size	15	+2%	−1%
Unknown applicant algorithm or assumptions	10	+3%	+3%
Inoperable installed equipment	9	−7%	−2%
Inaccurate fuel-specific accounting after switch	7	+0%	−5%
Inaccurate occupancy estimate	5	+1%	−3%
Other[2]		+2%	−7%
Total difference		−21%	−40%

[1] An RR of one indicates that the evaluated gross savings are identical to the program-reported savings. RRs not equal to one indicate positive or negative differences between evaluated gross savings and program-reported savings.

[2] Other categories individually contribute less than 1% to the kWh and MMBtu RR reduction, examples of which include: differences in modeling software, differences in cooling or heating interactivity, incorrect reference to billing data, ineligible measures, and inaccurate plug loading estimates.

1.2.2 Regional Greenhouse Gas Initiative Savings

Table 1-4 presents the impact evaluation results for Regional Greenhouse Gas Initiative (RGGI)-funded projects completed between 2009 and 2011. RGGI funding targets a reduction in greenhouse gas emissions and is limited only to measures that reduce fossil fuel consumption.

Table 1-4. MPP RGGI Impact Evaluation Fossil Fuel Results, 2009–2011

Metric	Fossil Fuel Energy (MMBtu)	Greenhouse Gas Emissions (ton CO_2)
A – Reported savings	142,127	14,732
B – Realization rate	0.45	0.70
C – Evaluated gross savings (A x B)	63,832	10,319
D – Net-to-gross ratio[1]	0.55	0.55
E – Evaluated net savings (C x D)	35,108	5,675
F – Relative precision of evaluated net savings at 90% confidence	28%	14%

[1] NYSERDA's activity in the multifamily market may undergo changes per the New York State Public Service Commission's Clean Energy Fund (CEF) proceeding. As the extent or details of these changes are not yet known, the Impact Evaluation Team recommends that careful consideration is exercised when assessing the applicability of this study's results to future multifamily programs in New York State.

The Program's savings database was limited in tracking fuel-specific impacts for dual-fuel or fuel-switch projects, which were prevalent among projects receiving RGGI funding. For this primary reason, the RGGI-funded projects featured a realization rate 15% lower than the MMBtu savings performance factor for SBC- and EEPS-funded projects. Other contributing reasons to the 45% realization rate are similar to the fossil fuel savings reductions quantified in Table 1-3.

1.3 ATTRIBUTION FINDINGS

The net-to-gross (NTG) ratio indicates the proportion of savings attributable to the Program above and beyond the level of efficiency investment that would have occurred in the absence of the Program. The NTG ratio reflects the impact of both FR (negative adjustment) and SO (positive adjustment). The formula for NTG ratio is:

$$\text{NTG ratio} = 1 - \text{FR} + \text{ISO} + \text{OSO} + \text{NPSO}$$

This study's NTG results reveal a medium level of program influence as indicated by NTG ratios of 0.58 for electric (kWh) and 0.55 for fossil fuels (MMBtu). The starting point for the calculation of the NTG ratio is one. With respect to the MPP NTG ratios, the program FR level is the predominant effect causing the NTG ratio to deviate from one. SO is relatively small; however, it could rise over time as program-induced market effects take hold. Table 1-5 summarizes the components that comprise the MPP NTG ratios.

Table 1-5. MPP Impact Evaluation Net-to-Gross Results Summary

Attribution Variable	Electric Measures	Fossil Fuel Measures
FR	0.44	0.48
ISO	0.02	0.03
OSO	< 0.01	< 0.01
NPSO	<< 0.01	<< 0.01
NTG ratio	0.58	0.55

The following factors contribute to reduced Program influence. Note that these factors are not mutually exclusive and may each impact the Program influence on a given project.

- **A significant share of projects was associated with the major rehabilitation of buildings.** Each such project has mixed motivations behind it, thereby reducing the influence of any one factor (such as the desire to improve energy efficiency). Virtually all decision-makers associated with the largest projects indicated that their primary goal was the enhanced marketability of rental units, and not necessarily energy savings. Such projects had lower NTG ratios, mostly ranging from 0.25 to 0.50. A significant number of these large projects also had incentives that represented a very small share of the total project costs.
- **Many projects received funding from multiple, non-NYSERDA sources.** The evaluators determined that several large projects received funding not related to energy efficiency. This exacerbates the mixed motivation and mixed influence phenomenon and generally reduces the influence of any one source. The program incentive for the very largest projects, while large in absolute dollars, represented a very small share of the total cost of such projects, typically upwards of $20 million, thereby reducing the overall influence on the project.

- **A high percentage of projects involved the replacement of old equipment.** Although equipment replacement is an important milestone event/opportunity for program intervention, if the participating owner was already planning to install energy efficient equipment before learning about the Program, it can result in high free-ridership. Of the projects evaluated which cited replacement of old equipment as a key decision influence[10], the NTG ratio averaged 0.51. Nearly half of such projects featured NTG ratios ranging from 0.00 to 0.50[11].

In parallel, there are Program-related factors and interventions that serve to increase the influence of the MPP:

- **Incentives and loans provided by NYSERDA were frequently cited as a critical part of meeting financial requirements.** In addition, incentives allowed the project scope to be expanded to include more measures. This is one of the core reasons given in cases where high program influence is indicated.
- **The key value of the ERP was providing a reliable, unbiased source of energy and cost savings estimates, rather than being the source of the energy efficiency project concept**. While the ERP was not the main source of the ideas for which energy efficiency measures to install, other quantitative information provided, such as measure-specific savings estimates, were also valued highly.

1.4 CONCLUSIONS AND PROGRAM RECOMMENDATIONS

The Program's comprehensive approach to savings, driven by its 20% energy reduction target, is effective in helping customers achieve deep savings. Further, the Program has developed a community of performance partners[12] that help to educate facility staff on energy-saving measures that otherwise may not have been considered and to guide facility management during the incentive application and project implementation periods. These performance partners have become skilled in advanced technical assistance approaches (primarily using building modeling software) that have led to realistic savings expectations among participating multifamily

[10] As indicated by a score of 8, 9 or 10 in importance.

[11] Comparatively, projects that did not cite replacement of old equipment as a primary motivator featured average NTG ratios of 0.58, with approximately 30% of such projects in the 0.00 to 0.50 NTG ratio range.

[12] Performance partners are Program-approved sponsors who initiate the development and guide the progress of each of the Program's projects. Performance partners include builders, construction experts, developers, and HVAC contractors. Partners are responsible for the development of the project's energy reduction plan and the progression through subsequent incentive payment milestones.

customers. The 17% average facility energy reduction and 79% electric energy savings RR reflect a significant savings achievement.

Regarding program influence, the multifamily market in New York State is a complex one, with many funding sources playing a role in renovation and rehabilitation projects. The primary objective of property management is to ensure that the multifamily building is sufficiently marketable in order to maintain a high level of occupancy. As such, energy savings is not the sole or even primary driver of many of the multifamily renovation/rehabilitation projects the MPP has funded. The impact evaluation results are indicative of the many funding sources and motivations behind multifamily renovation projects. An NTG ratio of 0.58 for electric-saving measures indicates that 42% of the Program's reported savings during the evaluation time frame would have occurred absent the Program. Note that these factors pertain to the types of projects developed under the program approach in effect between 2007 and 2011, which emphasized Program incentives to reduce measure-specific paybacks. NYSERDA's activity in the multifamily market may undergo changes per the New York State Public Service Commission's Clean Energy Fund proceeding. As the extent or details of these changes are not yet known, the Impact Evaluation Team recommends that careful consideration is exercised when assessing the applicability of these study results to future multifamily programs in New York State.

Other major findings from the impact evaluation study include the following:

- Though the Program's savings tracking system is comprehensive and often properly populated, it featured fuel-specific inaccuracies for dual-fuel and fuel-switch projects.
- The Program's Simulation Guidelines provide mostly accurate measure-specific guidance for performance partners, with a few exceptions: compact fluorescent lighting, cogeneration, and sub-metering measures.
- Through the evaluators' on-site verification of measure adoption rate (MAR), it is apparent that projects that receive an ERP but no incentives for measure installation result in significant energy savings that are likely attributable to the Program. However, the Impact Evaluation Team's research on MAR was strictly investigative and concludes that savings from ERP-only projects are substantial enough to justify more rigorous future research that will lead to savings claimable by the Program.

In analyzing the major findings identified above, the Impact Evaluation Team identified two major recommendations. These recommendations are further outlined in Section 4.6.

1. **Enhance the savings tracking system to more robustly track fuel-specific savings by measure.** The Program's current tracking database is limited in tracking fuel-specific impacts for dual-fuel or fuel-switch projects and only allows one heating fuel impact to be wholly assigned to the measure's most-impacted heating fuel type (e.g., natural gas, fuel oil, steam). This system has led to tracking inaccuracies for many measures that affect multiple fuels or result in fuel switches. The evaluators believe that fuel-specific savings tracking will become more critical as the Program continues with EEPS funding, which specifically targets natural gas reduction. Therefore, the Impact Evaluation Team recommends that the Program augment its savings tracking system with the addition of fuel-specific savings fields, allowing three or more heating fuel savings to be correctly tracked for each measure.

2. **Broaden the role of utility bills in Program self-evaluation and performance prediction.** Currently, the Program investigates past project performance through pre-/post-project billing analysis for the facilities that submit sufficient post-project utility consumption data required by the performance incentive application. The evaluators recommend that the Program's self-evaluation process continue and be expanded to include even projects that do not apply for the bonus incentive[13]. This analysis allows the Program to potentially identify specific measures, performance partners, modeling approaches, building types, or locations that led to unexpected savings results. "Real-time" feedback (once post-project consumption data is available) could lead to actionable adjustments to optimize program effectiveness as soon as possible.

With respect to attribution, certain types of measures were found to have higher FR, due largely to their becoming common practice. Such measures include energy efficient cooling systems, boilers, and low-emissivity windows. To maximize the Program's impact going forward, the MPP should take steps to de-emphasize common-practice measures, while instead promoting measures and higher-efficiency equipment that are less prevalent within the New York multifamily market. This shift will benefit the Program not only in its current environment but also in future contexts under consideration in ongoing Clean Energy Fund proceedings.

[13] The Impact Evaluation Team acknowledges that this expanded self-evaluation would require additional effort from program staff to obtain, process, and analyze pre- and post-project utility bills. This process is estimated to take 4-6 hours per additional project on average.

SECTION 2: INTRODUCTION

The New York Public Service Commission established the earlier System Benefits Charge (SBC) programs and later Energy Efficiency Portfolio Standard (EEPS) programs to provide energy efficiency assistance in New York. Customers of Central Hudson Gas and Electric Corporation, Consolidated Edison Company of New York, Inc., New York State Electric and Gas Corporation, Niagara Mohawk Power Corporation d/b/a National Grid, Orange and Rockland Utilities, Rochester Gas and Electric Corporation, Corning Natural Gas Corporation, KeySpan Gas East Corporation d/b/a National Grid, Brooklyn Union Gas Company d/b/a National Grid New York, and National Fuel Gas Distribution Corporation fund SBC and EEPS through payment of the SBC on utility bills.

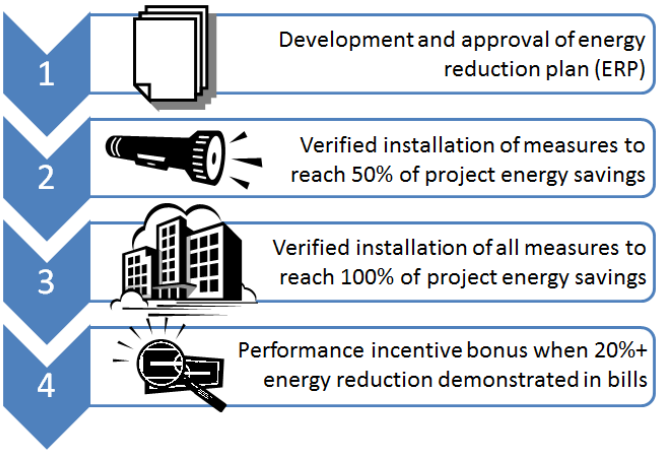
This section provides background information for NYSERDA's Multifamily Performance Program (the MPP or, the Program).

2.1 MULTIFAMILY PERFORMANCE PROGRAM BACKGROUND

The MPP offers incentives to reduce overall energy use in multifamily buildings by a minimum of 20%. During the evaluation time frame of projects installed 2009–2011, the Program awarded incentives primarily from SBC funding, with some funds coming from EEPS and the Regional Greenhouse Gas Initiative (RGGI). The Program serves most of the multifamily buildings (defined as having five or more units) in the SBC territory. The MPP has two tracks: 1) new construction (ENERGY STAR Multifamily Building Program), and 2) existing buildings (Multifamily Building Performance Initiative). Both tracks include targeted services to the low-income sector in addition to market-rate buildings.

To achieve aggressive energy reduction targets, the Program funds a comprehensive analysis of a suite of energy-saving measures at participating facilities. The cornerstone of this process is the energy reduction plan (ERP) analysis, which is typically completed by a performance partner (partner), who recommends a package of efficiency improvements for the facility with associated incentive offerings from the Program. Figure 2-1 illustrates the typical sequence of incentive payments for projects completed between 2009 and 2011.

Figure 2-1. MPP Incentive Structure by Payment Type



Upon project implementation, the partner and facility receive incentive payments (payments #2 and #3 in Figure 2-1) once progress thresholds of 50% and 100% installation are demonstrated. Participating facilities are eligible for a bonus incentive payment (the "performance payment" or payment #4) if the target energy reduction is evident when comparing pre- and post-project utility consumption data.

The Program's framework has evolved over the years 2007–2013, as illustrated by the MPP's six distinct design versions. Table 2-1 provides a timeline and comparison of the six program versions leading up to and following the evaluation period. All but four projects within the impact evaluation population are classified as Version 1–3 projects.

Table 2-1. Timeline and Comparison of MPP Design Versions

Program Version	Application Time Frame	Source Energy Reduction Target	Notes
1	Jan 2007 – Dec 2007	20%	Primarily SBC funding[1]
2	Dec 2007 – Jan 2008		
3	Jan 2008 – Sept 2010		
4	Sept 2010 – Jan 2012	15%	EEPS, RGGI funding introduced
4.1	Jan 2012 – May 2012		
5	May 2012 – present	15%	Addition of pre-approved measure options

[1] Due to multiyear project timelines, some Version 1-3 projects extended into the Version 4 time period and therefore received nominal non-SBC funding. Some Version 1-3 projects received RGGI funding as well.

2.2 PREVIOUS PROGRAM EVALUATIONS

The Program, as it currently exists, has not been evaluated from an impact perspective.[14] NYSERDA sponsored a process evaluation and a Con Edison territory-specific market characterization study in 2008.[15] The program logic model was recently updated in 2013.[16] NYSERDA sponsored a process evaluation and market characterization study, with the results published in June 2014.[17]

[14] Predecessor programs were evaluated some time ago and at a much reduced rigor level/budget.

[15] *Multifamily Performance Program: Con Edison Territory Multifamily Market Characterization Study*, NYSERDA, December 2008 and *Multifamily Building Performance Program Process Evaluation Report*, prepared for NYSERDA by Research Into Action, Inc., April 2008.

[16] *Multifamily Performance Program Final Logic Model Report*, prepared for NYSERDA by Research Into Action, Inc., September 2013. http://www.nyserda.ny.gov/-/media/Files/Publications/PPSER/Program-Evaluation/2013ContractorReports/2013-PLM-Multifamily-Performance-Program.pdf. This updated the *Multifamily Performance Program Logic Model Report*, prepared for NYSERDA by GDS Associates, Inc., January 2011. http://www.nyserda.ny.gov/-/media/Files/Publications/PPSER/Program-Evaluation/2011ContractorReports/2011-PLM-MPP-Report.pdf

[17] *Multifamily Performance Program Process Evaluation and Market Characterization Study*, prepared for NYSERDA by Research Into Action, Inc. and Wirtshafter Associates, Inc., June 2014. http://www.nyserda.ny.gov/-/media/Files/Publications/PPSER/Program-Evaluation/2014ContractorReports/2014-MPP-Process-Evaluation.pdf

SECTION 3: METHODOLOGY

This section describes the techniques used to estimate the savings attributable to the Multifamily Performance Program (MPP). Forthcoming subsections address the overall approach, the sample designs, the realization rate (RR) methods, the net-to-gross (NTG) approach, and the calculation of total evaluated net savings.

3.1 EVALUATION OBJECTIVE AND OVERALL APPROACH

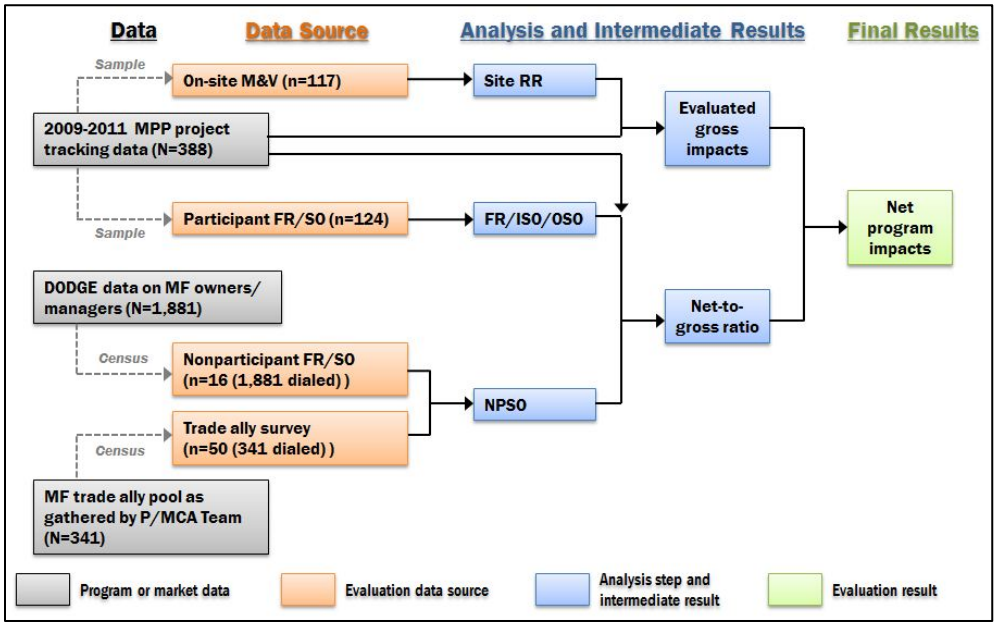
The primary objective of the MPP impact evaluation is to establish rigorous and defensible estimates of evaluated gross savings attributable to the Program. This objective features two distinct methodologies with separate but concurrent data collection and analysis approaches:

1. **Measurement and verification (M&V) approach –** To establish evaluated gross savings, for electric energy and summer coincident peak demand, as well as for fossil fuels, the evaluators assessed the project performance for a sample of 117 projects through on-site M&V.

2. **NTG approach –** Through telephone interviews among participants, nonparticipants, and market actors, the Impact Evaluation Team assessed free ridership (FR), inside spillover (ISO), outside spillover (OSO), and nonparticipant spillover (NPSO) to determine the NTG ratio leading to evaluated net savings.

Figure 3-1 provides an overview of the methods and their merging together to determine the Program's evaluated net savings.

Figure 3-1. Overall MPP Impact Evaluation Approach



3.2 SAMPLING PLAN

The Program funded a total of 388 projects completed between 2009 and 2011; these projects represent the evaluation population. This evaluation timeline was chosen primarily due the Impact Evaluation Team's reliance on monthly utility billing data to inform post-project, whole-building performance. Projects completed at the end of 2011 would theoretically have amassed a full year of monthly utility bills by the time M&V field work was begun in January 2013.

The following sections outline the precision goals and outcomes of the M&V and attribution samples leading to calculation of evaluated net savings for the Program.

3.2.1 Precision and Bias

The evaluators relied on stratified ratio estimation (SRE) sampling to develop an efficient sample design with the goal of obtaining 15% relative precision with 90% confidence (90/15) or better[18] for evaluated net savings in each of these domains of interest:

- Existing buildings (EB) and new-construction (NC) projects
- Market-rate and affordable housing

The design precision targets and precision results for this impact evaluation are summarized in Table 3-1.

Table 3-1. MPP Sample Design Precision Targets and Outcomes on Net Energy Savings

	Existing Buildings		New Construction	
Confidence/Precision	**Target (%)**	**Actual (%)**	**Target (%)**	**Actual (%)**
Gross M&V	90/7	90/9	90/15	90/34
Participant FR/ISO	90/7	90/4	90/7	90/17
Participant surveys, OSO	90/5	90/4	90/10	90/17
NPSO surveys, NPSO	90/5	N/A	90/10	N/A
Participant on-sites, OSO	Not applicable – census attempt[1] on sites with largest reported SO			
Nonparticipant on-sites, NPSO				
Final net savings	90/10	90/10	90/15	90/38
Percent of program savings	97%		3%	

[1] The relative precision of a census attempt is 0%, as all projects in the population are surveyed in a census attempt.

As is evident in the table, some precision targets were not achieved as planned. In particular, the targeted precision for NC M&V and net-to-gross (NTG) ratio results were not achieved due to higher-than-expected variation among the 13 NC projects in the M&V sample and the small

[18] The New Construction sample segment targeted 90/15 confidence/precision, due to the relatively small savings of New Construction projects within the evaluation population. The Existing Buildings sample targeted 90/7 confidence/precision.

number of installed NC projects in the evaluation population (40), coupled with a lower survey response rate (42%). However, the evaluators achieved the targeted precision of 10% on net savings for EB projects, which comprise 97% of the savings in the evaluation population, and the relative precision of the overall program-wide net savings was 10% at the 90% confidence interval.

3.2.2 On-Site Measurement and Verification Sample Design

An initial definition of M&V sample parameters is given in Table 3-2 to provide a context for the sample discussion that follows.

Table 3-2. Summary of MPP Measurement and Verification Sample Components

Sample Component	Sample Approach	Comments
Primary sampling unit	Project	Some projects consist of multiple buildings.
Sample frame	Projects completed between 2009 and 2011	Billing analysis is the preferred approach and lag time is needed to obtain post-installation billing records. The sample frame excluded the 132 smallest projects, which accounted for about 4% of program savings.
Variable to be estimated	Evaluated gross site MMBtu	Of the projects, 95% feature both electric and fossil fuel savings.
Method	Stratified ratio estimation	SRE generally works well for RR as there is usually a strong correlation between program-reported and evaluated gross savings.

When designing the M&V sample, the Impact Evaluation Team first considered the program components that might lead to statistically different results. These included project type, incentive level, primary fuel savings, market type, and location. Table 3-3 outlines the sampling strategy for each of these segments during sample planning.

Table 3-3. Measurement and Verification Sample Design by MPP Program Component

Program Component	Segments	Stratification Approach	Comments
Project type	Existing buildings New construction	High-level stratification[1]	The Program is designed to offer different incentive levels and performance payment opportunities by project type.
Incentive level	Performance payment No performance payment	High-level stratification	Projects applying for the bonus incentive were hypothesized to generally perform better than those that did not.
Savings magnitude	Large Medium Small	Lower-level stratification[2]	Project savings were defined as the maximum MMBtu between electric (converted to source MMBtu) and fossil fuel savings to ensure that fuel-switch projects were not underrepresented.

Program Component	Segments	Stratification Approach	Comments
Market type	Market-rate Affordable housing	Post hoc stratification[3]	Of the population, 76% is affordable housing. The evaluators performed an interim assessment of market-rate projects in the sample to ensure that the market-rate results were statistically meaningful.
Location	Upstate Downstate	Post hoc stratification	Of the population, 58% are upstate projects, but downstate projects generally save more. The evaluators felt confident that upstate and downstate results could be meaningfully separated after the site work was complete.
Funding source	RGGI Non-RGGI (EEPS I and SBC)	Post hoc stratification	13 RGGI-funded projects are included in the M&V sample, out of the 28 RGGI-funded projects in the population. The 13 sampled RGGI projects mostly include the largest-saving RGGI projects and represent 82% of total RGGI-funded MMBtu savings in the evaluation population.

[1] High-level stratification – Separate samples were designed for these components and segments.

[2] Lower-level stratification – Segmented samples were divided within the high-level strata by this particular component.

[3] Post hoc stratification – These components were not segmented within the planned sample; rather, their results were aggregated and analyzed separately after M&V was complete.

In addition, aggregate electric and fossil fuel savings were analyzed separately using the SRE size strata developed for the source MMBtu savings reported by the Program. This approach was selected due to the high incidence of projects with both electric and fossil fuel savings.

Given the sample plan summarized in Tables 3-2 and 3-3 above, the planned and actual M&V sample sizes for each high-level stratum are compared in Table 3-4.

Table 3-4. On-Site Measurement and Verification Sample Design and Disposition

Program Component	Stratum	Total Number of Projects	Total Reported Source MMBtu[1] Savings	Planned Sample Size	Number of Replacements	Final Sample Size
Existing buildings with performance payment[2]	Census	11	187,682	11	0	11
	Random	65	291,722	24	4	24
Existing buildings without performance payment	Census	14	367,734	14	0	12
	Random	132	462,014	56	10	57
New construction	Census	9	21,860	9	0	8
	Random	25	26,013	5	0	5
Small saver, excluded sites	N/A	132	54,740	0	0	0
M&V Total		**388**	**1,411,765**	**119**	**14**	**117**

[1] Source MMBtu savings is the sum of the fossil fuel energy savings plus the site-reported electric savings converted to source MMBtu. The source electric MMBtu savings is the product of the following: site electric kWh savings x 3.142 MBtu/kWh x 0.001 MMBtu/MBtu x 2.98 Btu input/Btu output (per NYSERDA guidance, to account for power plant and distribution inefficiencies). The sample design took into account the source electric savings to ensure fair representation of electric-saving measures in the sample and to reflect the Program's design target of 20% source energy reduction.

[2] The Program designates the fourth payment in the tiered incentive structure as a "performance payment," which facilities receive if a 20% energy reduction is demonstrated in post-project utility billing analysis performed by the Program.

The original M&V sample of 119 projects decreased to 117 projects[19]; otherwise, after the assignment of fourteen replacement projects, the target sample sizes for the random strata were reached.

3.2.3 Attribution Sample Design

The attribution sample design was based on conducting two broad categories of surveys to support the estimate of program influence: (1) surveys of multifamily property owners/managers and (2) surveys of market actors involved with multifamily energy efficiency projects. Within each of these categories, surveys of participating and nonparticipating firms were pursued. The surveys of participating owners/managers and market actors support the estimates of program FR and ISO/OSO, while those of nonparticipating owners/managers and of market actors were used to estimate NPSO.

To a large extent, the design of the attribution sample of participating owners/managers mirrored the design of the M&V sample. As with the M&V sample, upper level stratification was conducted by project type (existing building/new construction) and incentive level (performance payment vs. no performance payment). The size stratification by source MMBtu savings was also maintained. In addition, quotas were established for primary funding sources[20] (SBC vs. EEPS) and for fuel type (electric vs. fossil fuels).

The sample consisted of all M&V sampled projects plus a large number of the remaining 271 projects in the evaluation population. Table 3-5 provides a breakout of the MPP attribution survey sample sizes.

[19] The evaluators experienced isolated recruitment difficulties due to facility changes in management or unresponsiveness, leading to a small number of projects removed from the sample.

[20] Projects receiving RGGI funding were not addressed in a separate quota. The largest RGGI-funded projects were included in the SBC and EEPS quotas.

Table 3-5. MPP Attribution Survey Sample Sizes Breakout

Program Component	Population	Target Sample Size	Target Relative Precision	Total Completed Surveys	Total Surveyed Projects[1]	Achieved Relative Precision
Participating Owners/Managers Survey (FR/ISO/OSO)						
EB with performance payment	133	71	90/7	40	40 (fossil) 38 (electric)	90/7
EB without performance payment	215	139	90/7	50	50 (fossil) 46 (electric)	90/5
NC	40	30	90/7	15	15 (fossil) 14 (electric)	90/14
Oversample	N/A[2]	20	N/A	0	0	N/A
Totals	**388**	**260**	**90/7**	**105 (fossil) 98 (electric)**	**105 (fossil) 98 (electric)**	**90/5 (fossil) 90/4 (electric)**
Engineering Follow-Up of Participating Customers Reporting Spillover						
SO cases identified during M&V work	117	N/A	N/A	12 projects identified	6 (fossil fuel) 6 (electric)	N/A
Engineering verification of SO reported in participant surveys	147 total surveys	15 sites reporting SO	N/A	7 sites with confirmed SO	1 (fossil fuel) 4 (electric) 2 (both)	N/A
Nonparticipating Owners/Managers Survey (NPSO)						
Nonparticipating owners and managers screening surveys	1,800	50	N/A	16 sites with possible NPSO	N/A	N/A
Nonparticipating owners and managers reporting SO	16	16	90/10	1 site with confirmed NPSO	1 (electric)	90/0
Participating Program Partners/Market Actors[3] Survey (FR/ISO/OSO)						
Performance partners only	105[a]	59	N/A	50	N/A	N/A
Nonparticipating Market Actors Survey (NPSO)						
Nonparticipating market actors reporting SO	341	341	N/A	7 instances of possible NPSO	0 confirmed NPSO projects	N/A

[1] Projects typically feature both electric and fossil fuel savings. Interviews on fossil fuel-saving measures are slightly more prevalent than electric, as the Impact Evaluation Team focused interviews on the three-largest saving measures per project (from a source MMBtu basis).

[2] N/A indicates "not applicable" for specified cells.

[3] Key market actors include contractors, architect/engineering firms, and construction firms.

[a] Pool of performance partners reflects the number of unique performance partners, as they can be involved with multiple projects.

3.3 DATA COLLECTION

Table 3-6 summarizes the extent and timing of all M&V and attribution data collection associated with the above sample designs.

Table 3-6. MPP Data Collection Summary

Output Element	Method	Target Group	Target Sample Size	Actual Count	Data CollectionTime Frame (Start-Finish)
M&V	On-site	MPP participant facilities Existing buildings (EB) and new construction (NC)	119	117	Feb 2013 – Nov 2013
ISO	On-site	MPP participant facilities EB & NC	15	15	Feb 2013 – Nov 2013
Net savings (FR, ISO, OSO)	Survey	Participating customers – EB & NC	260	124	Nov 2013 – Mar 2014
Net savings (OSO, NPSO)	Survey	Nonparticipating customers – EB & NC	50	15	Jan 2014 – Mar 2014
Net savings (OSO, NPSO)	Survey	Participating program partners	59	50	Oct 2013 – Nov 2013
Net savings (OSO, NPSO)	Survey	Nonparticipating vendors	341	341	Oct 2013 – Dec 2013

3.4 M&V SAVINGS METHODOLOGY

The engineering analysis of the M&V sample outlined in Table 3-4 reflected the whole-building design of the Program. Since projects included on average, 17 measures, the evaluators focused on calculating whole-building savings by fuel type. The whole-building approach primarily involved two analysis methods, depending on project type, among the sample of 117 projects:

1. For the 104 EB projects in the sample, the evaluators' first choice was analysis of pre- and post-project monthly utility consumption data, normalized for weather conditions and adjusted to account for any significant fluctuations in occupancy. When monthly data records were incomplete, the evaluators also relied on building energy modeling[21], measure-specific M&V, and/or verification approaches as needed.

2. For the 13 NC projects in the sample, the evaluators used a building energy modeling approach. In most cases, a model simulating the facility's energy-consuming systems was calibrated with at least 12 months of post-project utility consumption data.

Each of the sampled projects received at least one on-site visit by the evaluators.

[21] The evaluators referenced resources such as the New York Technical Manual (NYTM), ENERGY STAR savings calculators, and the DOE's Federal Appliance Standards to define measure-specific assumptions within each building energy model, as needed.

3.4.1 Levels of Rigor

The Impact Evaluation Team applied the most appropriate of four possible M&V methods based on data availability, equipment accessibility and interactivity, and complexity of measures. A comparison of the planned and achieved allocation of the M&V sample across the rigor categories is provided in Table 3-7.

Table 3-7. MPP M&V Evaluation Allocation of Rigor

Approach and IPMVP Option	Planned Allocation	Achieved Allocation	Criteria
Site-specific utility bill analysis (IPMVP Option C)	35%	55%[1]	Availability of pre- and post- bills in common area and units; substantial measure impact and interactivity; EB projects only
Whole-building simulation (IPMVP Option D)	40%	25%	Availability of pre- or post- bills; availability of applicant model; NC projects
Equipment performance monitoring (IPMVP Options A and B)	20%	15%	Equipment accessibility and measurability; highly weather-dependent or complex measures; spreadsheet model developed
Verification	5%	5%	Inaccessible equipment; relatively unsubstantial savings; in-unit measures
Total	**100%**	**100%**	

[1] Through formal utility requests and requests of facility staff, the evaluators obtained a larger-than-anticipated selection of utility bills. This data collection allowed a larger portion of the M&V sample to be analyzed via billing analysis. Further information on the Impact Evaluation Team's decision-making process to ensure the best approach is provided in Appendix C.

Many of the projects within the M&V sample required thoughtful approaches on topics such as measure baseline, fuel switches, in-unit measures, and summer coincident peak demand savings. The following two sections address the evaluators' approach on measure baseline and dual-fuel projects, while other interesting M&V approaches are covered in Appendix C.

3.4.2 Baseline

The Impact Evaluation Team's baseline framework first takes into account the project type. For the M&V sample of NC projects, the baseline generally reflects the energy code[22] at the time of project application.

In defining the baseline for EB projects, the evaluators determined the age, operability, and repair history of replaced or retrofitted equipment. When pre-project documentation, interviews with facility staff, and/or inspection of equivalent systems indicated that the pre-project equipment was expected to operate for a full year after project completion and/or was repaired and maintained as needed, the evaluators chose an early replacement baseline. When pre-project equipment was

[22] The New York State Energy Conservation Construction Code (NYSECCC) was primarily referenced, with ASHRAE 90.1 as a secondary energy code reference.

determined to be unsuitable for first-year operation, the baseline generally reflected the energy code at the time of project application.

This baseline framework follows the DPS's guidance outlined in the 2011 Appendix M and subsequent orders, though each was issued after a majority of projects in the M&V sample were implemented. Appendix M reflects and codifies evaluation standard-practice guidance for multifamily central equipment baseline definition and was therefore used as a baseline decision-making reference by the Impact Evaluation Team. Further details on the baseline framework and data collection process are provided in Appendix B.

3.4.3 Dual-Fuel and Fuel-Switch Projects

Several projects in the M&V sample featured a partial or complete switch from one heating fuel type to another. For dual-fuel or fuel-switch measures, the evaluators first assessed the operability of the prior fuel-consuming equipment to determine measure baseline, per Section 3.4.2. If the prior fuel-consuming equipment represented an appropriate baseline, the evaluators next aggregated the pre- and post-project usage by fuel type. The evaluators assessed each project's fuel-specific savings and then aggregated all fossil fuel MMBtu together to assess the project's total fossil fuel savings.

Although the majority of Program projects completed between 2009 and 2011 targeted only electric savings, the evaluators tallied the fuel-specific savings by project for two primary reasons:

1. To evaluate the greenhouse gas emissions reduction for projects receiving Regional Greenhouse Gas Initiative (RGGI) funding.
2. To assess program performance by heating fuel type and to determine whether the Program accurately reported natural gas savings during primarily EEPS-funded periods.

3.5 PROGRAM ATTRIBUTION METHODOLOGY

The methodology used to calculate the project and program-level net-to-gross (NTG) ratios was developed to address the unique needs of multifamily customers participating in the Program. This method relies exclusively on the self-report approach (SRA) to estimate project and program-level NTG ratios, since other available methods and research designs are generally not feasible for the evaluation of programs such as MPP.

This methodology provides a standard framework, including decision rules, for integrating findings from both quantitative and qualitative information in the calculation of the NTG ratio in

a systematic and consistent manner. This approach is designed to fully comply with the requirements and procedures outlined in documents from the DPS and its advisors.[23] Appendix D contains both additional details on the attribution framework and the results of applying these procedures in this evaluation, while Appendix E provides a copy of the participant telephone survey.

3.5.1 Net-to-Gross Ratio Framework and Scoring Algorithm

The self-report-based NTG analysis relies on responses to a series of survey questions that are designed to measure the influence of the Program on the participant's decision to implement program-eligible energy efficiency measures. An NTG ratio is derived based on the responses to these questions and is computed using the following formula:

$$\text{NTG ratio} = 1 - \text{FR} + \text{ISO} + \text{OSO} + \text{NPSO}$$

The FR component of the NTG ratio is calculated as an average of three scores. Each of these scores represents a different way to measure MPP influence.

1. Score 1 reflects the influence of the most important of various Program- and non-Program-related elements in the customer's decision to select the specific measure at this time. Program influence through trade ally recommendations is also incorporated in this score.
2. Score 2 captures the perceived importance of the MPP (whether incentive, partner recommendation, training, or other program intervention) relative to non-program factors in the decision to implement the specific measure(s) that are eventually adopted or installed.
3. Score 3 captures the likelihood of various actions the customer might have taken at this time and in the future if the MPP had not been available (the counterfactual).

The calculation of each of the scores is discussed in Appendix D, including details on how they were computed.

3.6 NET-TO-GROSS RATIO FRAMEWORK FOR SPILLOVER

This section describes the procedures for analyzing participant and nonparticipant SO in general.

[23] *New York Evaluation Plan Guidance for EEPS Program Administrators* (November 2012); Spillover Guidance Document (Appendix H of the Evaluation Plan Guidance); March 1, 2013 Memo on Emerging Net-to-Gross Ratio. Issues; Appendix M ("Guidelines for Early Replacement Conditions"); Appendix H ("Guidelines for Estimating Net-to-Gross Ratios Using the Self-Report Approach") June 2013 draft.

3.6.1 Participant Inside and Outside Spillover Methodology

Theoretically, the effects of participation in the Program – increased familiarity and comfort with energy efficient technologies, greater appreciation of energy savings benefits, or new awareness from performance partners and other market actors who can assist with measure selection and implementation – may cause program participants to implement additional energy efficiency projects they would not have implemented otherwise.

The approach to assessing participant SO considers the Program's effect on additional measures implemented at the specific site being evaluated as well as at other sites owned or operated by the same customer. These additional measures are implemented without receiving financial incentives, so they fall outside of the scope of the direct impacts that are assessed for other program measures. Participant SO is defined as follows: Reductions in the participating customer's energy consumption and/or demand caused by the presence of the energy efficiency program, beyond program-evaluated gross savings of participants. SO rates are calculated as these savings estimates divided by program-reported savings for the project. "Inside" SO occurs when, due to the project, additional actions are taken to reduce energy use at the same facility, but these actions are not included as program savings. "Outside" SO occurs when a program participant initiates additional actions that reduce energy use at other sites that are not participating in the Program.

Self-reported data collected from participating decision-makers during the NTG surveys and from facility managers during the site visit by the evaluators were the basis for the ISO analysis. When respondents identified OSO measures at their other facilities in New York, a person knowledgeable about that SO at that site was surveyed to calculate the savings and to determine if the Program had influenced that savings. The Program's influence was measured by a self-reported program-influence rating survey which required a score of 8 or more on a 0-to-10 scale to be considered influential. In all cases where SO was claimed, the resulting savings were then used to adjust the net savings and calculated NTG ratio for each site where SO was indicated.

M&V Site-Based Inside Spillover Findings

During site visits by lead M&V engineers, facility managers were asked to identify any additional measures that were installed beyond those incented or recommended by the Program. SO was identified at 12 sites by the M&V engineering team. A wide variety of measures comprised this category of ISO and accounted for a total of 634,144 kWh and 813 MMBtu of savings, which were converted into site-specific ISO ratios incorporated directly into the NTG ratio for each site

identified. The procedures used to evaluate these ISO measures correspond to the enhanced level of rigor described in New York Department of Public Service (DPS) evaluation guidelines[24].

3.6.2 Nonparticipant Spillover

The Program can also influence firms operating outside of it, creating NPSO. This effect is often the result of networking between participants and nonparticipants or of market actors' perceived need to stay competitive in a market[25] that is changing due to Program efforts as well as external factors and influences beyond MPP participants' control.

As with participant SO, in all cases where NPSO was indicated, program influence had to be established and detailed information obtained about the site-specific energy savings measures, including the equipment size, efficiency, and quantity. SO savings were then directly quantified from this data in a bottom-up fashion.

Of 16 sites initially identified as potential NPSO candidate sites, based on the nonparticipating owner-manager survey results, all but one were screened out because: (1) the measures installed were not energy efficient or (2) the importance score they attributed to NYSERDA's influence in the decision to install these energy efficiency measures was too low. The single remaining site involved installation of LED lighting, the savings from which was added to the total Program savings in a final step after project-level net savings were tabulated. Due to relatively small savings size, the procedure used to evaluate savings from the LED installation measure corresponds to the standard level of rigor described in DPS evaluation guidelines.

3.7 CALCULATION OF PROGRAM NET SAVINGS

Program net savings are defined as the product of program-reported savings, the RR,[26] and the NTG ratio. During this final calculation step, the Impact Evaluation Team paid careful attention to potential double-counting[27] between evaluated gross savings and NTG ratio results. Following

---

[24] *Evaluation Plan Guidance for EEPS Program Administrators*, November, 2012, http://www3.dps.ny.gov/W/PSCWeb.nsf/96f0fec0b45a3c6485257688006a701a/766a83dce56eca35852576da006d79a7/$FILE/NY_Eval_Guidance_Aug_2013.pdf

[25] The approach taken in this evaluation was to develop a basis for setting metrics for eventual measurement of the energy impacts due to Program-related market effects, via the use of particular survey questions in the nonparticipating customer and nonparticipating market actor surveys. These questions focused on the following preexisting baseline behaviors (i.e., those occurring outside of NYSERDA's programs) by firms involved in the multifamily market. See Appendix D for more information.

[26] Or, in the case of fossil fuels, the performance factor.

[27] Double-counting refers to instances where the M&V site work and NTG interviews simultaneously and separately reached the same conclusion on project savings attributable to the Program. An example of potential double-counting

the completion of the M&V site work and the NTG interviews, a site-by-site review was completed to discern whether there were any projects with potential double-counting. Only one project with a low NTG ratio of 0.08 was a clear case of double-counting; this project featured an evaluation baseline set to code during the M&V process. This overlapping project was removed from the NTG ratio sample frame, and the NTG ratio was recalculated.

involves baseline: if the evaluation engineer determined a code baseline (normal replacement) was more appropriate than the preexisting equipment (early baseline), that decision was communicated with the attribution team, to ensure the NTG ratio did not doubly reflect this difference in baseline. The Impact Evaluation Team ensured that no double-counting resulted from these two simultaneous efforts.

SECTION 4: RESULTS AND CONCLUSIONS

This section presents the results and conclusions of the impact evaluation study.

4.1 REALIZATION RATE RESULTS

The Impact Evaluation Team (or, the evaluators) analyzed the project-specific impacts for 117 projects in the measurement and verification (M&V) sample. The results of the M&V data collection and analysis are presented in the following sections. Additionally, the Impact Evaluation Team has identified and quantified the key contributors and their impacts to the electric energy realization rate (RR).

4.1.1 Electric Results

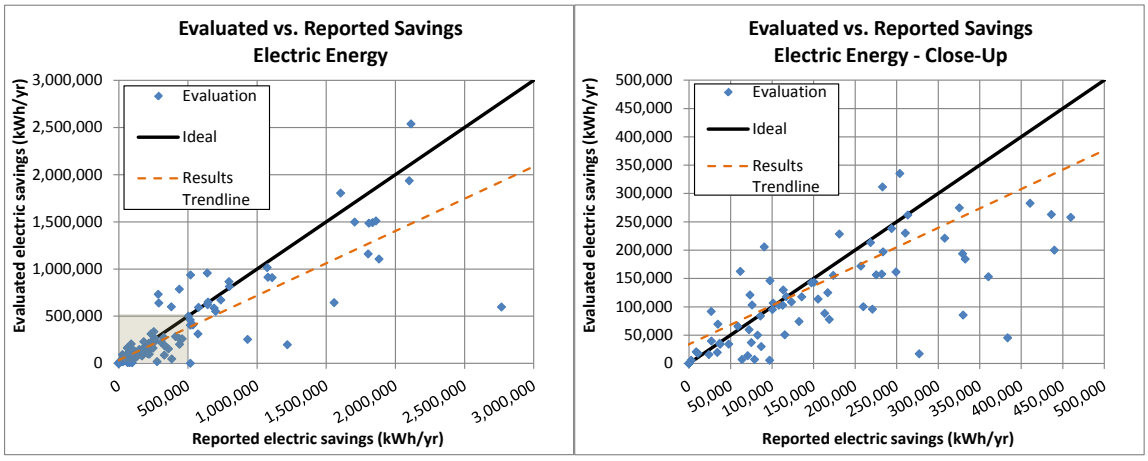
Table 4-1 presents the RRs – defined as the ratio of evaluated gross savings to the program-reported savings – for the evaluation population's electric energy and summer coincident peak demand savings. The table also presents the error ratio, which is the variance in the RR itself and will be useful in planning subsequent evaluations.

Table 4-1. MPP Electric Energy and Electric Peak Demand Realization Rates

Metric	Electric Energy (MWh)	Electric Peak Demand (kW)
A – Program-reported savings	80,426	7,695
B – RR	0.79	0.77
C – Evaluated gross savings (A x B)	63,537	5,925
D – Relative precision	7%	9%
E – Error ratio	0.57	0.93

Figure 4-1 compares the evaluated annual gross energy savings with the program-reported values for electric measures. Ideally, the evaluated savings would always match the program-reported savings. This ideal is shown as a solid black line on the charts.

Figure 4-1. MPP Evaluated Gross vs. Program-Reported Electric Energy Savings by Project



The right-hand figure represents a close-up of the shaded portion of the left-hand figure's grid. Figure 4-1 illustrates how several of the largest-saving electric projects in the sample either featured RRs near one (along the ideal line) or underperformed (below ideal line). The close-up indicates that the majority of small-saver projects slightly underperformed and only a handful deviated positively from the ideal line.

Figure 4-2 compares the evaluated gross summer coincident peak demand savings with the program-reported summer coincident peak demand savings for electric measures.

Figure 4-2. MPP Evaluated Gross vs. Program-Reported Electric Peak Demand Savings by Project

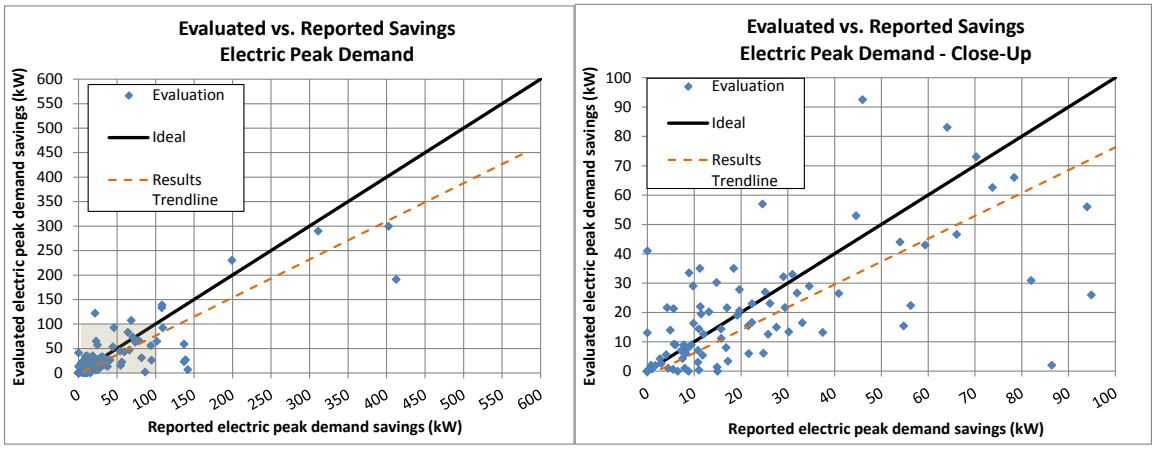


Figure 4-2 illustrates that the larger summer coincident peak demand-savings projects generally had RRs near one, while the small-to-medium-savings projects featured a wider scatter. The evaluators typically calculated summer coincident peak demand savings by applying New York Technical Manual (NYTM) factors to whole-building electric energy savings results.

Key Differences Influencing the Electric Realization Rate

The Impact Evaluation Team next analyzed the reasons for the evaluated gross electric energy savings being 21% lower than reported. This analysis began at the project level, where the M&V engineers classified different contributors to individual project RRs into 23 distinct categories. Next, the engineers estimated the impacts (positive or negative) attributable to each applicable category for each project in the M&V sample. Finally, this analysis was aggregated by energy impact (in kWh) across the M&V sample, leading to program-level information on the reasons why the RR was 79% for projects saving electric energy. The results of this analysis are presented in Table 4-2 with a description of each contributing category.

Table 4-2. Contributors to MPP Electric Energy Realization Rate

Category		Description	Negative		Positive	
			# of Projects	Impact on kWh RR	Impact on kWh RR	# of Projects
Administrative	Difference between applicant model and reported savings	When investigating differences in savings, the evaluators determined that the final applicant model output did not match the reported savings.	2	-1%	4%	7
	Administrative error	The evaluators determined a data entry error within the tracking savings database.	1	0%	2%	1
	Subtotal		**3**	**-1%**	**6%**	**8**
Pre - post inspection	Difference in quantity installed	The evaluators determined a different quantity of installed equipment as compared with the program-reported value.	45	-17%	5%	10
	Inaccurate pre-project characterization	The applicant's baseline building model did not reflect the pre-project characteristics determined during the energy reduction plan (ERP) inspection.	11	-5%	1%	5
	Difference in installed equipment size	The installed equipment size or rated capacity did not match that reflected in the project's reported savings.	7	-2%	4%	4
	Difference in installed equipment technology	The equipment inspected by the evaluators differed slightly from the specifications proposed within the ERP.	5	-4%	1%	4
	Ineligible measure	The project incented equipment did not meet the Program's eligibility requirements at the time of application.	2	0%	0%	0
	Inaccurate occupancy estimate	The facility featured a fluctuation in occupancy between pre- and post-project periods; this was not properly accounted for by the applicant.	0	0%	1%	2
	Subtotal		**70**	**-29%**	**12%**	**25**
Baseline	Incorrect baseline reference	The applicant did not correctly model the replaced equipment compared to the data gathered during the pre-project inspection.	16	-5%	6%	6
	Incorrect baseline reference to code	The applicant did not reference a code baseline when the preexisting equipment was determined to represent an inappropriate baseline.	4	-2%	0%	0
	Subtotal		**20**	**-8%**	**6%**	**6**
Analysis assumptions	Differences in modeling software	Slight differences in savings occurred due to variations in modeling software or version.	2	0%	1%	10
	Unknown applicant algorithm or assumptions	The evaluators could not find sufficient documentation explaining the applicant's reported savings calculation methodology.	1	0%	3%	3
	Inaccurate normalization to typical weather	The applicant model did not accurately normalize the reported savings with the most proximate weather station data.	2	0%	0%	0
	Inaccurate plug loading estimate	The applicant misestimated the tenant plug load density within the building model, slightly affecting the building's electric load profile.	1	-1%	0%	0
	Incorrect reference to billing data	The applicant's baseline model did not closely reflect the pre-project monthly utility consumption data.	1	0%	0%	0
	Subtotal		**7**	**-1%**	**3%**	**13**
Operating characteristics	Difference in equipment operating efficiency	The evaluation analysis indicated that the incented equipment operated at an efficiency level different from the Program's assumption.	20	-14%	16%	13
	Inaccurate estimation from applicant model	The applicant's analysis estimates on facility or measure characteristics differed slightly from those determined by evaluators.	15	-4%	3%	11
	Difference in equipment load profile	From metered data and/or bills, the evaluators determined an equipment loading level different from that assumed in the reported savings analysis.	14	-5%	7%	11
	Difference in equipment hours of operation	The incented equipment operates for a longer or shorter duration than that assumed by the applicant, as determined through evaluator metering.	16	-4%	1%	7
	Difference in installed control strategy	The incented equipment is controlled differently than assumed within the reported savings analysis.	10	-4%	1%	3
	Insufficient assessment of measure interactivity	The evaluators determined interactive impacts among measures that were not appropriately accounted for within the applicant model.	8	-2%	1%	3
	Inoperable installed equipment	The evaluators determined that the incented equipment does not operate as assumed by the applicant.	6	-6%	0%	0
	Variation in HVAC settings	The evaluators determined that the Program's incented HVAC equipment operated at a setpoint different from that assumed by the Program.	5	-1%	0%	1
	Subtotal		**94**	**-40%**	**30%**	**49**
Totals			**194**	**-78%**	**57%**	**101**

Table 4-2 highlights a number of key contributors to the 79% RR for electric energy savings. Some notable contributing categories include the following:

- Differences in quantity installed was the highest contributor to the 79% RR, primarily due to the difference in the number of in-unit CFLs that were actually installed compared to program-reported claims. Additionally, categories related to pre- and post-project inspection – inaccurate pre-project characterization and differences in installed equipment technology – resulted in a 7% reduction of the electric energy RR.
- Several measure characterization and equipment operation categories such as incorrect baseline reference, difference in equipment load profile, and difference in equipment operating efficiency, affected several projects but resulted in relatively high positive and negative kWh impacts that mostly canceled each other out. Equipment loading levels and operating hours are often difficult to predict. These findings indicate that the Program's Simulation Guidelines and performance partner network are leading to realistic savings predictions on average.
- Inoperable installed equipment led to a 6% drop in electric energy RR. One high-impact example of inoperable equipment is a submetering measure that was never implemented due to legal complications; this occurred in three separate projects.

Actual site-specific examples of each contributing category have been provided in Appendix G.

4.1.2 Fossil Fuel Results

Table 4-3 compares the evaluated gross fossil fuel savings to the program-reported fossil fuel savings for the evaluation population's SBC- and EEPS-funded projects. Overall fossil fuel savings include natural gas, all grades of fuel oil, district steam, and propane. Section 4.2 will present the RR for Regional Greenhouse Gas Initiative (RGGI)-funded projects.

Table 4-3. Comparison of Evaluated Gross and Program-Reported Fossil Fuel Savings for MPP System Benefits Charge- and EEPS-Funded Projects[1]

Metric	Fossil Fuel Energy (MMBtu)
A – Program-reported savings	995,146
B – Performance factor[2]	0.60
C – Evaluated gross savings (A x B)	600,274
D – Relative precision	11%
E – Error ratio	1.09

[1] Results do not include RGGI-funded projects.

[2] Since projects completed between 2009 and 2011 were primarily SBC-funded and targeted electric savings only, this table uses the term "performance factor" to distinguish from a "realization rate." Careful consideration must be taken when applying this impact evaluation's results to natural gas savings of later EEPS-funded projects.

Figure 4-3 compares the evaluated gross fossil fuel savings with the program-reported fossil fuel savings for all projects in the M&V sample.

Figure 4-3. MPP Evaluated Gross Fossil Fuel Savings vs. Program-Reported Fuel Savings

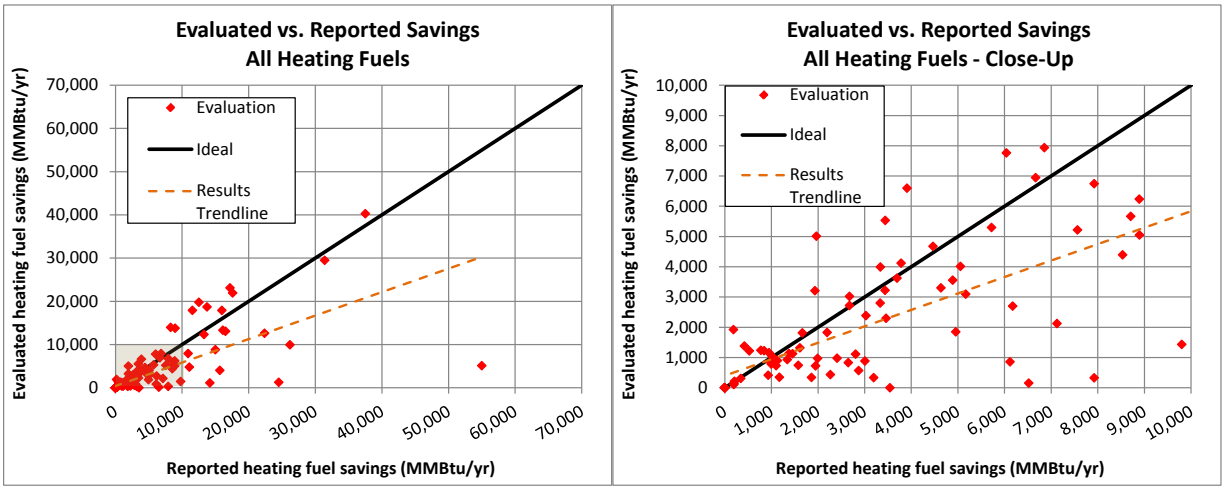


Figure 4-3 illustrates the generally lower-than-anticipated evaluated gross fossil fuel savings among small- and medium-saving projects in the M&V sample. Though about a dozen of the largest-saving projects featured near-ideal results, there were about as many large savers that significantly deviated from the ideal line.

Key Differences Influencing the Fossil Fuel Performance Factor

The Impact Evaluation Team next analyzed the reasons why the evaluated gross fossil fuel savings were 40% lower than reported. The results of this analysis are presented in Table 4-4 with a description of each of the 22 contributing categories.

Table 4-4. Contributors to MPP Evaluated Gross Fossil Fuel Savings

Category		Description	Negative		Positive	
			# Projects	Impact on MMBtu RR	Impact on MMBtu RR	# Projects
Administrative	Difference between applicant model and reported savings	During the evaluator's investigation of differences in savings, it was determined that the final applicant model output did not match the reported savings.	7	0%	1%	3
	Administrative error	The evaluators determined a data entry error within the tracking savings database.	2	0%	0%	0
	Subtotal		**9**	**-1%**	**1%**	**3**
Pre - post inspection	Difference in quantity installed	The evaluators determined a different quantity of installed equipment as compared with the program-reported value.	25	-5%	0%	4
	Inaccurate pre-project characterization	The applicant's building model did not reflect the pre-project characteristics determined during the ERP inspection.	9	-5%	0%	1
	Difference in installed equipment technology	The equipment inspected by the evaluators differed slightly from the specifications proposed within the ERP.	7	-2%	0%	2
	Inaccurate fuel accounting after switch	The project involved a fuel switch and/or multiple fuel impacts. The fuel-specific impacts were not properly accounted for in reported savings.	5	-8%	3%	2
	Difference in installed equipment size	The installed equipment size or rated capacity did not match that reflected in the project's reported savings.	3	-1%	0%	1
	Inaccurate occupancy estimate	The facility featured a fluctuation in occupancy between pre- and post-project periods; this was not properly accounted for by the applicant.	2	-3%	0%	1
	Subtotal		**51**	**-24%**	**5%**	**11**
Baseline	Incorrect baseline reference	The applicant did not correctly model the replaced equipment as compared with data gathered during the pre-project inspection.	15	-3%	3%	9
	Incorrect baseline reference to code	The applicant did not reference a code baseline when the preexisting equipment was determined to represent an inappropriate baseline.	9	-2%	0%	2
	Subtotal		**24**	**-5%**	**3%**	**11**
Analysis assumptions	Inaccurate normalization to typical weather	The applicant model did not accurately normalize the reported savings with the most proximate weather station data.	9	-1%	0%	1
	Unknown applicant algorithm or assumptions	The evaluators could not find sufficient documentation explaining the applicant's reported savings estimation.	2	0%	3%	4
	Inaccurate plug loading estimate	The applicant misestimated the tenant plug load density within the building model, slightly affecting the building's heat load and project savings.	0	0%	0%	1
	Subtotal		**11**	**-2%**	**3%**	**6**
Operating characteristics	Difference in equipment operating efficiency	The evaluation analysis indicated that the incented equipment operated at an efficiency level different from the Program's assumption.	27	-11%	6%	17
	Inaccurate estimation from applicant model	The applicant's analysis estimates on facility or measure characteristics differed slightly from those determined by evaluators.	18	-15%	12%	15
	Difference in equipment load profile	From metered data and/or bills, the evaluators determined an equipment loading level different from that assumed in the reported savings analysis.	17	-13%	6%	13
	Difference in installed control strategy	The incented equipment is controlled differently than assumed within the reported savings analysis.	13	-2%	3%	5
	Variation in HVAC settings	The evaluators determined that the Program's incented HVAC equipment operated at a setpoint different from that assumed by the Program.	8	-3%	1%	8
	Difference in cooling or heating interactivity	The interactive effect of an equipment replacement or retrofit on the building's heat load was not fully accounted for in the applicant's analysis.	4	-1%	0%	5
	Insufficient assessment of measure interactivity	The evaluators determined interactive impacts among measures that were not appropriately accounted for within the applicant model.	6	-2%	0%	1
	Difference in equipment hours of operation	The incented equipment operates for a longer or shorter duration than that assumed by the applicant, as determined through evaluator metering.	2	-1%	0%	1
	Inoperable installed equipment	The evaluators determined that the incented equipment does not operate as assumed by the applicant.	3	-2%	0%	0
	Subtotal		**98**	**-49%**	**29%**	**65**
Totals			**193**	**-81%**	**41%**	**96**

Table 4-4 highlights a number of key contributors to the 60% performance factor for fossil fuel savings. Some notable contributing categories include:

- Inaccurate fuel accounting after switch led to a 5% decrease in the fossil fuel performance factor. This category pertains to an error or missing entry when tracking a penalty associated with a fuel-switch measure. Missing fuel-switch penalties, though there are only seven across the M&V sample, led to high-value reductions in evaluated gross savings.
- Difference in equipment operating efficiency and equipment load profile also significantly affected the fossil fuel performance factor, leading to an overall 12% reduction. For nearly all cogeneration measures, the evaluators determined that a higher level of natural gas input was needed to achieve the plant's electric output, leading to an overall lower plant efficiency as compared to that predicted.
- The Program generally characterized equipment baselines correctly, as evidenced by the "incorrect baseline reference to code" category. The evaluators found 11 instances of a more appropriate normal replacement baseline, which reduced the evaluated gross savings by only 2%.
- Like electric-saving measures, differences in quantity installed and incorrect pre-project characterization led to a significant reduction in evaluated gross savings for fossil fuels. Since Version 3, the Program has enhanced its tracking and inspection practices to better update the project characteristics with information collected on-site.

Actual site-specific examples of each contributing category have been provided in Appendix G.

Savings Tracking Issues for Measures Affecting Two or More Fuels

Since Tables 4-3 and 4-4 above present the evaluated gross savings for all heating fuels in aggregate, one particular fuel-specific issue discovered by the Impact Evaluation Team is not evident in either table. Following the approach outlined in Section 3.4.3, the evaluators calculated the savings by fuel type (e.g., natural gas, fuel oil) for each project in the M&V sample. The fuel-specific evaluated gross savings varied widely by fuel type, with fuel oil-saving measures realizing more than three times the MMBtu savings as reported, but natural gas-saving measures actually resulting in a 40% penalty compared to reported MMBtu savings.

The evaluators investigated this issue and determined that the Program's current database is limited in tracking fuel-specific impacts for dual-fuel or fuel-switch projects, such as those funded by RGGI. The database currently features a single field for MMBtu impacts for each measure line item, and all MMBtu

impacts are attributed to the most impacted fuel only. This limitation resulted in fuel oil savings being incorrectly claimed as natural gas or, in some cases, an associated fuel switch penalty that was not reported at all.

The following example best illustrates the limitations of the Program's tracking database. Consider a multifamily facility's boiler that was converted from consuming #6 fuel oil to natural gas via the installation of a high-efficiency burner. The project results in significant #6 fuel oil savings but increases natural gas usage. However, the Program reported only the incremental MMBtu savings due to the high-efficiency burner and claimed those savings as natural gas only. In this example, the evaluated #6 fuel oil savings are significantly higher than the zero reported by the Program, while the natural gas usage has increased over the baseline usage, resulting in a savings penalty compared to reported natural gas savings.

4.2 REGIONAL GREENHOUSE GAS INITIATIVE SAVINGS

The Program supported 28 projects with RGGI funding in the evaluation population. RGGI targets greenhouse gas reduction and therefore often funds dual-fuel or fuel-switch projects within the MPP. The evaluators analyzed the 13 RGGI projects in the M&V sample, which represented 82% of total RGGI-funded MMBtu savings in the evaluation population, to determine the evaluated gross fossil fuel savings in MMBtu and greenhouse gas emissions reduction in tons CO_2. These results are illustrated in Table 4-5.

Table 4-5. Evaluated vs. Program-Reported Fossil Fuel Savings for MPP RGGI-Funded Projects

Metric	Fossil Fuel Energy (MMBtu)	Greenhouse Gas Emissions (ton CO_2)
A – Program-reported savings	142,127	14,732
B – Realization rate	0.45	0.70
C – Evaluated gross savings (A × B)	63,832	10,319
D – Relative precision	28%	14%
E – Error ratio	1.26	0.78

Due to the dual-fuel tracking complications addressed in the last three paragraphs of the previous section, the evaluators determined a wide variance of RGGI results, leading to a lower realization rate and higher relative precision than other evaluation results. Because RGGI projects often featured fuel-switch measures, they were more likely to have incorrectly tracked MMBtu impacts of the introduced fuel. For example, there were two RGGI projects that featured a CHP measure for which the natural gas impact of the system was not tracked.

The greenhouse gas emissions reduction realization rate of 70% for RGGI projects was higher than the MMBtu realization rate, as the evaluators calculated higher RGGI fuel oil savings than those reported by

the program. Fuel oil emits about five times as many tons of CO_2 as compared with natural gas; therefore, greater levels of fuel oil MMBtu savings led to a more favorable greenhouse gas reduction result.

4.3 MEASURE ADOPTION RATE VERIFICATION

Not all of the energy reduction plans (ERPs) funded by the Program during the evaluation time frame resulted in reported energy savings. The evaluators determined that 168 projects received an incentive for ERP approval (see Figure 2-1 payment #1), but extenuating circumstances (lack of funds, change in ownership) or the inability to reach the 20% energy reduction goal led to project termination. These 168 projects also include facilities that may have installed a portion of the recommended measures but failed to reach the 50% project implementation milestone for incentive payment #2.

In September 2011 NYSERDA program staff conducted a telephone survey of a sample of 64 ERP-only customers to determine the measure adoption rate (MAR) attributable to the Program's involvement. To validate the self-report telephone survey results and to investigate the ERP-only savings potentially claimable by the Program, the Impact Evaluation Team conducted on-site verification visits at 15 of the 64 ERP-only facilities surveyed by NYSERDA.

Using the results of the NYSERDA study as a starting point, and based on field verification findings, the evaluators adjusted the Program's previous MAR estimates for both electric and fossil-fuel saving measures. Installed measures that received non-MPP funding from NYSERDA, utility programs or any other efficiency entity were excluded from the final verified MAR to avoid possible double reporting of savings in the future. Table 4-6 compares the original, telephone survey-derived MAR (row A) with the final on-site verified MAR (row E).

Table 4-6. Results of MPP Measure Adoption Rate On-Site Verification of 15 Sites[1]

Metric	Electric-Saving Measures	Fossil Fuel-Saving Measures
A – Telephone survey MAR	0.34	0.48
B – On-site verification adjustment	0.46	0.87
C – Preliminary verified MAR (A × B)	0.16	0.42
D – Adjustment for other funding	0.98	0.97
E – Final evaluation MAR (A × B × D)	0.15	0.40

[1] The Impact Evaluation Team's MAR research is investigative at this stage. The research concludes that the MAR of the Program's ERP-only projects is significant enough to warrant more rigorous research in the future, to lead to savings potentially claimable by the Program.

The evaluators determined an electric MAR 54% lower than the original telephone survey MAR, while the verified fossil fuel MAR was 15% lower. Only a few measures were excluded due to non-MPP funding. The evaluators believe the primary source of MAR discrepancy was miscommunication by

facility management during the initial telephone survey on equipment installation, quantity, or size. Additional MAR results, including MAR curves by year after ERP approval, are provided in Appendix H.

The impact evaluation research was intended to investigate the magnitude of ERP-only savings claimable by the MPP and to recommend whether the Program should pursue these savings with a more rigorous study. Despite lower-than-anticipated MAR values, the evaluators believe the ERP-only projects amount to substantial savings potentially claimable by the Program. For example, the electric MAR of 15% applied to the evaluation population's 168 ERP-only projects leads to potential electric savings that amount to approximately 10% of the evaluation population's reported kWh savings. Future MPP MAR research should reflect a scope similar to that of previous NYSERDA FlexTech impact evaluation MAR studies[28] in order to more rigorously quantify and claim the ERP-only savings attributable to MPP.

4.4 ATTRIBUTION RESULTS

This section presents the attribution results for specific segments of interest within the MPP. These include the weighted net-to-gross (NTG) ratios for each sampling domain and for the various subgroups of interest. Additionally, the Impact Evaluation Team has examined the qualitative data obtained to deepen our understanding of the results. Behind each of the NTG ratios calculated for each project is a host of contextual factors that may have influenced the project, either directly or indirectly. These factors provide a set of clues as to what is driving project decision-making and help shape our recommendations to improve program attribution moving forward.

4.4.1 Weighted Net-to-Gross Ratio Results

The methodology used to develop the site- and measure-specific NTG estimates is summarized in Section 3. This section presents the weighted results for each sampling domain and for several additional segments of interest. To produce an estimate of the program-level NTG ratio, the individual NTG ratios for each of the projects in the sample were weighted by the size of the program-reported impacts associated with each project and the proportion of the total sampling domain impacts represented by each sampling stratum. For projects that involved measure-level decision-making, NTG ratios were first computed at the measure level. Next, project-level NTG ratios were developed from the measure-level

[28] The MAR research completed in previous NYSERDA FlexTech impact evaluations featured a higher level of rigor and budget to include (1) a statistically representative sample of facilities receiving a technical assistance study, (2) enhanced levels of M&V on a nested sample of projects, and (3) a separate NTG study addressing the attribution of MAR projects only.

results by applying weights for each measure based on the size of the program-reported impacts associated with each measure.

These NTG ratios are based on projects completed between 2009 and 2011 that reflect a program design that consisted of program-funded studies completed by MPP partners along with incentives to reduce the payback on recommended measures. However, the Program is likely to undergo changes related to the New York State Public Service Commission's Clean Energy Fund (CEF) proceeding. As the extent or details of these changes are not yet known, the Impact Evaluation Team recommends that careful consideration is exercised when assessing the applicability of this study's results to future multifamily programs in New York State.

Results by Fuel Domain

NTG ratio results for the electric and fossil fuel domains are presented in Table 4-7. NTG results reveal a medium level of program influence as indicated by NTG ratios of 0.58 for electric (kWh) and 0.55 for fossil fuels (MMBtu).

Table 4-7. MPP Weighted Net-to-Gross Ratios by Component for Electric and Fossil Fuel Domains

NTG Ratio Component or Sampling Metric	Electric (All projects)	Fossil Fuel (All projects)
Free ridership (FR)	0.44	0.48
Inside spillover (ISO)	0.02	0.03
Outside spillover (OSO)	<0.01	<0.01
Nonparticipant spillover (NPSO)	<<0.01	<<0.01
NTG ratio = 1 – FR + ISO + OSO + NPSO	0.58	0.55
Relative precision at the 90% confidence level	4%	5%
Error ratio	0.30	0.34

The NTG ratio reflects the impact of both FR (negative adjustment) and SO (positive adjustment).

Results by Segment

The Impact Evaluation Team also performed an analysis of NTG ratios by various segments of interest as shown in Table 4-8. Note that the evaluators observed little variation across the various segments in general.

Table 4-8. MPP Net-to-Gross Ratios by Sampling Segment

Category	Segment	Electric NTG Ratio	Fossil Fuel NTG Ratio
Total results	N/A	0.58	0.55
Project type	Existing buildings (EB)	0.58	0.55
	New construction (NC)	0.65	0.64
Market	Market rate	0.62	0.45
	Affordable	0.58	0.59
Geography	Upstate	0.56	0.54
	Downstate	0.59	0.54
Performance payment status	EB with performance payment	0.60	0.59
	EB without performance payment	0.55	0.48

The NTG ratios for each analyzed segment fall within the confidence bounds for the total weighted NTG ratios and the segment-specific results are generally not statistically different from the average values for the electric and fossil fuel domains, with these exceptions (see shaded cells in Table 4-8):

- NTG ratios are somewhat lower for the fossil fuel domain, particularly for the market rate (0.45) and EB no performance payment (0.48) segments.
- NTG ratios are somewhat higher for NC (0.65 for electric, 0.64 for fossil fuel) although sample sizes are low.

4.4.2 Key Factors Influencing Net-to-Gross Ratios

The very largest projects received in-depth professional interviews, and the resulting rich set of data obtained enables the development of an NTG ratio "story" around each project, which is based on a combination of qualitative and quantitative findings. This information is particularly valuable in helping to provide guidance to program design for future years. It may be, for example, that responses to the core questions yield a high NTG ratio for a project, but additional information sources strongly suggest that the program-qualifying technology has since become common practice for the firm or industry, so that FR rates in future years are likely to be higher if program rules are not changed. This feedback can then be used to change the set of program-eligible measures in future years. With respect to attribution, certain types of measures were found to have higher FR, due largely to their becoming common practice within the New York multifamily market. Such measures included energy efficient cooling systems, boilers, and low-emissivity windows. To maximize the Program's impact going forward, the Program should take

steps to research and de-emphasize equipment and efficiency levels that have become standard practice, while instead promoting measures or efficiency levels that are less well-accepted.

The NTG ratio themes and other interview results from smaller projects were mined to extract key themes of the factors that are driving project installations. These themes reveal the many challenges that exist in serving this large and complex multifamily market. In general, this is a well-designed program serving a customer base that includes the largest and most highly sophisticated of energy users. As such, a significant amount of FR is to be expected in this market.

Among the factors that are contributing to **reducing** the program's influence are:

- **Major rehabilitations of buildings were common among the largest projects implemented.** Such large projects often featured multiple, non-NYSERDA funding sources that did not pertain to energy efficiency. The program incentive for the very largest projects, while large in absolute dollars, represented a very small share of the total cost of such projects, typically upwards of $20 million, thereby reducing the overall influence on the project.
- **A high percentage of projects involved the replacement of old equipment.** Although equipment replacement is an important milestone event/opportunity for program intervention, if the participating owner was already planning to install energy efficient equipment before learning about the program, it results in high free ridership. Of the projects evaluated which cited replacement of old equipment as a key decision influence[29], the NTG ratio averaged 0.51, with nearly half of such projects featuring NTG ratios ranging from 0.00 to 0.50.

In parallel, there are program-related factors and interventions that serve to **increase** the influence of the MPP:

- **In cases where high program influence was indicated, the incentives provided by NYSERDA were crucial to fulfilling project financial requirements.** Program incentives allowed payback or return-on-investment requirements to be met and also enabled the project scope to be expanded to include more measures.
- **The key value of the program-funded ERP was providing a reliable, unbiased source of energy- and cost-savings estimates.** While the ERP was often not a primary source of the idea for the

[29] As indicated by a score of 8, 9 or 10 in importance.

installed measures, it did provide valuable information on measure-specific savings estimates that was also key to decision-making.

4.5 PROGRAM NET SAVINGS

Given the M&V results presented in Section 4.1 and the NTG results presented in Section 4.4, the Impact Evaluation Team calculated the net savings attributable to the MPP. Program net savings represent the product of the program-reported savings, the RR, and the NTG ratio, as illustrated by the following formula:

$$\text{Program net savings} = \text{Program-reported savings} \times \text{RR} \times \text{NTG ratio}^{30}$$

Tables 4-9 and 4-10 present the program net electric, fossil fuel, and RGGI-funded greenhouse gas savings, respectively.

Table 4-9. MPP Impact Evaluation Electric Energy and Peak Demand Results, 2009–2011

Metric	Electric Energy (MWh)	Electric Peak Demand (kW)
A – Reported savings	80,426	7,695
B – RR	0.79	0.77
C – Evaluated gross savings (A × B)	63,536	5,925
D – NTG ratio[1, 2]	0.58	0.58
E – Evaluated net savings (C × D)	36,851	3,437
F – Relative precision of evaluated net savings at 90% confidence	8%	10%

[1] NTG ratio = 1 – 0.44 + 0.02 + 0.00 + 0.00 = 0.58

[2] NYSERDA's activity in the multifamily market may undergo changes per the New York State Public Service Commission's Clean Energy Fund (CEF) proceeding. As the extent or details of these changes are not yet known, the Impact Evaluation Team recommends that careful consideration is exercised when assessing the applicability of this study's results to future multifamily programs in New York State.

[30] NTG ratio = 1 – FR + ISO + OSO + NPSO.

FR = 0.44 (electric), 0.48 (fossil fuel)

ISO = 0.02 (electric), 0.03 (fossil fuel)

OSO = < 0.01 (electric, fossil fuel)

NPSO = << 0.01 (electric, fossil fuel)

Table 4-10. MPP Impact Evaluation Fossil Fuel Results – SBC and EEPS Funding, 2009–2011

Metric	Fossil Fuel Energy (MMBtu)
A – Reported savings	995,146
B – Performance factor[1]	0.60
C – Evaluated gross savings (A × B)	597,088
D – NTG ratio[2, 3]	0.55
E – Evaluated net savings (C × D)	328,398
F – Relative precision of evaluated net savings at 90% confidence	11%

[1] Since projects completed between 2009 and 2011 were primarily SBC-funded and targeted electric savings only, this table uses the term "performance factor" to distinguish from a "realization rate." Careful consideration must be taken when applying this impact evaluation's results to natural gas savings of later EEPS-funded projects.

[2] NTG ratio = 1 – 0.48 + 0.03 + 0.00 + 0.00 = 0.55

[3] NYSERDA's activity in the multifamily market may undergo changes per the New York State Public Service Commission's Clean Energy Fund (CEF) proceeding. As the extent or details of these changes are not yet known, the Impact Evaluation Team recommends that careful consideration is exercised when assessing the applicability of this study's results to future multifamily programs in New York State.

4.6 CONCLUSIONS AND RECOMMENDATIONS

This section concludes the impact evaluation study by revisiting the major M&V and attribution research findings and by recommending areas for Program improvement.

4.6.1 Conclusions

The Impact Evaluation Team analyzed the achieved electric and fossil fuel energy savings among a sample of 117 projects completed between 2009 and 2011. Additionally, through telephone surveys among participating and nonparticipating customers, the Impact Evaluation Team assessed the level of achieved savings attributable to the Program. These research activities resulted in the following eight significant findings:

1. **The MPP's unique program design is ambitious yet effective.** Projects in the evaluation population were designed to achieve 20% or greater source energy reduction through a suite of comprehensive measures affecting the facility's electric and fossil fuel consumption. The evaluators determined that projects are achieving a 17% source energy reduction on average. Though the ambitious goal was not met, this significant reduction in consumption is primarily attributable to the Program's thorough Simulation Guidelines and established network of qualified performance partners, leading to reasonable savings estimates for participating customers.

2. **The Program's savings tracking system featured fuel-specific inaccuracies for dual-fuel and fuel-switch projects.** Although most of the Program's projects during the evaluation time frame received funding for electric savings only, the evaluators determined fossil fuel savings tracking

inaccuracies for nearly a third of the M&V sample. The Program's current tracking system attributes each measure's fossil fuel savings to only the most affected fuel type (e.g., natural gas, various grades of fuel oil). Additionally, measures that affect more than one fuel type, such as a cogeneration system or a boiler fuel switch, often did not correctly report the measure's associated fuel penalty, leading to a substantial evaluated fuel penalty.

3. **The Program's Simulation Guidelines are mostly accurate, save for three measures.** The Program provides a comprehensive guidebook for training performance partners in the savings estimation of several measures offered by the Program. These guidelines ensure modeling accuracy as well as consistency among the 50+ partner firms certified by the Program. The evaluators believe this document's guidelines can be slightly improved by implementing three measure-specific updates to reflect this study's M&V findings:

    a. **Compact fluorescent lamps (CFLs)** – One of the Program's most popular measures during the evaluation time frame often featured lower-than-predicted installation rates, as indicated in program post-project inspection documentation. The Simulation Guidelines assume a 100% installation rate for CFL measures, whereas industry research[31] suggests an approximate 75% installation rate in residential settings due to CFL shelving or removal.

    b. **Cogeneration systems** – Combined heat and power (CHP) systems, though they are not covered in the Program's Simulation Guidelines and are usually not modeled in software, generally performed differently than expected in the Program's analysis spreadsheet template. CHP systems were often anticipated to recover the full domestic hot water (DHW) load at a multifamily facility, but the evaluators determined lower actual recovered waste heat for DHW heating, resulting in lower overall plant efficiency.

    c. **Submetering or direct metering** – The transfer of electric utility bill payment to tenants resulted in nearly double the amount of savings anticipated by the Program. The Program assumed an 8% reduction based on a previous internal study, but the evaluators' assessment of 13 projects in the M&V sample indicated a 15% reduction on average[32].

[31] "The Uniform Methods Project: Methods for Determining Energy Efficiency Savings for Specific Measures," National Renewable Energy Laboratory, February 2014. http://www.nrel.gov/extranet/ump/pdfs/20140514_ump_res_lighting_draft.pdf

[32] These additional savings are reflected in Table 4-2 in the "Difference in Equipment Operating Efficiency" category.

4. **Projects that receive an ERP but no incentives for measure installation result in significant energy savings likely attributable to the Program.** Though only investigative at this point, the Impact Evaluation Team's measure adoption rate (MAR) research through on-site verification indicates that ERP-only projects result in future measure installations with savings potentially claimable by the Program. The evaluators estimate these savings to be approximately 10%–15% of the source MMBtu savings in the 2009–2011 evaluation population. However, the evaluators did not perform statistical sampling, performance measurement, or attribution research for the 15 selected ERP-only projects; this level of rigor will be required for the Program to claim MAR savings in the future.

5. **With few exceptions, the NTG ratios for each analyzed segment (see Table 4-8) fall within the confidence bounds for the total weighted NTG ratios.** Therefore, the segment-specific results are generally not statistically different from the average values for the electric (NTG ratio = 0.58) and fossil fuel (NTG ratio = 0.55) sampling domains.

6. **A number of non-Program factors contribute to reducing the MPP's influence**. Given the complexities of the multifamily market in New York, the evaluators believe a significant amount of FR is to be expected. The most important contributors to MPP FR are as follows:

    a. **Many projects received funding from multiple sources.** The Program's incentive for the very largest projects, while often large in absolute dollars, represented a very small share of the total cost, thereby reducing the Program's overall influence on the project.

    b. **A high percentage of projects addressed replacement of old equipment.** This occurrence can be an important milestone for promoting new energy efficient equipment, as long as the decision-maker has not already made plans to purchase it on their own.

7. **Program interventions that are needed and appreciated by multifamily owners/managers help to increase Program NTG ratios**, notably the Program's incentive, which help to meet financial requirements, and the ERP, which provides an unbiased source of information on energy and cost savings to support project decision-making.

8. **Attribution research indicates that certain measures are already being adopted absent Program interventions.** Analysis of NTG ratios by measure category revealed much lower NTG ratios for certain types of measures, particularly for those commonly installed in Existing Building retrofit projects.

4.6.2 Program Recommendations

The principal goal of the assessment was to analyze the energy savings associated with the MPP projects completed between January 1, 2009 and December 31, 2011. During this effort, the Impact Evaluation Team also observed opportunities to improve program effectiveness and savings estimation in the future to hopefully narrow the variation in RRs and improve program attribution. The recommendations are as follows:

1. **Enhance the Program's savings tracking system to more robustly track fuel-specific savings by measure.** The Program's current tracking database is limited in tracking fuel-specific impacts for dual-fuel or fuel-switch projects. The evaluators recommend the creation of multiple fuel-specific savings fields for each project and measure within the Program's tracking database to better track fuel-specific savings and penalties for measures affecting more than one fuel type. For example, for a boiler fuel conversion measure, the savings would be attributed to the old fuel type, while the associated penalty would be tracked for the new fuel type, all in the same measure line item. Although the MPP's completed projects during 2009–2011 were primarily funded for electric savings only, the Program has transitioned into EEPS funding, which specifically targets natural gas savings. More careful measure-specific tracking of natural gas, fuel oil, and district steam impacts is crucial to ensure accurate quarterly reporting moving forward. The Impact Evaluation Team acknowledges that the Program has taken steps to more accurately estimate fuel impacts by measure, namely with the transition from TREAT to eQUEST modeling software. This recommendation would ensure that the Program's improved fuel-specific savings estimates are appropriately tracked and reported by measure.

2. **Broaden the role of utility bills in Program self-evaluation and performance prediction.** Currently, the Program collects pre-project utility consumption data for all applicants and post-project utility consumption data for the projects that apply for the performance payment a year after project completion. The Program has investigated past project performance through billing analysis. The evaluators recommend that this self-evaluation process continue and be expanded to include the projects that do not apply for the bonus incentive[33]. This broader analysis allows the Program to potentially identify specific measures, performance partners, modeling approaches, building types, or

[33] The Impact Evaluation Team acknowledges that this expanded self-evaluation would require additional effort from program staff to obtain, process, and analyze pre- and post-project utility bills. This process is estimated to take 4-6 hours per additional project on average.

locations that led to unexpected savings results. Real-time feedback (once post-project consumption data is available) could lead to actionable adjustments to optimize Program effectiveness as soon as possible.

With respect to attribution, the evaluators determined, through participant and non-participant survey responses, that certain types of measures were found to have higher FR, due largely to their becoming standard practice. Such measures included energy efficient cooling systems, boiler replacements and fuel conversions, and low-emissivity windows. To maximize the Program's impact going forward, the MPP should take steps to research and de-emphasize measures that have become standard practice, while instead promoting measures and higher-efficiency equipment that are less prevalent within the New York multifamily market. This shift in marketing and incentive strategy will benefit the Program not only in its current environment but also in future contexts under consideration in the ongoing Clean Energy Fund proceedings.

APPENDIX A: GLOSSARY OF TERMS[1]

appendix M[2] – An appendix to the New York Technical Manual (NYTM) that provides guidance to program administrators and evaluators for the use of early replacement baseline versus normal replacement baseline. Appendix M does not directly apply to most of the projects in this evaluation population; however, its guidance allows evaluators to define preexisting equipment as the evaluation baseline when appropriate.

applicant – The Impact Evaluation Team uses this generic term to describe the entity estimating each project's reported savings. In most MPP cases, the applicant reflects the performance partner representing the customer.

billing analysis – Estimation of program savings through the analysis of utility consumption records comparing consumption prior to program participation and following program participation. This term encompasses a variety of types of analysis, from simple pre/post comparison to complex regressions that involve weather normalization.

census – All individuals in a group. In evaluations of energy efficiency programs census typically refers to all projects in a stratum of program projects.

early replacement – The replacement of equipment before its effective useful life has been reached.

energy reduction plan (ERP) – The MPP's term for the technical assistance study submitted by the performance partner for each project. The ERP's overall objective is to introduce and quantify the energy efficiency measures by which the facility will reach the Program's energy reduction goal.

error ratio – In energy efficiency evaluation, the error ratio is a measure of the degree of variance between the reported savings estimates and the evaluated estimates. For a sample, the error ratio is:

$$er = \frac{\sqrt{\sum_{i=1}^{n} w_i \frac{e_i^2}{x_i^\gamma} \quad \sum_{i=1}^{n} w_i x_i^\gamma}}{\sum_{i=1}^{n} w_i y_i}$$

[1] NYSERDA generally follows and uses the terms as defined in the "Northeast Energy Efficiency Partnerships Glossary of Terms," found at http://neep.org/uploads/EMV%20Forum/EMV%20Products/EMV_Glossary_Terms_Acronyms.pdf. This glossary defines those terms absent from the Northeast Energy Efficiency Partnerships (NEEP) report or provides more specific definitions to generalized NEEP terms.

[2] Appendix M can be found at: http://www3.dps.ny.gov/W/PSCWeb.nsf/96f0fec0b45a3c6485257688006a701a/06f2fee55575bd8a852576e4006f9af7/$FILE/Appendix%20M%20final%205-05-2011.pdf

where,

n is the sample size

w_i is the population expansion weight associated with each sample point i

x_i is the program reported savings for each sample point i

y_i is the evaluated gross savings for each sample point i, the constant gamma, $\gamma = 0.8$ (typically), and the error for each sample point $e_i = y_i - bx_i$, where b is the program realization rate

evaluated gross savings – The change in energy consumption and/or demand that results directly from program-related actions taken by participants in an efficiency program, regardless of why they participated, as calculated by program evaluators.

evaluated net savings – The total change in load that is attributable to an energy efficiency program, as calculated by program evaluators. This change in load may include, implicitly or explicitly, the effects of free drivers, free riders, energy efficiency standards, changes in the level of energy service, and other causes of changes in energy consumption or demand.

free rider, free ridership (FR) – A free rider is a program participant who would have implemented the program measure or practice in the absence of the program. Free ridership refers to the percentage of savings attributed to customers who participate in an energy efficiency program but would have, at least to some degree, installed the same measure(s) on their own if the program had not been available.

IPMVP Option A – This M&V option involves the partial measurement of isolated equipment affected by the evaluated measure. Relevant equipment variables are spot-measured when possible or stipulated when necessary.

IPMVP Option B – This M&V option involves full measurement of the isolated equipment affected by the evaluated measure. No stipulations are allowed. Both short-term and continuous data monitoring are included under Option B.

IPMVP Option C – This M&V option involves the use of utility meters to assess the performance of a total building. Option C addresses measure impacts in aggregate, not individually, if the affected equipment is connected to the same meter.

IPMVP Option D – This M&V option involves the use of computer modeling to determine facility or equipment energy use. Option D requires calibration with actual utility consumption data for either the pre-project or post-project period.

measure adoption rate (MAR) – A ratio that quantifies the percentage of energy reduction plan-recommended savings that customers chose to adopt after the MPP had ceased involvement in the project.

net to gross (NTG) – NTG is the relationship between net energy and/or demand savings – where net is measured as what would have occurred without the program or what would have occurred naturally – and gross savings (often evaluated savings). The NTG ratio is a factor represented as the ratio of net savings actually attributable to the program divided by program gross savings. For NYSERDA programs the NTG ratio is defined as 1 minus free ridership plus spillover.

New York Technical Manual (NYTM) – An abbreviation of New York State's 2010 measure savings guidance document, "New York Standard Approach for Estimating Energy Savings from Energy Efficiency Programs."[3]

nonparticipants/nonparticipating – Any customer or contractor who was eligible but did not participate in the program under consideration. Nonparticipating contractors can include (1) contractors that have never participated in the program and (2) contractors that formerly participated, prior to the year(s) being evaluated, but have not participated since.

normal replacement – The replacement of equipment that has reached or passed the end of its measure-prescribed energy useful life.

performance factor – A term used in place of realization rate to denote that the Impact Evaluation Team does not recommend the application of this factor during future program reporting. In this study, the term "performance factor" is associated with ancillary fossil fuel impacts as well as any supplemental analysis findings for which statistical significance was not planned to be achieved.

performance partner – The program-approved sponsor who initiates the development and guides the progress of each of the Program's projects. Performance partners include builders, construction experts, developers, and HVAC contractors. Partners are responsible for the development of the project's energy reduction plan and the progression through subsequent incentive payment milestones.

population expansion weight – The total number of units in a population divided by the number of units in the sample.

---

3 http://www3.dps.ny.gov/W/PSCWeb.nsf/96f0fec0b45a3c6485257688006a701a/766a83dce56eca35852576da006d79a7/$FILE/TechManualNYRevised10-15-10.pdf

realization rate (RR) – The ratio of the evaluated gross savings to the Program's reported savings. The RR represents the percentage of program-estimated savings that the evaluator estimates as being actually achieved based on the results of the evaluation M&V analysis. The RR calculation for electric energy for a sampled project is shown below:

$$RR = \frac{kWh_{evaluation}}{kWh_{program}}$$

where,

RR is the realization rate

$kWh_{evaluation}$ is the evaluation M&V kWh savings (by evaluation M&V contractor)

$kWh_{program}$ is the kWh savings claimed by program

relative precision – Relative precision reflects the variation due to sampling as compared to the magnitude of the mean of the variable being estimated. It is a normalized expression of a sample's standard deviation from its mean. It represents only sampling precision, which is one of the contributors to reliability and rigor, and should be used solely in the context of sampling precision when discussing evaluation results.

Relative precision is calculated as shown below. It must be expressed for a specified confidence level. The relative precision (*rp*) of an estimate at 90% confidence is given below:

$$rp = 1.645 \ \frac{sd(\mu)}{\mu}$$

where,

μ is the mean of the variable of interest

sd(μ) is the standard deviation of μ

1.645 is the *z* critical value for the 90% confidence interval

For the 90% confidence interval, the error bound is set at 1.645 standard deviations from the mean. The magnitude of the *z* critical value varies depending on the level of confidence required.

Simulation Guidelines – The MPP provides this document to its performance partners to assist them in developing the building energy model presented in each energy reduction plan. This document ensures consistency in parameter assumptions and modeling techniques across a number of multifamily systems, including HVAC, building envelope, lighting, DHW, and tenant loads.

spillover (SO) – Refers to the energy savings associated with energy efficient equipment installed by consumers who were influenced by an energy efficiency program, but without direct financial or technical assistance from the program. SO includes additional actions taken by a program participant as well as actions undertaken by nonparticipants who have been influenced by the program. Sometimes SO is referred as "market effects." Market effects are program-induced impacts or program-induced changes in the market over time. These market effects may be current or may occur after a program ends. When market effects occur after a program ends, they are referred to as "momentum" effects or as "post-program market effects." SO is often a narrower definition because it does not include impacts that accrue due to program-induced market structure change and seldom looks for effects that occur well after program intervention or effects that occur after a program ends. This evaluation addresses participant inside spillover, participant outside spillover, and nonparticipant spillover, but not the broader definition of program effects within market effects.

inside spillover (ISO) - Occurs when, due to the project, additional actions are taken to reduce energy use at the same site, but are not included as program savings, such as when, due to the program, participants add efficiency measures to the same building where program measures were installed, but they did not participate in the program for these measures.

outside spillover (OSO) - Occurs when an actor participating in the program initiates additional actions that reduce energy use at other sites that are not participating in the program. This can occur when a firm installs energy efficiency measures they learned about through the program at another of their sites without having that other site participate in a NYSERDA program. OSO is also generated when participating vendors install or sell energy efficiency to nonparticipating sites because of their experience with the program.[4]

nonparticipant spillover (NPSO) - The reduction in energy consumption and/or demand from measures installed and actions taken at nonparticipating sites due to the program's existence but not due to participation in the program and not induced by program participants – either building owners/managers or program performance partners. These actions could be due to program-induced decision-making of nonparticipating building owners or encouragement of nonparticipating vendors or contractors because of program influence.

stratified ratio estimator (SRE) – An efficient sampling design combining stratified sample design with a ratio estimator. It's most advantageous when the population has a large coefficient of variation,

[4] This definition is one that NYSERDA has used throughout its history with energy efficiency programs. There may be other states where the latter circumstance of participating vendors influencing nonparticipating sites is defined as a type of nonparticipant spillover.

which occurs, for example, when a substantial portion of the projects have small savings, and a small number of projects have very large savings. The ratio estimator uses supporting information for each unit of the population when this information is highly correlated with the desired estimate to be derived from the evaluation, such as the tracking savings and the evaluated savings.

summer coincident peak demand period – For this evaluation, the Impact Evaluation Team defined the summer coincident peak demand period as the energy reduction during the hottest non-holiday summer (June through August) weekday during the hour ending at 5 p.m. While this definition is consistent with the NYTM, that document was not published until 2010; therefore, program-reported savings for projects in the evaluation population might reflect a different summer coincident peak demand definition.

trade ally – A business that plays a role in the development and/or implementation of program-qualifying energy efficiency projects. Such businesses are either developed through the program or outside of the program on the customer's own initiative. These trade allies include energy auditing firms (including the program's performance partner participants), architect/engineering firms, contractors, and equipment vendors.

APPENDIX B: MPP EVALUATION BASELINE FRAMEWORK

The Multifamily Performance Program, by design, targets a reduction in the facility's pre-project energy consumption. Therefore, in almost all MPP retrofit projects, the preexisting conditions serve as the project baseline. The program's baseline framework, along with its holistic approach that includes many interactive measures, poses a challenge to determining true evaluation baseline and M&V savings for sampled projects.

In preparation of this evaluation baseline framework, the Impact Evaluation Team examined several DPS documents regarding baseline, early replacement, normal replacement, and the applicability to multifamily equipment. Although the DPS documents discussed below were published after the evaluated projects were applied for and completed, and thus do not directly apply to the projects included in this evaluation's population, the Impact Evaluation Team referenced these documents for valuable baseline guidance.

The New York Technical Manual's (NYTM's) Appendix M[1] outlines a process for determining the appropriate dual baseline weighting for savings calculations over the life of the early replacement measure. However, this evaluation focuses on first-year savings only. Follow-up orders to the NYTM and Appendix M were released in 2010 and 2011, respectively. Therefore, these documents do not directly apply to many of the projects included in this evaluation's population. However, the evaluators referenced these documents' valuable baseline guidance on multifamily central equipment that allowed evaluators to define preexisting equipment as the evaluation baseline when appropriate. A follow-up order to the NYTM, issued October 18, 2010,[2] addresses the "special circumstances" for which an early replacement baseline might be considered even for replacement of multifamily central equipment that has exceeded energy useful life (EUL). According to the order:

> *Special circumstance replacements relate only to commercial and industrial machinery and multifamily central systems, but not to lighting equipment. . . . Special circumstance replacements would typically address equipment operated by customers which are influenced by initial costs more than by life cycle economics, customers lacking capital, customers with split incentives (such as landlord cost for tenant benefit), customers with short time horizons, and other factors*

[1] "Appendix M: Guidelines for Early Replacement Conditions," effective January 1, 2011. http://www3.dps.ny.gov/W/PSCWeb.nsf/96f0fec0b45a3c6485257688006a701a/06f2fee55575bd8a852576e4006f9af7/$FILE/Appendix%20M%20final%205-05-2011.pdf

[2] Case 07-M-0548, Energy Efficiency Portfolio Standard (EEPS), Order Approving Consolidation and Revision of Technical Manuals (issued October 18,2010). http://documents.dps.ny.gov/public/Common/ViewDoc.aspx?DocRefId=%7B90EF3CB5-16EC-4141-B25F-C19937351402%7D

which tend to prevent long range economic decision-making with regard to the installation of high efficiency equipment . . . the general outline of criteria regarding the equipment in place to be determined onsite will be:

- *Equipment age significantly exceeds its effective-useful-life;*
- *Energy consumption significantly exceeds that of current high efficiency models;*
- *There is a history of significant repair or replacement with used equipment; and*
- *The prospective next repair or replacement is likely to initially be much less expensive than replacement with new higher efficiency machinery.*

Equipment fitting these criteria would be subject to a form of dual baseline TRC screening which will reflect the concept that the equipment, while past its effective-useful-life, would likely operate for several additional years, and will allow energy savings for that period to be calculated against the in-place equipment. Under this approach, first year savings would be reported as the difference between the existing equipment's electric usage and that of the high efficiency equipment which replaces it.

The DPS baseline guidance on multifamily central equipment was used to define preexisting equipment as the evaluation baseline when deemed appropriate. This was accomplished by the evaluation engineers asking a series of questions while on-site to determine whether or not the replaced equipment had reached the end of its life. The site-specific evaluation survey was intended to confirm (or, in a few cases, disprove) the Program's early replacement claim. The question battery included the following:

B1. How old was the preexisting equipment? Provide estimate/range if unknown.

B2. Was the preexisting equipment operable at the time of equipment replacement? *If no, skip to B8.*

B3. Were any equipment components replaced in the past ten years (e.g., boiler burner)?

B4. Were any major patches required to keep the equipment operable over the past ten years?

B5. How often was the equipment inspected or recommissioned in the preexisting configuration?

B6. Please describe the maintenance procedure for the preexisting equipment.

B7. Please estimate how long the preexisting equipment would have operated had it not been replaced as a result of the project?

End.

B8. Please describe the performance issues with the preexisting equipment.

B9. If the equipment had not been replaced as a result of the project, would you have repaired the preexisting equipment to prolong its life?

End.

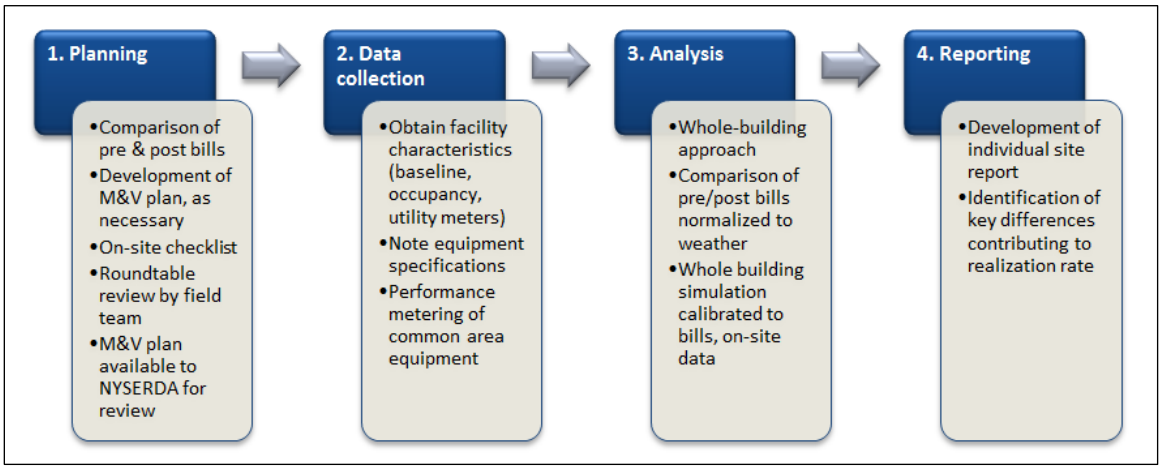
After considering responses to the questions, reviewing the application materials,[3] accounting for the Appendix M special circumstances applicability and overall framework, the engineer judged whether the replaced equipment was replaced early or at the end of its life.

[3] The MPP application materials contain unusually good data on the age of removed equipment.

APPENDIX C: M&V METHODOLOGY AND LEVELS OF RIGOR

This appendix provides more information on the project-specific measurement and verification (M&V) approach applied by the Impact Evaluation Team. Additionally, the methodologies for notable M&V concepts such as summer coincident peak demand savings calculation and in-unit measure approach are explained in more detail. The general planning, data collection, and analysis approach for each sampled M&V project is summarized in Figure C-1 and as follows:

Figure C-1. Site-Specific Progression for MPP M&V Sample



1. **Planning** – Before the on-site visit, the evaluators completed a preliminary analysis of pre/post utility consumption data and/or drafted an M&V plan for each sampled project.

2. **Data collection** – During each site visit, the evaluators collected information on facility characteristics, such as occupancy, utility meter configuration, and fuel-specific end uses. When incented equipment was safely accessible, the evaluators deployed metering equipment on energy-consuming systems relevant to whole-project analysis. For measures affecting a large quantity of equipment (e.g., the replacement of 200 lighting fixtures in hallways and stairwells), the evaluators selected a random sample proportional to equipment size at a confidence/precision similar to previous NYSERDA program impact evaluations. The measurement of in-unit (tenant) equipment was not included in the scope of this evaluation.

3. **Analysis –** The evaluators assessed each project's comprehensive, fuel-specific impacts using data collected on-site, information from the Program's project files, and equipment-specific metered data. For non-billing analysis projects, the utility bills were used to calibrate the building model or spreadsheet analysis. Each analysis featured weather normalization and a true-up to occupancy fluctuations and/or other projects affecting facility energy consumption, if applicable.

4. **Reporting** –Evaluators analyzed the key drivers influencing the electric realization rates and fossil fuel. Each project's analysis methodology and findings were detailed in site-specific M&V reports.

USE OF UTILITY CONSUMPTION DATA

To enhance the evaluation analysis with real-world performance data, the evaluators requested at least 12 months of utility bills at the facility after project completion. A two-pronged request with the utilities as well as with the customers themselves resulted in greater-than-anticipated availability of utility consumption data, which was mainly used in one of two ways:

1. **Billing analysis** – Evaluators compared at least 12 months of pre- and post-project monthly consumption data to determine comprehensive project impacts. The evaluators' data collection provided information on occupancy fluctuations or other equipment additions or removals that might affect facility usage. The monthly data was adjusted as needed to ensure a fair comparison resulting in appropriate project impacts by fuel.
2. **Model calibration** – For projects with insufficient utility consumption data to allow billing analysis, or for new construction projects, the evaluators used pre- or post-project monthly consumption data to calibrate the building energy model with actual facility conditions.

To account for year-to-year fluctuations in weather, evaluators incorporated weather normalization into all analysis methods. Specifically, historic facility consumption data was correlated with historic National Oceanic and Atmospheric Administration (NOAA) weather and extrapolated with typical meteorological year (TMY) weather to ensure that year-to-year variance in weather patterns did not affect the evaluated project impacts.

SUMMER COINCIDENT PEAK DEMAND CALCULATION

The evaluation M&V approach reflected the Program's whole-building design and therefore resulted in the calculation of facility-wide monthly electric energy savings. Information on specific equipment performance during the summer peak period was often not obtainable due to metering limitations and/or broad project scope. Therefore, for all whole-building approaches including billing analyses and models, the evaluators applied a systemic method of estimating peak demand savings based on the facility's summer electric energy savings and information about the measures intended to save during the peak period.

The NYTM defines the summer coincident peak hour as the hottest non-holiday summer (June, July, and August) weekday during the hour ending at 5:00 p.m. Evaluators first analyzed the facility's electric energy savings during these months. After identifying the equipment with expected summer peak demand savings,

the evaluators referenced the NYTM factors translating measure-specific energy savings into estimated peak demand savings. These factors include equipment full-load hours (FLH), peak coincidence factor (CF), and various HVAC interactive factors. Measure-specific peak demand savings were summed to determine evaluated project-level summer peak demand savings.

IN-UNIT MEASURE APPROACH

In-unit, tenant-controlled measures account for 23% of the evaluation population's total electric energy savings. Due to the relative savings and increased logistical challenge of metering a sample of in-unit equipment at each facility, the evaluators applied a verification-only approach for in-unit measures, which include compact fluorescent lights (CFLs), showerheads, and refrigerators.

During each site visit, evaluators requested to verify installed equipment within vacant units or occupied units (with tenant permission). This verification was used to corroborate or revise the findings from the post-project inspection performed by Program contractors during incentive approval phase(s). Evaluators understand that the presence or operability of incented equipment within the tenant unit can fluctuate in the years between project completion and the evaluation inspection. Therefore, the Program inspection documentation often provided a starting point for evaluators when investigating the performance of in-unit measures.

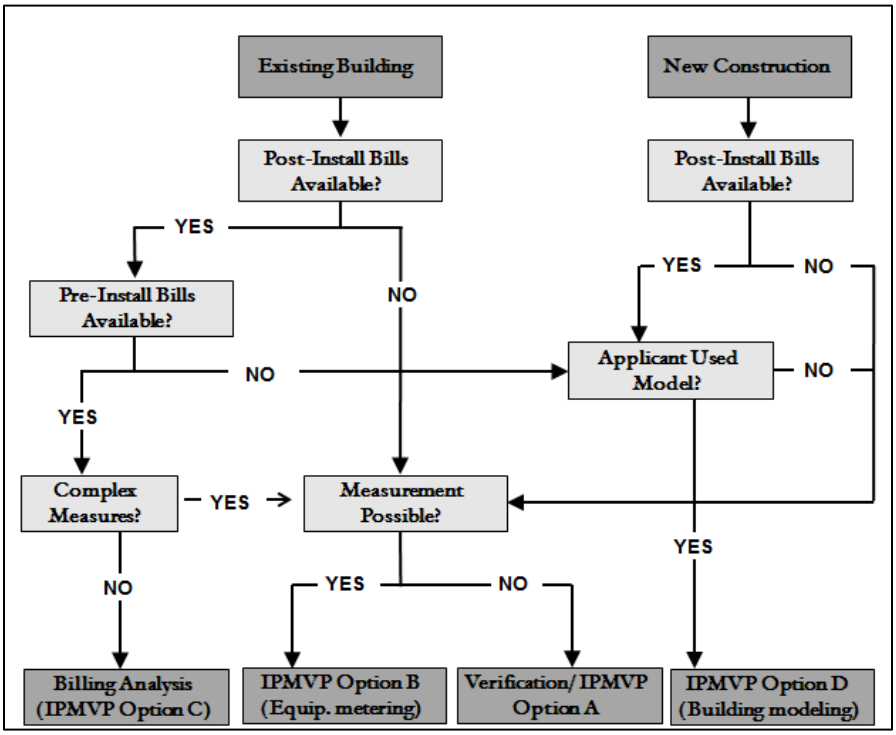
Since evaluators did not install metering devices on in-unit equipment, industry-standard performance metrics were referenced when calculating in-unit measure savings. The evaluators cited two main sources for such metrics:

1. **New York Technical Manual (NYTM)** – Provided information on annual operating hours and coincidence factor for CFLs, showerheads, refrigerators, and window air conditioners.
2. **ENERGY STAR** – Provided information on refrigerator annual energy consumption by make/model, as well as consumption information for federal standard equipment at the time of project application.

LEVELS OF RIGOR

The Impact Evaluation Team employed the most appropriate of four possible M&V methods based on data availability, equipment accessibility, and complexity of measures. Figure C-2 illustrates the method by which sites were assigned a level of rigor by availability of utility bills and applicant models and by measurability of installed equipment.

Figure C-2. Method for Assignment of Rigor for MPP



A discussion on allocating appropriate levels of rigor for both existing buildings (retrofits) and new construction projects is below.

Existing Buildings

For existing building projects with sufficient consumption data, engineers estimated savings primarily from site-specific pre/post weather- and occupancy-normalized billing analysis of participants' energy use. The billing analysis involved both common-area electric and fossil fuel data and samples of unit-electric data. When this type of analysis was not possible, the engineer performed either building simulation models, retrofit isolation M&V, or verification.

New Construction Buildings

New construction program-reported savings estimates generally are based on computer modeling of code-defined baseline and program-supported design conditions. On-site M&V of a statistically representative sample of sites using a combination of modeling, metering, and utility data calibration in the analysis is the best method for determining the evaluated savings. As is common for new construction projects, the program defines the New York State Energy Conservation Construction (NYSECC) code as the baseline in order to qualify a project and establish incentive levels. Due to the inherent uncertainty in determining new construction project baseline conditions, program-reported savings estimates have greater engineering

uncertainty and potential for bias than existing buildings savings estimates, even when the program funds independent analysis using advanced techniques.

The Impact Evaluation Team used a combination of modeling, metering, and utility data calibration to determine the realization rates for a representative sample of new construction projects. In all 13 new construction projects in the M&V sample, the evaluators obtained sufficient post-project monthly utility data with which to calibrate the whole-building model. A model representative of each measure's energy code requirements was also created, representing the evaluation baseline. The difference in annual consumption between the two models is defined as the evaluated project savings.

APPENDIX D: DETAILED NET-TO-GROSS METHODS

This appendix complements Sections 3.6 and 3.7 by providing a more detailed overview of the Impact Evaluation Team's attribution methodology.

FREE-RIDERSHIP ANALYSIS BY PROJECT TYPE

The evaluators' approach to calculating free ridership varied by project size and complexity. The most detailed level of analysis, the **Standard – Very Large Project NTGR**, is applied to the largest and most complex projects (representing 10% to 20% of the total sample) with the greatest program-reported savings. The **Standard NTGR**, involving a somewhat less detailed level of analysis, is applied to projects with medium to high levels of program-reported savings. The least detailed analysis, the **Basic NTGR**, is applied to all remaining projects. At the inception of the MPP impact evaluation, the population of completed projects was reviewed and sampled projects were classified according to each of these thresholds. Projects with incentives of $500,000 and greater were assigned to the **Standard – Very Large Project NTGR**, those with incentives ranging from $200,000 to $500,000 were classified as **Standard NTGR** projects, and all other projects with incentives below $200,000 were considered **Basic NTGR** projects.

FREE RIDERSHIP SCORING ALGORITHM

The evaluators quantified each sampled project's free ridership based on an algorithm comprised of three scores, each based on responses to participant survey questions.

Score 1

Score 1 is based on responses by the decision maker regarding how important the Program was in influencing their decision as well as other factors. The decision maker was asked to rate the following on a 0-to-10 scale, where 0 means "not at all important" and 10 means "very important."

- The age or condition of the old equipment (if applicable)
- Availability of incentives through the Program
- The Energy Reduction Plan provided by the Program
- Previous experience or prior success with this type of project
- Previous experience or prior success with the Program
- Non-energy benefits (examples: occupant comfort, improved habitability)
- Payback on the investment
- Reduced energy use and costs
- Benchmarking of buildings

- Training provided by the Program
- Recommendation from performance partner
- Recommendation from an equipment supplier or manufacturer (if a score of greater than 5 is given, a trade ally interview was triggered.)
- Information provided by another energy efficiency information source
- Standard practice of the business
- Corporate policy or guidelines
- Compliance with normal maintenance or equipment replacement policies
- Other reasons for upgrading to energy efficient equipment

Trade allies (if an interview is triggered) were also asked similar questions regarding their decision to recommend the MPP to the customer, and a score (termed "VMAX") was calculated.

Score 1 was calculated as the highest Program influence score divided by the sum of the highest Program influences plus the highest non-Program influence score, multiplied by 10.

If the trade ally interview was triggered, the VMAX score was multiplied by the score the decision maker assigned to the trade ally recommendation.

Score 2

Score 2 is based on questions surrounding whether the participant learned about the MPP before or after a decision was made to implement a particular measure and how important the Program was in relation to other influencing factors, including installed equipment efficiency levels. Score 2 was calculated as the importance of the Program, on a 0-to-10 scale, and then reduced by half if the respondent learned about the Program after the decision had been made. For example, if the respondent assigned a Program importance score of 8, but revealed that they had already made their decision to upgrade to energy efficient equipment prior to learning about the MPP, this score would be reduced by half to 4. Had they revealed they had known about the MPP before making their decision, the original score of 8 would stand.

Score 3

Score 3 investigates what the decision maker would have installed in the absence of the Program. Score 3 was calculated as 10 minus the likelihood of installing the same equipment multiplied by 1 minus the deferred net-to-gross (NTG) timing fraction associated with the timing of that installation.

Score 3 = 10 - Likelihood × (1 - NTG timing fraction)

The net-to-gross timing fraction was set at 25% for one year of equipment replacement deferral (i.e., facility management would have independently replaced equipment one year later than the MPP project), 50% for two years of replacement deferral, 75% for three years of replacement deferral, and 100% for four or more years of replacement deferral. These values have been used in other jurisdictions[1] and provide a sliding scale where the Program gets less credit for shorter deferral periods (three years and less) and full credit for longer periods of four or more years.

SPILLOVER PROCEDURE

During participant and nonparticipant telephone interviews, the Impact Evaluation Team investigated the savings associated with measure installations not incented by the Program. In order to identify and quantify potential inside spillover (ISO), outside spillover (OSO), and nonparticipant spillover (NPSO), the evaluators asked the following questions to decision makers for each implemented measure:

- Whether the facility implemented additional energy efficiency measures beyond those that were directly recommended or incented by the Program.
- Detailed information on each measure, including the size, efficiency, and quantity.
- How important the Program was, on a 0-to-10 scale, in influencing the decision to install these measures at the specific facility.
- Whether the owner/manager firm installed additional energy efficiency measures at other facilities without receiving direct support from the Program.
- How important the Program was, on a 0-to-10 scale, in influencing the decision to install these additional measures at other facilities.
- The savings (in dollars, kWh, therms, or percentage terms) expected from measures installed at other facilities.

This battery was repeated for the top three incented energy-saving measures at each participating location in the attribution sample. For spillover (SO) measures identified at those sites reporting both the largest SO opportunities and a high level of MPP influence on these installations, the evaluation engineers conducted in-depth, follow-up telephone interviews to further quantify the SO attributable to MPP.

BASELINE DEVELOPMENT FOR FUTURE MARKET EFFECTS STUDIES

The approach taken in this evaluation was to develop a basis for setting metrics for eventual measurement of the energy impacts due to Program-related market effects, via the use of particular survey questions in

[1] Example jurisdictions and utilities that have adopted similar approaches, along with links to their evaluation report databases, are: Wisconsin (https://focusonenergy.com/about/evaluation-reports), Illinois (http://www.ilsag.info/evaluation-documents.html), and Consolidated Edison of New York (http://www.coned.com/energyefficiency/program_evaluation_reports.asp).

the nonparticipating customer and nonparticipating market actor surveys. These questions focused on the following preexisting baseline behaviors (i.e., those occurring outside of NYSERDA's programs) by firms involved in the multifamily market:

- Adopted internal policies and practices related to energy use
- Reliance on outside firms to provide energy efficiency advice and planning, both currently and in the future
- Sources of information on new energy-using equipment for multifamily buildings
- Use of a comprehensive approach to building efficiency, including energy modeling
- Preexisting goal of LEED certification in rehabilitation and new construction projects
- Frequency of renovating major multifamily building systems (lighting, HVAC)

The intent is to repeat these questions in surveys in future evaluations of the Program. The trends discerned, along with other information, will provide a solid foundation for documenting market effects and quantifying the consequent energy savings attributable to the MPP.

APPENDIX E: PARTICIPANT ATTRIBUTION SURVEY

This appendix provides a copy of the participating owner/manager attribution survey. Trade ally survey questions, to assess nonparticipant spillover, were incorporated into the Process Evaluation Team's surveys administered in November 2013.

PARTICIPATING PROPERTY OWNERS/MANAGERS – PROFESSIONAL INTERVIEW GUIDE

Introduction/Screening

Hello. This is _____ calling from Itron, on behalf of the New York State Energy Research and Development Authority, NYSERDA. May I please speak with <*PROGRAM CONTACT*>?

(WHEN RESPONDENT COMES ON THE LINE) Hello. This is _____ calling from Itron, on behalf of the New York State Energy Research and Development Authority. I am calling to learn about your recent energy efficiency improvements and your experience with the NYSERDA energy efficiency program at your multifamily property.

Our records show that an Energy Reduction Plan was developed by your Multifamily Partner *(PARTNER)* for your property during the past three years. Shortly after that you purchased and installed a number of energy efficiency measures in your multifamily property, and received an incentive from NYSERDA. We are calling to do a follow-up study about your participation in NYSERDA's program, which is called the Multifamily Performance Program. Throughout the remainder of the survey, we will refer to the Multifamily program as the MPP program, and to the New York State Energy Research and Development Authority as NYSERDA.

Our firm is conducting research for NYSERDA. The information you provide will be used to improve NYSERDA's programs and will be kept confidential to the extent permitted by law.

SC1. Are you the person most knowledgeable about the decision to participate in the program? *[IF NOT, ASK TO BE TRANSFERRED TO MOST KNOWLEDGEABLE PERSON OR RECORD NAME & NUMBER.]*

IF YES, CONTINUE. IF NO, ASK TO SPEAK TO THE PERSON WHO WAS MOST INVOLVED WITH THE DECISION TO IMPLEMENT THE PROJECT, THEN CONTINUE. IF THAT PERSON HAS LEFT THE COMPANY, ASK FOR THEIR NEW CONTACT INFORMATION. IF THEY DECLINE, THEN THANK AND TERMINATE.

SC2 What was your specific role in the project?

Our firm is conducting research for NYSERDA. The information you provide will be used to improve NYSERDA's programs and will be kept confidential to the extent permitted by law.

This survey will take about 60 minutes. *[If no, schedule call-back]*

Is now a good time?

Screener for Address

SC2 Our records show your multifamily property is located at *[ADDRESS]* in *[CITY]*. Is that correct? *[CONTINUE IF ADDRESS REPORTED BY RESPONDENT IS SIMILAR ENOUGH, SUCH AS MATCHING STREET NAME AND/OR MATCHING STREET NAME AND BUILDING NUMBER IS IN SAME BLOCK]*

Comment: The questions in this survey will refer to your "property," which means ALL of the buildings and tenants located at *[ADDRESS]* in *[CITY]*.

Property Manager and Site Characteristics

Now, I'd like to get some background information about you and the multifamily property at *[ADDRESS] [City]*.

SC3a. What is your position or job title?

SC3b. How many years have you been in the business of multifamily property ownership and/or multifamily property management?

SC3c. Have these multifamily buildings at *ADDRESS* been fully occupied during the last 24 months?

1 Yes

2 No

SC3cc. *[IF SC3c = NO, THEN ASK]* What is the <u>average</u> percentage the units have been occupied during the last two years?

SC3d. Are any of the following tenant costs covered in YOUR bill? *[READ EACH] [DO NOT READ: As opposed to costs the tenant pays directly to the energy services provider.]*

SC3d1. Tenant space cooling

1 Yes

2 No

SC3d2 Heating

1 Yes

2 No

SC3d3. Hot water heating

1 Yes

2 No

SC3d4. About how many dwelling units are located in the building or buildings at this multifamily property?

Comment: Now I have a few broad questions about your organization. *[IF NEEDED: By "organization," I mean all of the buildings owned and managed by your firm, and not just those involved in this particular project.]*

SC3e. Is your organization a for-profit company, a nonprofit, a government agency, or something else?

SC3f. Thinking of your multi-unit properties that are five or more units in New York State, do you or your firm only own property, only manage property, or do you both own and manage property? (Select all that apply)

SC3f1. How many <u>total</u> apartment units are there in the buildings that you own, manage only, or own and manage?

SC3f2 And what percentage of those units that you just mentioned have subsidized rents or are occupied by households that qualify for fuel assistance?

SC3g. Excluding the property at *[ADDRESS]* in *[CITY]*, what percentage of the units you own are eligible for the NYSERDA MPP program? *[READ, IF NEEDED: i.e., what percentage is served by an investor-owned utility in NY State, such as Con Ed, NYSEG, Orange and Rockland, Rochester Gas and Electric, etc.?]*

SC3h. What percentage of your multifamily units eligible for NYSERDA's MPP program have participated in NYSERDA's Multifamily Energy Efficiency initiatives since May 2007?

Process Questions

Next, I would like to ask you a few questions about your overall experience participating in the MPP program.

If [EXISTING BUILDING] then ask, else P2

P1 Which of the following best describes the situation at your multifamily building(s) before starting your MPP project at *[ADDRESS] [City]*. Were you... *[READ and select one]*

1 Planning a renovation

2 Just starting a renovation

3 Not planning a renovation but thinking about ways to reduce energy costs

4 Not planning a renovation or thinking about ways to reduce energy costs

Other**:**

P1a In general, how often do you renovate the common areas of your building?

P2 Before starting this project did you know about NYSERDA's MPP program opportunities or did a program representative, such as a Multifamily Program Partner, introduce the program to you?

P3 What do you believe the MPP program's primary strengths are?

P4 What concerns do you have about the MPP program, if any?

P5 On a scale of 0 to 10, where 0 is completely dissatisfied and 10 is completely satisfied, how would you rate your OVERALL satisfaction with the MPP program?

Future Participation

P6. And thinking about the future, based on your experience with this project, how likely are you to initiate another MPP project? Would you say you are:

1 Not at all likely

2 Somewhat likely, or

3 Very likely to participate in another MPP project

4 Not applicable: e.g., not thinking about it one way or the other

IF P6=1, THEN ASK, ELSE P7.

P6aa. Why are you unlikely to initiate another MPP project in the future?

Program Services Received

P7. *[IF GJGNY LOAN = 1, THEN ASK]* Our records show that you received a loan through NYSERDA's Green Jobs Green New York in addition to the incentive. How did this loan influence your decision making on this project?

P8. *[IF NO GJGNY LOAN, THEN ASK]* If you had known that you could have borrowed money for your project through the NYSERDA GJGNY loan fund at half the interest rate you would normally qualify for, would you have taken advantage of it?

1 Yes

2 No

Measure Loop

[ASK ALL]

B11. The project that I will be interviewing you on involved *[read description of project based on the three largest measures]* Note that we are focusing today on the three largest energy savings measures, and not all of the measure that were implemented. Was there a single decision that led to your approval of all three of these measures, or were there multiple decisions?

1 Single decision

2 Multiple decisions

B11a. *[IF B11 = MULTIPLE DECISIONS, THEN ASK]* Can you please describe each decision involved and which measures were associated with each. This will help us to determine how to approach the interview.

*[DO NOT READ: The focus on this inquiry is each separate **decision** made by the customer, whether at the measure level, building level, or project level (i.e., with multiple measures). The variable "project" is synonymous with "decision" in this regard. The baseline equipment questions and NTG loop are repeated for each separate decision indicated by the respondent.]*

Baseline equipment

B1. Did <*PROJECT*> replace existing equipment or was this entirely new equipment?

1 Replaced existing equipment

2 New (additional) equipment

B2. Was the equipment that was replaced working when you removed it?

1 Yes

2 No

NTG/Free Ridership Loop

These next few questions are specifically about the energy efficient <*PROJECT*> that was installed in the common areas of your multifamily building.

Project Background

BB1. Has your organization installed similar types of <*%PROJECTS*> at this location in the past?

1 Yes

2 No

BB2. In deciding to do a <*PROJECT*> of this type, there are usually a number of reasons why it may be undertaken. Can you tell me why your organization decided to implement this <*PROJECT*>*? [DO NOT READ; ACCEPT MULTIPLES]*

1 To replace old or outdated equipment

2 As part of a planned remodeling, build-out, or expansion

3 To get an incentive from the program

4 To protect the environment

5 To reduce energy costs

6 To reduce energy use/power outages

7 To update to the latest technology

8 *[IF VERSION =2]* To reach the 15% minimum savings threshold

9 *[IF VERSION =1]* To reach the 20% minimum savings threshold

Other *[RECORD VERBATIM]*

History with Program Partner

BB3. Did you have an existing relationship with <*PARTNER*> before you decided to undertake this <*PROJECT*>?

1 Yes

2 No

BB4. How did you find <*PARTNER*>?

BB5. Was <*PROJECT*> introduced by <*PARTNER*>?

1 Yes

2 No

BB5a. *[IF BB5=2,88,99 THEN ASK]* Who or what was the source of the idea for this project?

BB6. Did you decide to install this <*PROJECT*> before or after you started working with <*PARTNER*> or some other trade ally?

1 Before

2 After

Other**:**

BB7. Your Program Partner provided you with an Energy Reduction Plan that recommended specific measures to install and the energy savings associated with those measures. However, you may have also had your own ideas and information. On a scale of 0 to 10, where 0 represents none of the information and 10 represents all of the information, how much of that information came from you as opposed to coming from your Partner?

Record 0-to-10 rating (_____)

BB8. Were measures that weren't your idea installed in order to reach the minimum *[IF VERSION1: 20%] [IF VERSION2]*: 15% threshold for savings? *[IF VERSION1: Twenty percent is the minimum savings level required by the MPP program to qualify for an incentive payment.] [IF VERSION2: Fifteen percent is the minimum savings level required by the MPP program to qualify for an incentive payment.]*

1 Yes

2 No

BB8a. *(IF BB8 = 1)* What were those measures?

BB8b. When were they installed?

Access to Information

BB9. Before your firm's first involvement in a NYSERDA program, did you have a source for energy saving information?

1 Yes

2 No

BB9a. *(IF BB9 = 1)* Who or what was that source?

If [EXISTING BUILDING] then ask, else FR1

BB9b. Before your involvement in the MPP program, did you have an energy audit completed for this property?

1 Yes

2 No

BB9c. *(IF BB9b = 1)* Was the energy audit done in the last 10 years?

1 Yes

2 No

BB9d. *(IF BB9b = 1)* Was the energy audit performed by an independent auditor not tied to sales of any products or services?

1 Yes

2 No

BB9e. *(IF BB9b = 1)* Did the energy audit cover all of the types of energy-using equipment on this property, or was it limited to one or two types, such as lighting only or lighting and HVAC?

1 All types

2 Not all types

B89f. *(IF BB9b = 1)* Was the energy audit associated with a government or utility program, or was it totally initiated and paid for by your firm?

1 Associated with government or utility program

2 Totally initiated and paid for by our firm

Other**:**

BB9g. *(IF BB9b = 1)* Did the audit include a detailed implementation plan that included equipment specification, equipment costs, and energy savings?

1 Yes

2 No

FREE RIDERSHIP

Program and Non-Program Components

FR1. Next, I'm going to ask you to rate the importance of a number of Multifamily program-related factors plus others not related to the Multifamily program that might have influenced your decision to implement the <*PROJECT*>. Now using a 0-to-10 point scale where 0 means not at all important and 10 means very important, please rate the importance of each of the following in your decision to implement the <*PROJECT*> at this time.

IF B1 = 1, THEN ASK, ELSE FR1b.

FR1a. Age or condition of the old equipment

If FR1a>7, then ask:

FR1aa. How, specifically, did this enter into your decision to upgrade to energy efficient equipment?

FR1b. Availability of incentives through the MPP program

If FR1b>7, then ask:

FR1bb. Can you please explain why you gave it that rating?

FR1c. The Energy Reduction Plan provided by the MPP program

If FR1c>7 or FR1c<5, then ask:

FR1cc. Can you please explain why you gave it that rating?

FR1d. Previous experience or prior success with this type of <*PROJECT*>

FR1e. Previous experience or prior success with the MPP program

FR1f. Non-energy benefits (Examples: Occupant comfort, improved ability to rent units)

88	Refused	FR1g.
99	Don't know	FR1g.

If FR1f>7, then ask:

FR1cc. Can you please explain which non-energy benefits are important?

FR1g. Payback on the investment

FR1h. Reduced energy use and costs

FR1i. Benchmarking of your buildings *[IF NEEDED: Energy benchmarking compares a building's energy performance against that of similar buildings. Energy performance is calculated as energy use per square foot, after adjusting for factors such as weather, size, and operational characteristics. This allows comparisons between buildings to be made on a level playing field.]*

FR1j. Training provided by the program

If FR1j>7, then ask:

FR1jj. Can you please explain why you gave it that rating?

FR1k. Recommendation from your MPP Partner

If FR1k>7 or FR1k<5, then ask:

FR1kk. Can you please explain why you gave it that rating?

FR1l. Recommendation from an equipment vendor or manufacturer

FR1m. Information provided by your source for energy efficiency information

[IF NEEDED: READ BB9a RESPONSE]

FR1n. Standard practice in your business

FR1o. Corporate policy or guidelines

FR1p. Compliance with your organization's normal maintenance or equipment replacement policies

If FR1p>7, then ask:

FR1pp. Can you please explain why you gave it that rating?

FR1q. Were there any other factors we haven't discussed that were influential in your decision to install this <*PROJECT*>? *[Record up to 3]*

FR1q1. Using the same 0-to-10 scale, how would you rate the influence of this factor(s)? *[Record up to 3]*

Relative Program Influence

Next, I would like you to rate the importance of the MPP program in your organization's decision to implement the <*PROJECT*> as opposed to other factors that may have influenced your decision such as...

[Read based on the responses to the previous question AND MENTION THOSE ITEMS WHERE THEY GAVE A RATING OF 8 or higher]

FR1a2. Age or condition of the old equipment

FR1b2. Availability of incentives through the Multifamily program

FR1c2. Energy Reduction Plan provided by the program

FR1d2. Previous experience or prior success with this measure(s)

FR1e2. Previous experience or prior success with MPP program

FR1f2. Non-energy benefits (Ex. Occupant comfort, improved ability to rent units)

FR1g2. Payback on the investment

FR1h2. Reduced energy use and costs

FR1i2. Benchmarking of your buildings

FR1j2. Training provided by the program

FR1k2. Recommendation from your MPP Partner

FR1l2. Recommendation from an equipment vendor or manufacturer

FR1m2. Information provided by your source for energy efficiency information

FR1n2. Standard practice in your business

FR1o2. Corporate policy or guidelines

FR1p2. Compliance with your organization's normal maintenance or equipment replacement policies

FR2. In summary, can you tell me, if you were given 10 points to award in total, how many points would you give to the importance of the MPP program and how many points would you give to these other non-program factors? We want these two sets of numbers to equal 10.

FR2a How many of the 10 points would you give to the importance of the MPP program in your decision?

FR2b. And how many points would you give to all of these other non-program factors?

Financial Decision Making

FR3. What financial calculations does your company typically make before proceeding with the installation of a high efficiency <*PROJECT*> like this one?

FR3a. *[IF PAYBACK OR ROI MENTIONED]* What is your threshold in terms of the payback or return on investment your company uses before deciding to proceed with an investment?

FR4. Did the incentive provided by the MPP program move your project from outside to within this acceptable range, thereby allowing it to meet your threshold?

1 Yes

2 No

3 Other**:**

****

Consistency Checks

[IF FR4=1, AND FR1b < 5, THEN ASK.]

FR4a The incentive seemed to make the difference between meeting your financial criteria and not meeting them, but you are saying that the incentive didn't have much effect on your decision. Why is that?

77	Record verbatim	FR5
88	Refused	FR5
99	Don't know	FR5

[IF FR4=2, AND Fr1b > 5, THEN ASK.]

FR4b. The incentive didn't cause the PROJECT to meet your company's financial criteria, but you said that the incentive had an impact on the decision to install the *PROJECT*. Why did it have an impact?

77	Record verbatim	FR5
88	Refused	FR5
99	Don't know	FR5

FR5. On a scale of 0 to 10, with a 10 meaning a "Very important" and a 0 meaning "Not at all important," how important in your decision was it that the project/measure was now in the acceptable range for your financial criterion?

#	Record 0 to 10 points (_____)	FR6
88	Refused	FR6
99	Don't know	FR6

****

Actions without the Program

We have discussed how the Program has impacted your organization's <*PROJECT*>. For these next few questions I would like you to think about the action you would have taken with regard to the installation of the specific <*PROJECT*> if the Program had NOT been available.

FR6. Now, using a scale from 0 to 10, where 0 is "Not at all likely" and 10 is "Extremely likely," if the MPP program, including the MPP Partner, the Energy Reduction Plan, and the Incentives, had NOT been available, what is the likelihood that your organization STILL would have installed exactly the same energy efficiency <*PROJECT*>?

****

Consistency Check

[IF FR1b > 7 and FR6 >7, THEN ASK:]

FR6aa When you answered *[INSERT FR1b SCORE]* for the question about the influence of the incentive, I would interpret that to mean that the incentive was quite important in your decision to install. Then, when you answered *[INSERT FR6 SCORE]* for how likely you would be to install the same equipment without the incentive, it sounds like the incentive was not very important in your installation decision. I want to check to see if I am misunderstanding your answers or if the questions may have been unclear.

[If they offer to change the appropriate answer (to FR1b or FR6) to correct the inconsistency, then record their verbatim answer. If not, follow up with something like: Will you explain in your own words the role the incentive played in your decision to install this efficient equipment?]

****

[IF FR6 NOT EXTREMELY LIKELY, score is < 10, THEN ASK, ELSE FR9]

Impact on Timing. We talked quite a bit about the influence of the MPP program on the efficiency level of your <*PROJECT*>. I would now like to talk about how the MPP program might have influenced the timing of your project. Remember, when I say the MPP program, I mean all of the components that we talked about before, such as the MPP Partner, the Energy Reduction Plan, and the Incentives.

FR8 In your opinion, did the MPP program influence you to complete the <*PROJECT*> EARLIER than you otherwise would have, or did it have no influence on when you completed the project?

1 Caused to install earlier

2 Did not influence when installed

3 Would not have installed the equipment at all without the MPP program

[ASK FR8a IF FR8=3]

FR8a Just to confirm, is it correct to say that if the MPP program had not been available, you would NOT have completed the project at all?

1. Yes
2. No

[ASK FR8b IF FR8=1 or IF FR8a=2,88,99]

FR8b If the MPP program had not been available, when would you have completed the project? Would you say . . .

1 Within 6 months of when you did

2 6 months up to 1 year later

3 1 up to 2 years later

4 2 up to 3 years later

5 3 up to 4 years later

6 4 or more years later

[ASK FR8c IF FR8b=6]

FR8c Why do you think it would have been 3 or more years later?

Impact on Project Quantities. And now, I want to understand if the MPP program influenced the scope or the size of the <*PROJECT*>. When answering please ONLY think about how the MPP program affected the quantity of *[IF END USES<>1 READ "HIGH EFFICIENCY"] <END USE>* that you installed.

FR9 If the MPP program had not been available, would the size of your <*PROJECT*> have been larger, the same, or smaller?

1. Larger
2. Same
3. Smaller
4. Would not have installed any equipment without <*PROGRAM*>

[ASK FR9a IF FR9=4]

FR9a Just to confirm, if the MPP program had not been available, you would NOT have completed the project at all, is that correct?

1. Yes
2. No

[LOOP THROUGH THE SECTION FOR EACH MEASURE TYPE FOR WHICH QUANTITY > 1]

FR10 If the MPP program had not been available, would you still have installed <QUANTITY> or would you have installed fewer?

1 Same quantity

2 Fewer

3 Would not have installed any equipment without <PROGRAM>

[ASK FR10a IF FR10 =3]

FR10a Just to confirm, if the MPP program had not been available, you would NOT have installed ANY <*MEASURE*> at all, is that correct?

1. Yes
2. No

FR10b How many fewer <*MEASUREs*> would you have installed?

Access to Information

[IF BB9 = 1 THEN ASK, ELSE ISO1.]

FR11. In an earlier response, you noted that you have a source for energy savings information. Did that source play a role in getting you to install this measure?

1. Yes
2. No

[IF FR11 = 1 THEN ASK, ELSE ISO1.]

FR11a. How important was that information in getting you to invest in the measures?

Participant Inside and Outside Spillover

Next, we would like to ask you a few questions about any additional energy efficiency measures installed by your firm at this site or at your other sites in New York State (excluding Long Island) that **did not** receive incentives or assistance from any NYSERDA or utility programs. The first set of questions relates to such measures installed at this site and the second set applies to your other building sites elsewhere in New York State.

Inside Spillover

ISO1. Did you implement any additional energy efficiency measures at this facility during the last 12 months that **did not** receive incentives through either NYSERDA's programs or any utility program?

1 Yes

2 No

ISO1a. HOW MANY additional energy efficiency measures did you implement at this facility during the last 12 months that **did not** receive incentives through either NYSERDA's programs or any utility program?

ISO1b. *[IF ISO1=1]* Why did you decide to implement additional energy efficiency measures at this facility during the last 12 months?

[RECORD UP TO 3 MEASURES]

ISO2a. *[IF ISO1a > 0]* What was the first measure that you implemented?

ISO2b. *[IF ISO1a > 1]* What was the second measure that you implemented?

ISO2c. *[IF ISO1a > 2]* What was the third measure that you implemented?

ISO2d. *[IF ISO1a > 0]* When did you install the first measure?

ISO2e. *[IF ISO1a > 1]* When did you install the second measure?

ISO2f. *[IF ISO1a > 2]* When did you install the third measure?

[Loop through for each measure:]

ISO3. *[IF ISO1a > 0]* I have a few questions about the FIRST measure that you installed.

ISO3a1. *[IF ISO1a > 0]* Why did you not install this measure through the Multifamily Program or any other NYSERDA or utility program?

ISO3b1. *[IF ISO1a > 0]* Please describe the QUANTITY of this measure.

ISO3c1. *[IF ISO1a > 0]* Please describe the SIZE of this measure.

ISO3d1. *[IF ISO1a > 0]* Please describe the EFFICIENCY of this measure.

ISO3e1. *[IF ISO1a > 0]* Was this measure or class of measures specifically recommended by an audit, report, or program technical specialist associated with another NYSERDA program?

1 Yes

2 No

ISO3f1. *[IF ISO1a > 0]* How significant was your experience in the Multifamily Program in your decision to implement this measure, using a scale of 0 to 10, where 0 is not at all significant and 10 is extremely significant?

[IF ISO3f > 7 THEN ASK, ELSE ISO3g1]

ISO3ff Why do you give it this rating?

ISO3g1. *[IF ISO1 > 0]* If you had not participated in the Multifamily Program, how likely is it that you would still have implemented this measure, using a 0-to-10 scale where 0 means you definitely WOULD NOT have implemented this measure and 10 means you definitely WOULD have implemented this measure?

[IF ISO1a > 1] Next, I have a few questions about the SECOND measure you installed.

ISO3a2. *[IF ISO1a > 1]* Why did you not install this measure through the Multifamily Program or any other NYSERDA or utility program?

ISO3b2. *[IF ISO1a > 1]* Please describe the QUANTITY of this measure.

ISO3c2. *[IF ISO1a > 1]* Please describe the SIZE of this measure.

ISO3d2. *[IF ISO1a > 1]* Please describe the EFFICIENCY of this measure.

ISO3e2. *[IF ISO1a > 1]* Was this measure or class of measures specifically recommended by an audit, report, or program technical specialist associated with another NYSERDA program?

1 Yes

2 No

ISO3f2. *[IF ISO1a > 1]* How significant was your experience in the Multifamily Program in your decision to implement this measure, using a scale of 0 to 10, where 0 is not at all significant and 10 is extremely significant?

[IF ISO3f2 > 7 THEN ASK, ELSE ISO3g2]

ISO3ff2 Why do you give it this rating?

ISO3g2. *[IF ISO1a > 1]* If you had not participated in the Multifamily Program, how likely is it that you still have implemented this measure, using a 0-to-10 scale where 0 means you definitely WOULD NOT have implemented this measure and 10 means you definitely WOULD have implemented this measure?

[IF ISO1a > 2] Next, I have a few questions about the THIRD measure you installed.

ISO3a3. *[IF ISO1a > 2]* Why did you not install this measure through the Multifamily Program or any other NYSERDA or utility program?

ISO3b3. *[IF ISO1a > 2]* Please describe the QUANTITY of this measure.

ISO3c3. *[IF ISO1a > 2]* Please describe the SIZE of this measure.

ISO3d3. *[IF ISO1a > 2]* Please describe the EFFICIENCY of this measure.

ISO3e3. *[IF ISO1a > 2]* Was this measure or class of measures specifically recommended by an audit, report, or program technical specialist associated with another NYSERDA program?

1 Yes

2 No

ISO3f3. *[IF ISO1a > 2]* How significant was your experience in the Multifamily Program in your decision to implement this measure, using a scale of 0 to 10, where 0 is not at all significant and 10 is extremely significant?

[IF ISO1a > 2] IF ISO3f3 > 7 THEN ASK, ELSE ISO3g3

ISO3ff2 Why do you give it this rating?

ISO3g3. *[IF ISO1a > 2]* If you had not participated in the Multifamily Program, how likely is it that you still have implemented this measure, using a 0-to-10 scale where 0 means you definitely WOULD NOT have implemented this measure and 10 means you definitely WOULD have implemented this measure?

ISO3gg. *[ASK ALL]* Next, were there any energy efficiency measures recommended in the Energy Reduction Plan that you did not include in this <*PROJECT*>, but subsequently installed on your own OUTSIDE of NYSERDA's programs? *[IF NEEDED: These were measures that you installed, but did not receive any incentives from NYSERDA for.]*

1 Yes

2 No

ISO3ggg. *[IF ISO3gg=1]* What were those items or measures?

ISO3gggg *[IF ISO3gg=1]* Why did you not install them through the Multifamily Program or any other NYSERDA program?

ISO3h. *[ASK ALL]* Now, I would like you to think broadly about your experiences with NYSERDA's Energy Efficiency services on this project, and how they may have influenced your views towards undertaking energy efficiency projects in the future. Do you think these experiences have increased or decreased the likelihood that you will seek to install more energy efficient measures or processes for your next project, or was there no change?

1 Increased

2 Decreased

3 No change

ISO3i. *[ASK IF ISO3h=1]* What specific program elements or activities have influenced your views in this way?

1 The program provided validation of my project/energy savings

2 The quality of the Program Partner/contractor was very high

3 The program provided a high value for the dollars I invested

Other**:**

Outside Spillover

OSO1. Have you installed any additional natural gas or electric efficiency measures during the last 12 months at your other existing facilities in New York (excluding Long Island) that did not receive incentives through any NYSERDA or utility energy efficiency program?

1 Yes

2 No

OSO1a. *[ASK IF OSO1=1]* Why did you decide to implement additional energy efficiency measures at your other existing facilities in New York (excluding Long Island) during the last 12 months?

OSO1b. HOW MANY additional energy efficiency measures did you implement at your other existing facilities during the last 12 months that **did not** receive incentives through either NYSERDA's programs or any utility program?

OSO1c. *[ASK IF OSO1=1]* Which buildings were they in and where are they located?

[RECORD FOR UP TO THE THREE LARGEST MEASURES.]

OSO1d. *[ASK IF OSO1b > 0]* What was the first measure that you implemented *[INCLUDING THE BUILDING NAME AND LOCATION]*?

OSO1e. *[ASK IF OSO1b > 1]* What was the second measure that you implemented *[INCLUDING THE BUILDING NAME AND LOCATION]*?

OSO1f. *[ASK IF OSO1b > 2]* What was the third measure that you implemented *[INCLUDING THE BUILDING NAME AND LOCATION]*?

[Loop through for each measure:]

OSO2. *[ASK IF OSO1b > 0]* I have a few questions about the FIRST measure that you installed.

OSO2a1. *[ASK IF OSO1b > 0]* Why did you not install this measure through the Multifamily Program or any other NYSERDA or utility program?

OSO2b1. *[ASK IF OSO1b > 0]* Please describe the QUANTITY of this measure.

OSO2c1. *[ASK IF OSO1b > 0]* Please describe the SIZE of this measure.

OSO2d1. *[ASK IF OSO1b > 0]* Please describe the EFFICIENCY of this measure.

OSO2e1. *[ASK IF OSO1b > 0]* Was this measure specifically recommended by an audit, report, or program technical specialist associated with another NYSERDA program?

OSO2f1. *[ASK IF OSO1b > 0]* How significant was your experience in the Multifamily Program in your decision to implement this measure, using a scale of 0 to 10, where 0 is not at all significant and 10 is extremely significant?

OSO2ff. *[ASK IF OSO1b > 0] [if OSO2f1 > 7 then ask]:* Why do you give it this rating?

OSO2g1. *[ASK IF OSO1b > 0]* If you had not participated in the Multifamily Program, how likely is it that you still have implemented this measure, using a 0-to-10 scale where 0 means you definitely WOULD NOT have implemented this measure and 10 means you definitely WOULD have implemented this measure?

[ASK IF OSO1b > 1] Next, I have a few questions about the SECOND measure that you installed.

OSO2a2. *[ASK IF OSO1b > 1]* Why did you not install this measure through the Multifamily Program or any other NYSERDA or utility program?

OSO2b2. *[ASK IF OSO1b > 1]* Please describe the QUANTITY of this measure.

OSO2c2. *[ASK IF OSO1b > 1]* Please describe the SIZE of this measure.

OSO2d2. *[ASK IF OSO1b > 1]* Please describe the EFFICIENCY of this measure.

OSO2e2. *[ASK IF OSO1b > 1]* Was this measure specifically recommended by an audit, report, or program technical specialist associated with another NYSERDA program?

OSO2f2. *[ASK IF OSO1b > 1]* How significant was your experience in the Multifamily Program in your decision to implement this measure, using a scale of 0 to 10, where 0 is not at all significant and 10 is extremely significant?

OSO2ff2. *[ASK IF OSO1b > 1] [if OSO2f2 > 7 then ask]:* Why do you give it this rating?

OSO2g2. *[ASK IF OSO1b > 1]* If you had not participated in the Multifamily Program, how likely is it that you still would have implemented this measure, using a 0-to-10 scale where 0 means you definitely WOULD NOT have implemented this measure and 10 means you definitely WOULD have implemented this measure?

[ASK IF OSO1b > 2] Next, I have a few questions about the THIRD measure that you installed.

OSO2a3. *[ASK IF OSO1b > 2]* Why did you not install this measure through the Multifamily Program or any other NYSERDA or utility program?

OSO2b3. *[ASK IF OSO1b > 2]* Please describe the QUANTITY of this measure.

OSO2c3. *[ASK IF OSO1b >2]* Please describe the SIZE of this measure.

OSO2d3. *[ASK IF OSO1b > 2]* Please describe the EFFICIENCY of this measure.

OSO2e3. *[ASK IF OSO1b > 2]* Was this measure specifically recommended by an audit, report, or program technical specialist associated with another NYSERDA program?

OSO2f3. *[ASK IF OSO1b > 2]* How significant was your experience in the Multifamily Program in your decision to implement this measure, using a scale of 0 to 10, where 0 is not at all significant and 10 is extremely significant?

OSO2ff3. *[ASK IF OSO1b > 2] [if OSO2f3 > 7 then ask]*: Why do you give it this rating?

OSO2g3. *[ASK IF OSO1b > 2]* If you had not participated in the Multifamily Program, how likely is it that you still have implemented this measure, using a 0-to-10 scale where 0 means you definitely WOULD NOT have implemented this measure and 10 means you definitely WOULD have implemented this measure?

Spillover in Planned New Buildings

OSO3. *[ASK ALL.]* Is your organization planning to build new multifamily buildings in New York State (excluding Long Island), or have you recently completed ones, where you **are not** planning to apply for incentives through a utility or a NYSERDA program?

1 Yes

2 No

OSO3a *[ASK IF OSO3 =1]* How many such buildings are there?

OSO4b *[ASK IF OSO4a > 0]* Which buildings are they and where are they located? *[QUERY ON BUILDINGS LOCATED IN NY STATE ONLY, excluding Long Island]*

OSO4c *[ASK IF OSO4a > 0]* Are you incorporating any energy efficiency measures into their construction?

1	Yes	OSO4d
2	No	B1

OSO4d *[IF OSO4c=Yes, THEN ASK]* At which specific buildings/locations are you incorporating energy efficiency measures into their construction?

General Energy Efficiency Behaviors

Now, I'd like you to think about your organization's experiences with NYSERDA's energy efficiency programs and your related efforts to improve the energy efficiency of your facility in general.

B1. For how many years have you been participating in NYSERDA's energy efficiency programs?

B2. What factors led you to participate in these program(s)?

1 Availability of incentives

2 Opportunity to make buildings more energy efficient

3 Expertise and assistance from Program Partner

Other**:**

B3. What types of actions have you taken during that time period to improve the energy efficiency of your facility(ies) beyond the projects that you developed through NYSERDA's programs?

B4. How have NYSERDA's programs influenced your organization’s internal policies and practices related to energy use, if at all? Specifically:

B4a. Does your organization have a *capital budgeting approach* that supports energy efficiency, i.e., by having a designated amount or percentage set aside for EE projects or otherwise prioritizing EE over non-EE equipment?

B4b. Does your organization have in place any *equipment specification/procurement policies* that incorporate an energy efficiency requirement? (e.g., purchasing equipment that exceeds code by a certain percentage or only purchasing from companies recognized as premier energy efficiency firms)

B4c. Does your organization have *energy use reduction goals* for this facility?

B4d Is there a person or people in your organization in charge of *managing the organization's energy use and costs*?

B4e. Does your organization have *financial decision-making criteria* to support energy efficiency; that is, a more lenient payback or return on investment threshold for EE projects?

B4f. Does your organization have any *corporate environmental or sustainability initiatives*? Is energy management part of your corporate environmental or sustainability initiative?

B4g. Do you have a process for measuring progress towards your sustainability goals?

B4h. How does your organization *learn about technologies and equipment* for saving energy?

JOBS QUESTIONS

Screening

QS1. As a result of your firm's participation in MPP since September 2010, have you experienced either a permanent or temporary increase in workload for your company?

1	Yes	QS2
2	No	R1

QS2 Considering all Multifamily Performance Projects that your company has participated in since September 2010, have you: *[ASK ALL]*

QS2a. Needed to hire property and/or management staff to support these MPP projects?

1 Yes

2 No

QS2b. Been able to retain property and/or management staff in your or your organization's employ who otherwise would have been let go?

1 Yes QS2c

1 Yes

2 No

QS2c. Increased the responsibilities of existing staff to support MPP projects? *[This could be due to a promotion or specialized training or knowledge acquired.]*

1 Yes

2 No

On-Site Recruiting

R1. As we've discussed, the Multifamily Performance Partners Program is an important component of NYSERDA's ongoing efforts to encourage homes and businesses to save energy. In order to improve this program's performance, NYSERDA would like to make an accurate measurement of the energy savings associated with energy efficiency equipment installed by collecting and analyzing information from selected customers.

Your input to this research is extremely important. By receiving an incentive through the MPP program, your firm has agreed to allow verification of the installation of the equipment that you reported to have installed outside of NYSERDA's programs, but where you reported high influence from your other experiences with NYSERDA's programs as a reason for such installations.

Our verification technician will need to meet a facilities representative of your company. This should be either the manager of the facility or part of the facilities staff.

R1a. May I please have the name of the person who our technician can call you to set up an appointment time? May I also have the best phone number for the technician to reach this person?

77 Record first person's name and phone number R1b.

R1b. Is there another person whom the engineer might speak with at your company, if this primary person is not available? May I please have their name so our technician can call them at another time? May I also have the best phone number for the technician to reach them?

77 Record second person's name and phone number *END*

[END OF SURVEY]

This concludes our survey. On behalf of NYSERDA, thank you very much for your time today.

APPENDIX F: ADDITIONAL M&V RESULTS

The Impact Evaluation Team examined the evaluated gross savings results to investigate any patterns or differences in project performance across a number of different segments. Though the measurement and verification (M&V) sample was not designed to achieve statistically significant results for any of these supplemental analyses, the evaluators' investigation might lead to further program research or recommendations to improve M&V sample design in future impact evaluations. This appendix presents a selection of results from the evaluators' supplemental analysis.

Though the Impact Evaluation Team does not recommend these segment-specific results to be applied by the Program, this analysis is particularly helpful for the Impact Evaluation Team to make recommendations to improve future impact evaluation sample designs.

EXAMINATION OF RESULTS AMONG SEGMENTS OF INTEREST

The Impact Evaluation Team first examined the evaluated gross electric energy and fossil fuel results across four categories of interest identified during the evaluation sample design. Table F-1 compares the two key segments in each category.

Table F-1. Comparison of MPP M&V Results among Segments of Interest[1]

Category	Segment	Projects in Population	Projects in Sample	Electric Performance Factor[2] (MWh)	Fossil Fuel Performance Factor (MMBtu)
Project type	Existing buildings	348	104	**0.78**	0.57
	New construction	40	13	**1.24**	0.86
Market	Market rate	125	37	**0.91**	0.58
	Affordable	263	80	**0.75**	0.58
Geography	Upstate	199	60	0.82	**0.66**
	Downstate	189	57	0.76	**0.50**
Incentive #4	Applied for	133	35	0.80	**0.71**
	Not applied for	215	69	0.76	**0.49**

[1] Numbers in bold indicate statistically significant differences determined for those segments.

[2] Though the Impact Evaluation Team examined M&V results across these segments, the evaluators do not recommend the application of these factors to specific segments' reported savings moving forward. The M&V sample was not designed to achieve statistical significance at this level. Therefore, the standard term "realization rate" has been replaced with "performance factor" to indicate that these findings are for informational purposes only.

The Impact Evaluation Team determined statistically significant differences for electric savings by project type and market type, and for fossil fuel savings by geography and performance payment status.

The fossil fuel differences, in particular, can be explained by field data collection findings:

- Downstate fossil fuel measures featured lower performance than upstate, due to the prevalence of oil-fired systems downstate. Oil-fired systems were likely candidates for fuel switch measures, which led to complications in the Program's savings tracking database.

- The Impact Evaluation Team initially hypothesized that customers who applied for the Incentive #4 performance payment[1] were more likely to perform better than those that did not. This hypothesis proved true for both electric and fossil fuel, though only fossil fuel results were statistically different between performance payment and non-performance payment projects.

The Impact Evaluation Team next examined in more detail the evaluated gross savings across two key segments: project type (existing buildings versus new construction) and market type (affordable housing versus market rate). For measures receiving Energy Efficiency Portfolio Standard (EEPS) funding, these two segments feature different funding sources and subsequently require separate savings reports. Table F-2 compares M&V results among project and market types.

Table F-2. MPP M&V Results by Project Type and Market Type

Fuel Type	Metric	Existing Buildings		New Construction		Total
		Affordable Housing	Market Rate	Affordable Housing	Market Rate	
Electric Energy (MWh)	A – Program-reported savings	57,489	20,283	2,281	373	80,426
	B – Realization rate	0.74	0.88	0.93	3.42	0.79
	C – Evaluated gross savings (A x B)	42,613	17,803	2,121	1,274	63,412
	D – Relative precision	9%	11%	22%	55%	7%
Non-RGGI Fossil Fuels (MMBtu)[1]	A – Program-reported savings	709,183	246,921	24,596	14,447	995,146
	B – Performance factor[2]	0.55	0.78	1.21	0.26	60%
	C – Evaluated gross savings (A x B)	392,022	191,826	29,804	3,709	600,274
	D – Relative precision	13%	18%	56%	32%	11%

[1] Non-RGGI measures feature SBC or EEPS funding.

[2] Since 2009-2011 projects were primarily SBC-funded and targeted electric savings only, the term "realization rate" has been replaced with "performance factor" to indicate a difference in future influence on fossil fuel reporting.

Market rate projects generally performed better than affordable housing projects, with the exception of new construction fossil fuel measures. New construction results were substantially less precise than existing buildings results, due to the limited number of new construction projects in the population and M&V sample.

Next, the Impact Evaluation Team performed a similar comparison for results by market type and by location (upstate versus downstate), as presented in Table F-3.

Table F-3. MPP M&V Results by Market Type and Geography

Fuel Type	Metric	Affordable Housing		Market Rate		Total
		Downstate	Upstate	Downstate	Upstate	
Electric Energy	A – Program-reported savings	27,986	31,785	16,173	4,483	80,426
	B – Realization rate	0.70	0.79	0.88	1.04	0.79

[1] The Incentive #4 performance payment requires the customer to demonstrate 20% or greater source energy reduction via pre/post utility bill analysis.

Fuel Type	Metric	Affordable Housing		Market Rate		Total
		Downstate	Upstate	Downstate	Upstate	
(MWh)	C – Evaluated gross savings (A x B)	19,657	25,034	14,198	4,666	63,412
	D – Relative precision	9%	14%	14%	14%	7%
Non-RGGI Fossil Fuels (MMBtu)[1]	A – Program-reported savings	397,664	336,115	168,114	93,254	995,146
	B – Performance factor[2]	0.46	0.68	0.86	0.62	0.60
	C – Evaluated gross savings (A x B)	184,299	228,466	145,149	57,504	600,274
	D – Relative precision	19%	17%	25%	21%	11%

[1] Non-RGGI measures feature SBC or EEPS funding.

[2] Since 2009–2011 projects were primarily SBC funded and targeted electric savings only, the term "realization rate" has been replaced with "performance factor" to indicate a difference in future influence on fossil fuel reporting.

Upstate projects generally performed better than downstate projects, with the exception of market rate fossil fuel measures. Affordable, downstate projects were most likely to feature oil-fired heating systems and fuel switching measures, leading to subsequent complications in program savings tracking and lower realized savings. Market rate results were slightly less precise than affordable housing results due to a majority of affordable housing projects in the M&V sample.

SOURCE ENERGY REDUCTION ANALYSIS

Next, the Impact Evaluation Team compared the evaluated gross energy savings to reported energy savings from a source energy reduction perspective. The source energy reduction includes all fossil fuels (in MMBtu) as well as electric energy converted into source MMBtu[2]. The objective of this analysis was to examine a possible correlation between aggressive energy reduction claims and project performance. The bar graph in Figure F-1 illustrates the comparison of achieved energy reductions (based on evaluated gross savings) to targeted energy reductions (based on reported savings).

[2] This conversion involved multiplication with the product of three factors: 3.142 MBtu/kWh, 0.001 MMBtu/MBtu, and 2.98 Btu input/Btu output (to account for power plant and distribution inefficiencies).

Figure F-1. Achieved vs. Targeted Source Energy Reductions among MPP M&V Sample

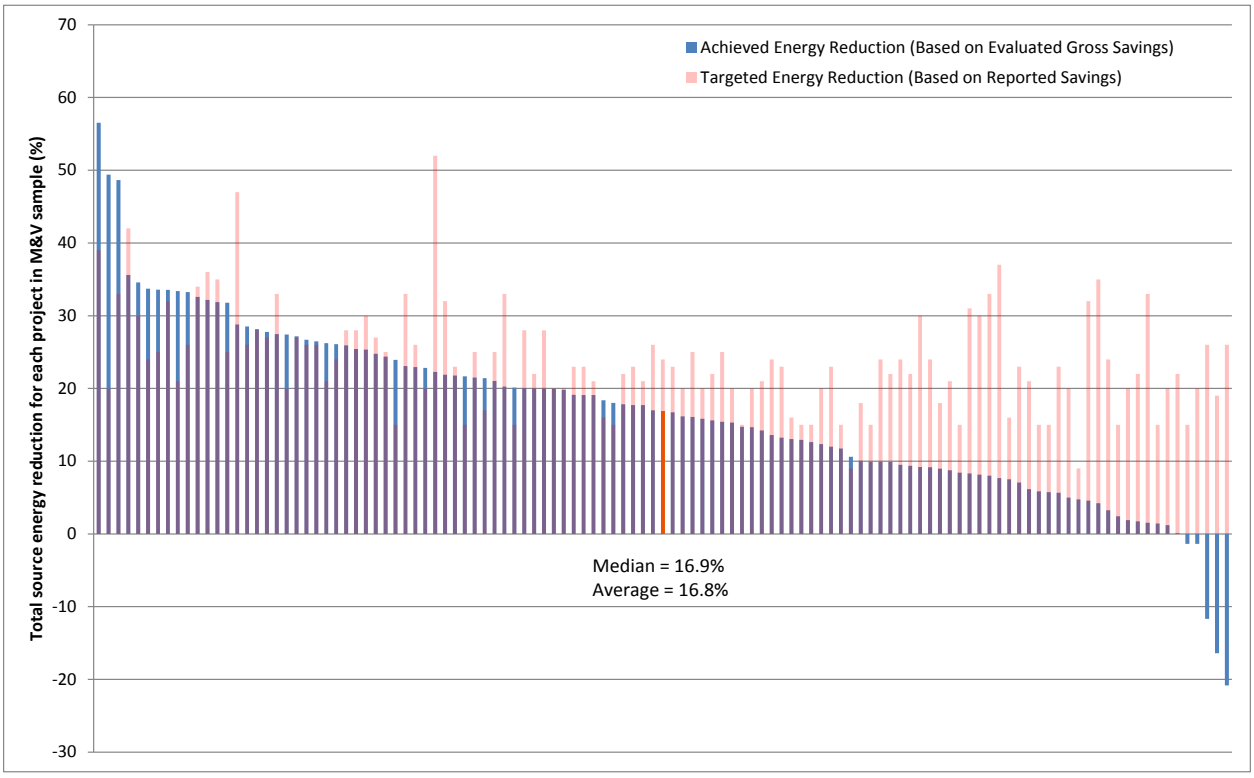


Figure F-1 illustrates little correlation between targeted and achieved source energy reduction. The proximity of the average (16.8%) and median (16.9%) source energy reductions indicates the consistency of the evaluation results—the average findings are not heavily influenced by a small number of overachieving or underachieving projects. Next, the Impact Evaluation Team examined whether a project's targeted energy reduction correlated with project performance. Did projects with aggressive savings reduction targets lead to low realization rates? The Figure F-2 scatter illustrates this comparison.

Figure F-2. Source Btu Realization Rate vs. Targeted Source Energy Reductions among MPP M&V Sample

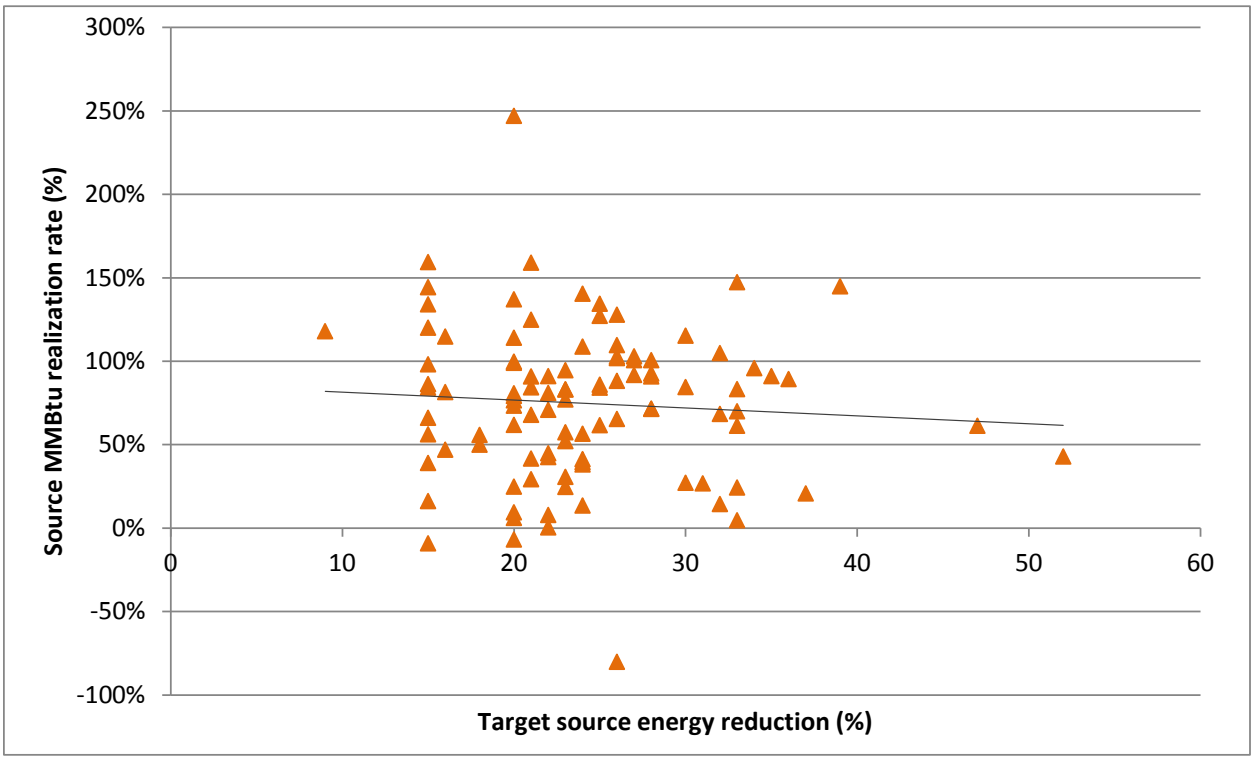


Figure F-2 indicates little correlation between savings claim and project performance; the trend line features only a slightly downward slope.

The Impact Evaluation Team next examined correlations of source Btu realization rates with the following parameters:

- **Building height or number of units**– Were high-rise buildings more likely to achieve energy reductions compared to mid- and low-rise? Did temperature stratification play a role in building overheating, leading to higher savings potential?
- **Pre-project energy usage intensity (EUI)** – Were energy-intensive buildings (per square foot) more likely to achieve energy savings?
- **Heating system type** – Were there differences in project performance for buildings with steam boilers, hot water boilers, furnaces, electric heating, etc.?

The evaluators determined no discernible correlations or differences for each of the above investigative analyses.

Finally, the Impact Evaluation Team compared targeted versus achieved source energy reductions among three major categories: project type (existing buildings vs. new construction), market type (market rate vs.

affordable housing), and incentive payment (performance payment applied for vs. not). The scatter plots of Figures F-3, F-4, and F-5 illustrate these comparisons.

Figure F-3. MPP Achieved vs. Proposed Source Energy Reduction by Project Type

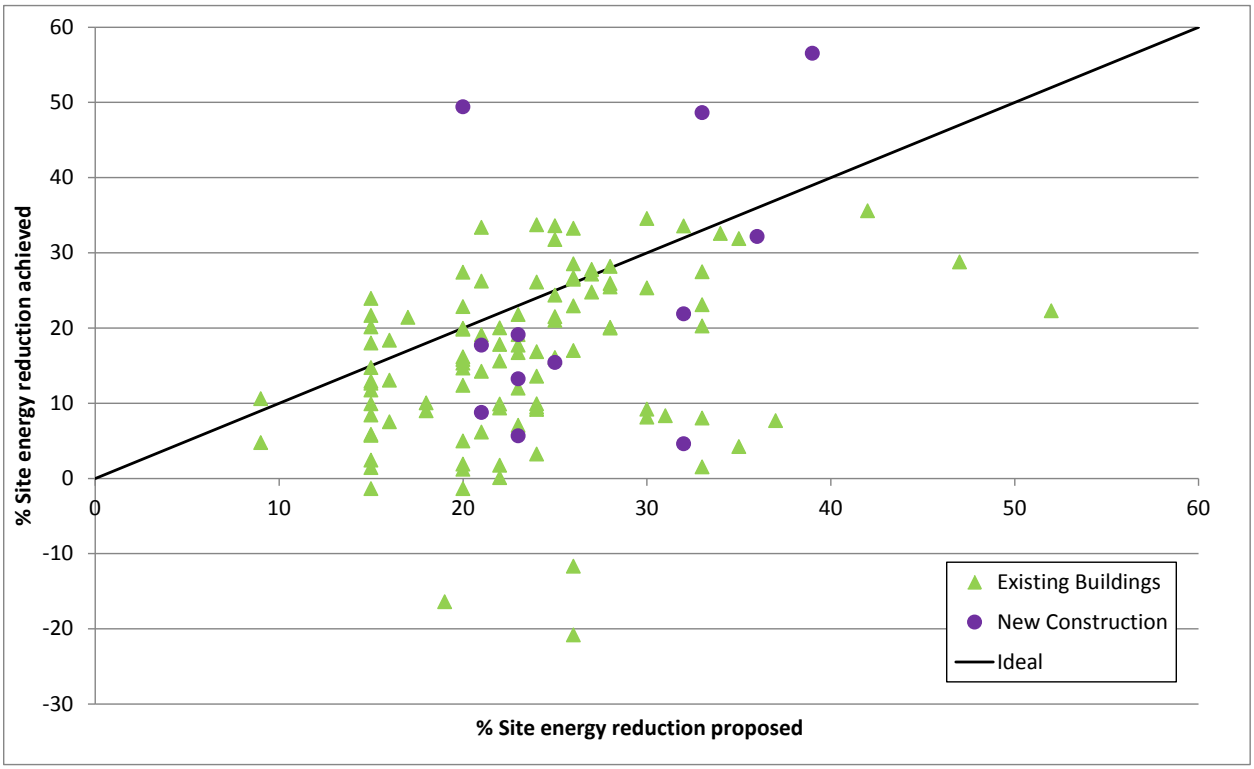


Figure F-3 indicates that the three highest-saving projects were new construction projects (when compared against energy code-equivalent systems). The highest saver among existing buildings projects was a 36% source energy reduction, while a handful of existing buildings projects actually resulted in a source energy increase at the facility.

Figure F-4. MPP Achieved vs. Proposed Source Energy Reduction by Market

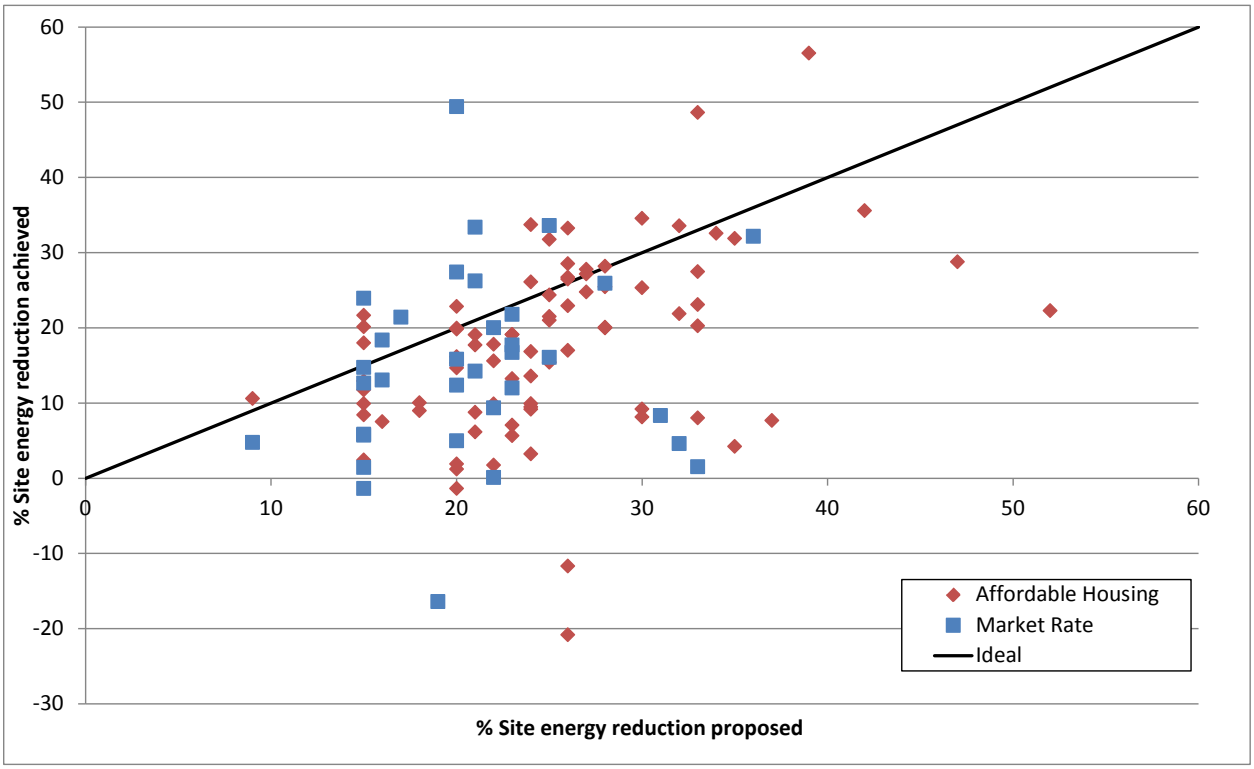


Figure F-4 indicates that affordable housing projects were more likely to claim high source energy reductions but did not often achieve those claimed savings.

Figure F-5. MPP Achieved vs. Proposed Source Energy Reduction by Incentive Payout

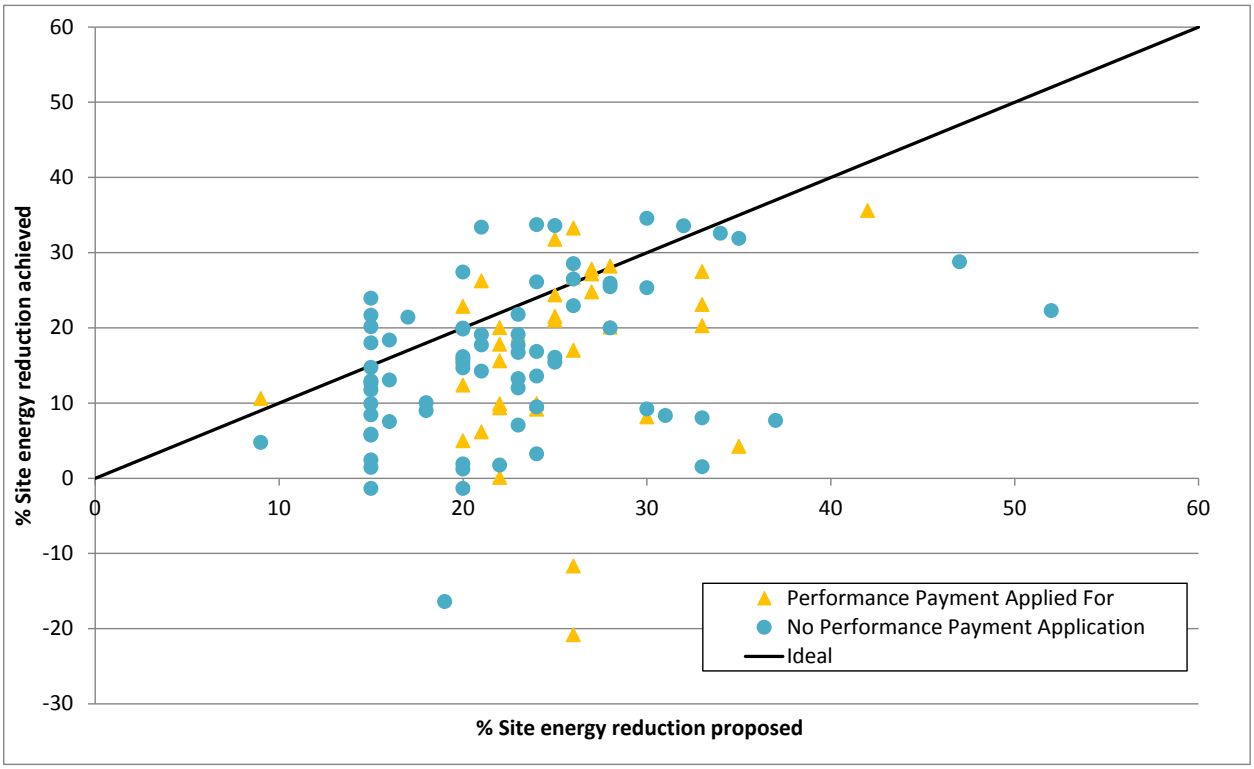


Figure F-5 indicates little correlation between achieved source energy reduction and the performance payment application status, as previously indicated in Table F-1. In fact, some of the highest-saving projects in the M&V sample did not apply for the performance payment, perhaps as a result of the Program's Exhibit C adjustment to project scope and incentives.

APPENDIX G: SITE-SPECIFIC EXAMPLES OF KEY DRIVERS CONTRIBUTING TO EVALUATION REALIZATION RATES

As is common in similar impact evaluations, nearly all of the 117 projects in the measurement and verification (M&V) sample featured evaluated savings that differed from the program-reported savings. The evaluators investigated and analyzed the site-specific reasons behind these deviations in realization rate. By categorizing and aggregating these differences, as well as estimating the energy impact of each, the evaluators were able to identify the categories with the most significant potential for improvement. This information helped shape the program recommendations presented in Section 4 of this report.

The following tables provide a detailed review of each of the difference categories, with site-specific examples, for both electric and fossil fuel-saving projects in the M&V sample. Please note that a single project can feature multiple key differences; therefore, the total number of positive and negative instances is greater than the population of 117 projects.

Key Drivers in Electric Realization Rate with Site-Specific Examples			Negative		Positive	
Category		Actual Project Example	# Projects	Impact on kWh RR	Impact on kWh RR	# Projects
Pre - post inspection	Difference in quantity installed	The post-installation inspection report indicated that only 789 (64%) of CFLs were installed at complex 2. This resulted in lower evaluated electric savings compared to reported savings.	45	-17%	5%	10
	Inaccurate pre-project characterization	The applicant inaccurately modeled the wattage of the preexisting fixtures. The applicant describes the fixtures as 75 W fixtures. The evaluators determined that these in-unit screw in fixtures were 60 W fixtures.	11	-5%	1%	5
	Difference in installed equipment size	The evaluators determined that the summed rated power of the four pumps is less than proposed by the applicant. The lower-rated as-built pumps operate in the same manner as the pre-project pumps. This difference led to higher evaluated impacts.	7	-2%	4%	4
	Difference in installed equipment technology	The applicant based hallway lighting savings on four-foot, four-lamp fluorescent fixture replacements. The evaluators found that the installed fixtures were four-foot, two-lamp fluorescent fixtures instead, thereby increasing the overall savings.	5	-4%	1%	4
	Ineligible measure	Measure involved a reduction in duct leakage. According to NYSECCC Section 803.2.8, all joints and seals in ductwork should be securely fastened, sealed, and insulated. No guidance is given on leakage rates.	2	0%	0%	0
	Inaccurate occupancy estimate	The applicant model assumed an unchanged occupancy rate of 75% at the facility. Project files show that occupancy increased from 75% to 98% between the pre- and post-project periods. The evaluation team adjusted the pre-bills to reflect the most up-to-date occupancy rate of 98%.	0	0%	1%	2
Operating characteristics	Difference in equipment operating efficiency	The proposed LPD was less efficient than the installed LPD, as determined through an on-site lighting inventory taken by the evaluators. This difference led to increased savings.	20	-14%	16%	13
	Inaccurate estimation from applicant model	The applicant estimated the baseline infiltration rate of 0.7 ACH at the facilty. By calibrating the applicant TREAT model with actually billing data, the evaluators believe the applicant estimated pre-installation infiltration rate was overestimated.	15	-4%	3%	11
	Difference in equipment load profile	The evaluators found the CHP was operating on average at about 135% of what was anticipated. This led to higher electric output and higher project savings.	14	-5%	7%	11
	Difference in equipment hours of operation	Through on-site examination and discussion with site staff, the evaluators have determined that the exhaust fan timers operate for 19 hours per day as opposed to 18 hours per day suggested in the ERP.	16	-4%	1%	7
	Difference in installed control strategy	The applicant proposed that heating hot water circulation pumps be set to turn on only when the return water temperature drops below 120°F. The evaluators observed a set temperature of 180°F and facility staff confirmed that this temperature was used to satisfy all the tenant requests.	10	-4%	1%	3
	Insufficient assessment of measure interactivity	The applicant did not account for the increase in fan energy from the increased pressure drop from the heat recovery measure.	8	-2%	1%	3
	Inoperable installed equipment	The applicant calculated savings for a 6 hour/day reduction in the DHW circulation pump operation. However, the evaluators discovered on-site that the timer control pins had been removed (allowing the pump to operate 24/7) and the facility staff had no intention of replacing them.	6	-6%	0%	0
	Variation in HVAC settings	The applicant's model showed the baseline heating setpoint was 73°F. Discussions with site staff have indicated that the setpoint for the electric heaters has not changed from 72°F throughout the course of the project.	5	-1%	0%	1
Baseline	Incorrect baseline reference	Since this project was classified by the program as new construction, the evaluators used the applicable code to define the baseline roof and wall insulation R-values. In contrast, the applicant used the preexisting conditions to define the baseline roof and wall insulation R-values.	16	-5%	6%	6
	Incorrect baseline reference to code	The evaluators found that the preexisting windows were in need of replacement and were more appropriately characterized with a code baseline. The project's installed windows did not exceed code specifications; this led to slightly lower cooling season savings.	4	-2%	0%	0
Analysis assumptions	Differences in modeling software	The evaluators used eQUEST to calculate the interactive impacts of all measures, while the applicant used REM/Rate to calculate savings for each measure individually. eQUEST allowed the evaluators to more accurately capture the interactive effects of the measures.	2	0%	1%	10
	Unknown applicant algorithm or assumptions	The evaluators used the baseline and as-built flow rates and NYTM to calculate the annual water usage of the baseline and as-built showers and lavatory faucets. The applicant's annual water usage assumptions were not included in project documents.	1	0%	3%	3
	Inaccurate normalization to typical weather	The applicant referenced TMY2 weather data for Rochester, NY. The evaluators referenced weather data for the more proximate Poughkeepsie, NY weather station and also used the newer TMY3 data.	2	0%	0%	0
	Inaccurate plug loading estimate	The evaluators believe that there is a higher number of tenant-owned AC units and space heaters in operation in the post-installation case, which are not accounted for within the plug loads of the applicant's model.	1	-1%	0%	0
	Incorrect reference to billing data	Through examination of the applicant's pre-project TREAT model, the evaluators determined that the applicant significantly overestimated the pre-project facility usage from the available billing data.	1	0%	0%	0
Administrative	Difference between applicant model and reported savings	The applicant TREAT models yielded a larger savings output than was claimed by the Program.	2	-1%	4%	7
	Administrative error	Two identical buildings were built as part of this project. The applicant received incentives for both buildings, but the Program only claimed savings for one of the buildings.	1	0%	2%	1
Totals			194	-78%	57%	101

Key Drivers in Fossil Fuel Realization Rate with Site-Specific Examples			Negative		Positive	
Category		Actual Project Example	# Projects	Impact on MMBtu RR	Impact on MMBtu RR	# Projects
Operating characteristics	Difference in equipment operating efficiency	The applicant's TREAT model assumes a district steam heating plant efficiency of 84%. The evaluators determined that the 87% efficiency of the on-site oil-fired boiler plant (as quoted in the ERP) represents a more accurate efficiency.	27	-11%	6%	17
	Inaccurate estimation from applicant model	The scaling factors were based solely upon square footages and did not account for variations among the buildings within each complex.	18	-15%	12%	15
	Difference in equipment load profile	New windows were installed prior to the project outside of the program. This reduced the load on the heating system, which reduced the space heating savings.	17	-13%	6%	13
	Difference in installed control strategy	The applicant assumed that exhaust fan run time would be reduced from 24 hours to 18 hours per day by being shut off between midnight and 6:00 a.m. However, the post-installation inspection indicated the timers resulted in a 19-hour reduction.	13	-2%	3%	5
	Variation in HVAC settings	Applicant model proposed a setback temperature of 75°F in the baseline case and a proposed setback temperature of 72°F. Per conversations with staff, evaluators believe that the baseline system maintained a setback temperature similar to the installed system.	8	-3%	1%	8
	Difference in cooling or heating interactivity	The applicant did not calculate the heating penalty that resulted from the lighting upgrades at the facility. In contrast, the evaluators' eQUEST model captured the heating penalty that resulted from the reduced lighting power consumption.	4	-1%	0%	5
	Insufficient assessment of measure interactivity	There is a high interactivity among the natural gas measures. The applicant reported the savings for each individual measure. Interactivity has the impact of reducing the overall savings for this project.	6	-2%	0%	1
	Difference in equipment hours of operation	The applicant proposed that heating hot water circulation pumps be set to turn on only when the return water temperature drops below 120°F. The evaluators observed a set temperature of 180°F and facility staff confirmed that this temperature was used to satisfy all the tenant requests.	2	-1%	0%	1
	Inoperable installed equipment	A steam trap survey conducted during the post-installation billing period shows that 14 steam traps had failed. The failed steam traps increased the post-installation space heating usage.	3	-2%	0%	0
Pre - post inspection	Difference in quantity installed	The applicant calculations included seven boiler replacements while on-site verification and discussions with site staff indicated only four were replaced.	25	-5%	0%	4
	Inaccurate pre-project characterization	Applicant model underestimated baseline system efficiency with low energy factor values, which lead to higher reported savings values than actual.	9	-5%	0%	1
	Difference in installed equipment technology	The evaluators discovered during the site visit that the Facility A community center thermostat was not replaced with a programmable thermostat as recommended.	7	-2%	0%	2
	Inaccurate fuel accounting after switch	The reported savings did not account for the increase in gas use with the operation of the new cogeneration system.	5	-8%	3%	2
	Difference in installed equipment size	The applicant TREAT model lists a total capacity of the condensing furnaces in measure #16 that is approximately 26% lower than the nameplate data of the installed equipment.	3	-1%	0%	1
	Inaccurate occupancy estimate	The applicant scaled pre-project natural gas consumption by square footage while the evaluation team scaled by occupancy due to the facility's natural gas end uses of DHW and cooking.	2	-3%	0%	1
Baseline	Incorrect baseline reference	The applicant claimed that the baseline efficiency of 9.3 EER was the baseline efficiency per code. While the indoor units are small enough to meet that efficiency requirement, the exterior units fall into the larger size category, resulting in a 10.1 EER requirement.	15	-3%	3%	9
	Incorrect baseline reference to code	Project documents indicated that the preexisting steam boilers were inoperable at the time of the initial audit, and that building management had a contractor ready to start the boiler replacement at that time because the heating season was approaching.	9	-2%	0%	2
Administrative	Difference between applicant model and reported savings	The applicant had an error in the ERP spreadsheet where not all measures were captured correctly. The applicant TREAT savings sum to 316 MMBtu, while the applicant's reported savings sum to 345 MMBtu.	7	0%	1%	3
	Administrative error	The applicant reported 1,472 MMBtu of savings for an in-unit hard-wired CFL retrofit. Since the ERP and the applicant's TREAT model did not claim these unwarranted gas savings, evaluators believe this is a simple data entry error.	2	0%	0%	0
Analysis assumptions	Inaccurate normalization to typical weather	The applicant referenced an Albany weather file in the TREAT model. Albany has colder winters than White Plains, where the building is located.	9	-1%	0%	1
	Unknown applicant algorithm or assumptions	The evaluators used eQUEST to calculate the interactive impacts of all interior measures, while the applicant's baseline R-value assumptions were not included in project documents.	2	0%	3%	4
	Inaccurate plug loading estimate	During the calibration process the annual internal plug load usage total per apartment was reduced to reflect post-installation electric bills. This increased the heating load, thus increasing the boiler savings.	0	0%	0%	1
	Totals		193	-81%	41%	96

APPENDIX H: MEASURE ADOPTION RATE (MAR) CURVES

Through the measure adoption rate (MAR) field verification study, the Impact Evaluation Team collected information on measure installations for energy reduction plan (ERP)-only projects. The impact evaluation research was intended to investigate the magnitude of ERP-only savings claimable by the MPP and to recommend whether the Program should pursue these savings with a more rigorous study in the future. Additionally, the evaluators collected information regarding installation timing and incentive funding for the ERP-only projects' installed measures to develop a MAR curve by number of years since ERP completion. Via on-site verification at a selection of fifteen ERP-only projects, this information was collected for both electric- and fossil fuel-saving measures.

Figure H-1 compares the NYSERDA 2011 study's MAR curve[1] with the evaluation verification MAR curve for electric-saving measures. Please note that the evaluation verification curve does not reflect savings for any measures that received incentive funding from programs other than MPP. In a similar fashion, the fossil fuel MAR curves are compared in Figure H-2. Figures H-1 and H-2 are cumulative—each year's data reflects the sum of that year's MAR with the prior years' MAR.

[1] The evaluators verified the MARs at 15 randomly selected facilities out of the 64 facilities contacted during the 2011 NYSERDA telephone survey. To ensure an apples-to-apples comparison, the MARs for these 15 evaluated sites are compared with the 2011 NYSERDA study's results on the same 15 sites.

Figure H-1. MPP Cumulative Measure Adoption Rate Comparison for Electric-Saving Measures

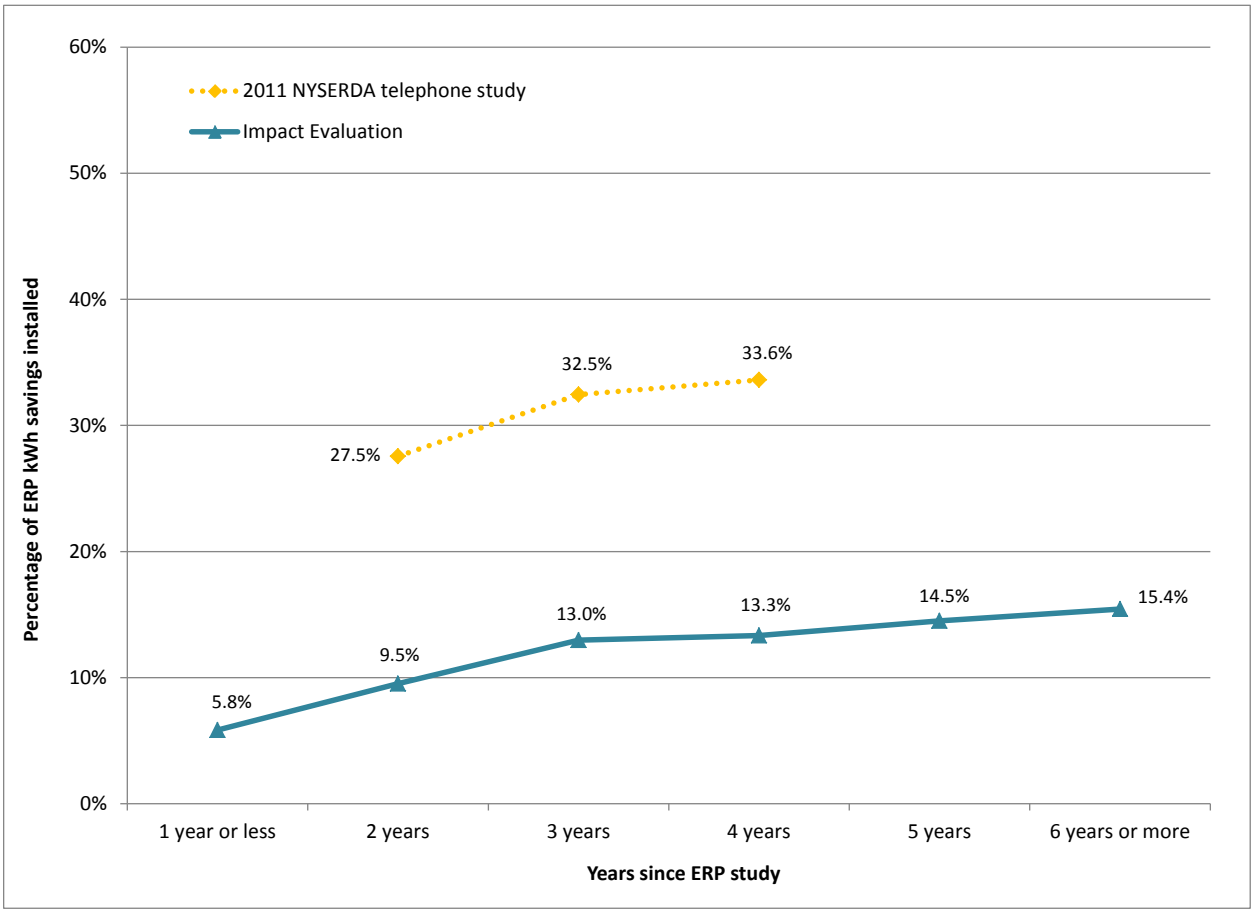


Figure H-1 indicates steady measure adoption from ERP completion through the six years following. Both datasets experienced the largest increase in MAR between the second and third years following ERP completion. However, evaluated electric MAR values constitute only 46% of program-claimed MAR on average; the Impact Evaluation Team determined that misinformation during previous telephone surveys was the likely reason for lower MAR determined during evaluation site visits.

Figure H-2. MPP Cumulative Measure Adoption Rate Comparison for Fossil Fuel-Saving Measures

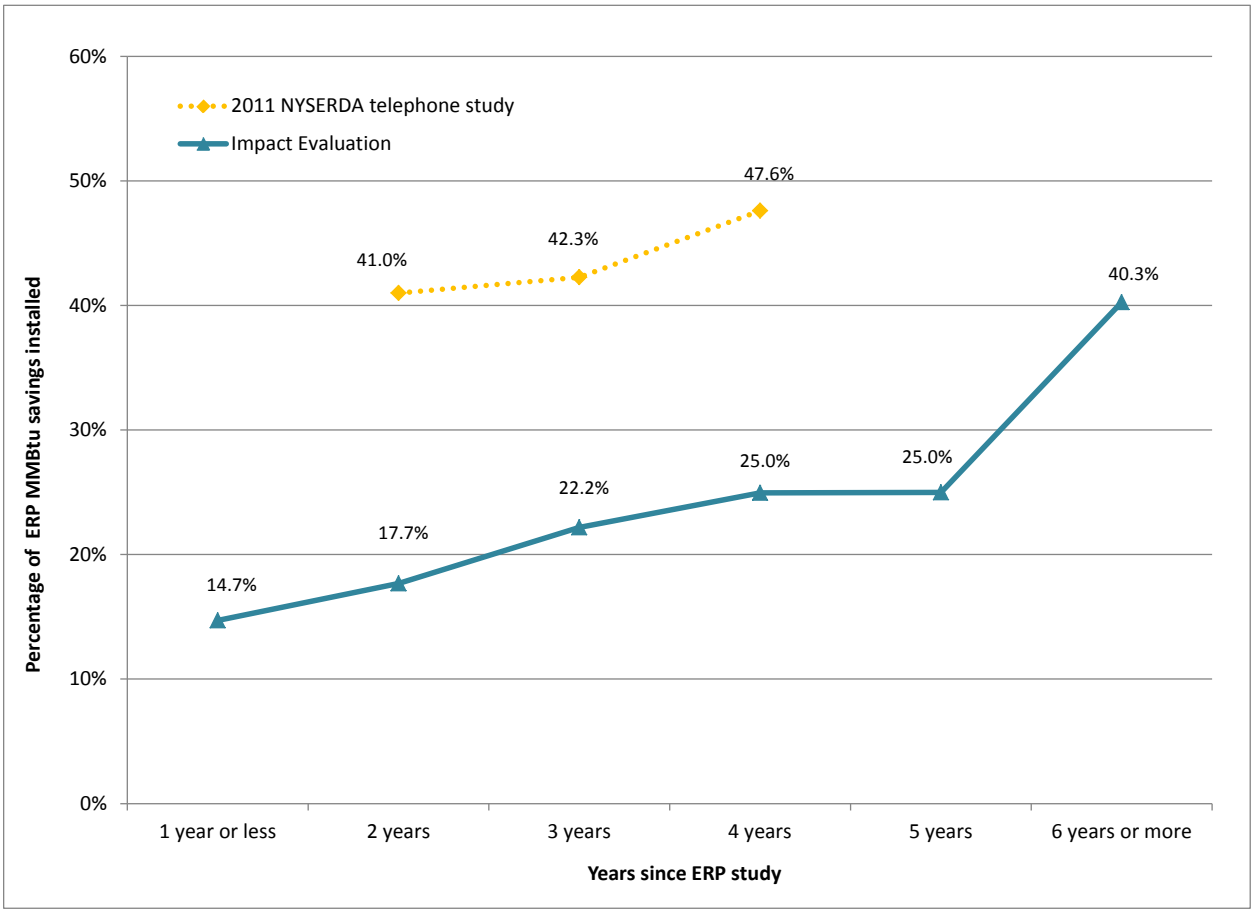


Figure H-2 indicates fossil fuel measure adoption about three times greater than electric measure adoption. A spike of 15% MAR five years after ERP completion led to an evaluated MAR approximately 85% of the program-claimed fossil fuel MAR. However, this spike is attributable to a lone high-saving measure at a large facility and cannot be assumed to be generally indicative of higher measure adoption in later years.

APPENDIX I: MEASURE-SPECIFIC DATA COLLECTION AND FINDINGS

Due to the Impact Evaluation Team's whole-building approach, which reflected the Program's whole-building design, measure-level results were difficult to achieve. Nonetheless, the evaluators used measure-specific measurement and verification (M&V) to support billing analysis results, calibrate whole-building models, and research reasons why measures performed differently than expected. Table I-1 provides information on the extent of the Impact Evaluation Team's measure-specific M&V and presents qualitative findings as a result of measure-level analysis and research. As the M&V sample did not target statistical precision at the measure level, these findings are not statistically representative and should be considered for informative purposes only.

Table I-1. Measure-Specific Data Collection and Findings for the MPP's Most Popular Measures

Measure	Number of Projects Requiring Metering	Total Number of Meters Installed	Findings
Boiler replacement or controls	25	45	• Evaluator measurements of installed boiler efficiency generally aligned with the applicant's assumption. • Program's estimate of boilers' condensing ability is conservative.
Cogeneration plant	11	28	• Systems generally run more frequently than modeled in ERP, leading to higher electric savings. • But at lower plant efficiency – DHW recovery not as extensive, introduced natural gas penalty often higher than estimated.
CFLs[1]	0	0	• Installation rate < 100% due to tenant removal or shelving. Industry studies[2] show an installation rate of approximately 75%. • New York Technical Mannual (NYTM) recommends 2.5 hr/day for screw-in fixtures in residences; Program has since updated Simulation Guidelines to reflect this value.
Common area lighting	20	144	• Better-than-expected performance due to higher common area lighting operating hours than assumed. • Bi-level fixtures and occupancy sensors generally reduced run time more than anticipated.
Sub-metering[3]	0	0	• Saves more than the NYTM recommendation of 8% reduction; evaluators calculated 15% on average. • However, there were three projects with legal complications preventing measure implementation.
Showerheads and aerators	0	0	• Difficult to draw a conclusion – nearly equal number of instances of increases and decreases in savings. • Increases in savings often due to higher preexisting gallons per minute (gpm) than modeled, or lower installed gpm than predicted. • Decreases often due to quantity installed – evidence of tenants removing low-flow fixtures.
Exhaust fans	8	26	• Control systems often manually overridden by facility management. • Program has since discontinued this measure offering.

[1] In-unit measures, such as CFLs and low-flow water fixtures, could not be metered due to inaccessibility within tenant units. However, the evaluators' on-site verification of the Program's post-inspection documentation provided valuable information on measure installation.

[2] *The Uniform Methods Project: Methods for Determining Energy Efficiency Savings for Specific Measures,* National Renewable Energy Laboratory, February 2014. http://www.nrel.gov/extranet/ump/pdfs/20140514_ump_res_lighting_draft.pdf

[3] The evaluators assessed submetering and direct-metering measure performance via a sample of tenant utility bills; no additional M&V was possible for these measures.