Real Time Energy Management Program Evaluation

Multifamily Direct and Indirect Benefits

Final Report

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Executive Summary

This report is a comprehensive program evaluation of the NYSERDA Real Time Energy Management (RTEM) program for the multifamily sector. The evaluation includes multifamily projects from Q1 of 2018 through Q4 of 2023 (indirect impacts) and Q1 2022 – Q2 2024 (direct impacts) for NYSERDA RTEM, a program that supported and encouraged the use of advanced, real-time energy management technologies in New York commercial and multifamily buildings. The report also includes findings around the non-energy benefits of the program and an examination on how the program has helped transform the New York multifamily building market.

Energy Management is an enabling technology that allows for the management of building energy consumption using a combination of building data collection and control systems (e.g., meters, sensors, equipment feeds, local/supervisory controllers), analytics, and building data information services. NYSERDA provided customers with incentives to install RTEM systems, using program-qualified vendors who installed RTEM systems and made recommendations for energy saving actions based on RTEM outputs. To quantify those savings, these vendors were required to make semi-annual service reports to NYSERDA documenting their recommendations.

The goal of this evaluation was to assess the savings that came directly from recommendations made by participating vendors (direct benefits). In addition, this evaluation assessed savings that were influenced by the program, but outside of the vendors' service reports (indirect benefits), along with market transformation efforts.

Approach

Indirect Benefit Approach

The multifamily indirect benefits evaluation included RTEM installations completed between January 1, 2018, through the end of 2023. Over the life of the program, the multifamily sector of the NYSERDA RTEM program consisted of 371 project sites from 223 unique projects overseen by 119 building owners or managers, served by 22 unique vendors. To collect the necessary data for indirect benefits, the evaluation team conducted interviews with four market actor groups, shown in Table ES-1.

Table ES-1. Overview of Indirect Benefits Data Collection Activities

Target Group/ Population (In-Depth Interviews)	Evaluation period	Pop. Size	Square Footage	Target Completes	Completes as % of Targets	Completes as % of Square Footage	Stratification
Program Staff	Q4 2020 to present	2	N/A	2	100%	N/A	N/A
RTEM Participating Building Owners/ Managers	Program inception to Q1 2024	119	47,137,219*	10	70%	82%*	Building System Type (boiler vs complex HVAC)
RTEM Participating Vendors	Program inception to Q1 2024	22		10	90%		Vendor activity (more active vs less active)
Non-Participating EM vendor	Program inception to Q1 2024	27	N/A	6	67%	N/A	RTEM qualified vs. not

**Total completed square footage is the same as the value for vendors because all interviewed customers used vendors that the evaluation team had already spoken with.*

Through the course of data collection efforts, the evaluation team contacted participating vendors, customers (building owners or managers), and nonparticipant vendors a minimum of three times. For participating vendors and customers, NYSERDA program staff conducted the initial outreach attempt due to their familiarity with participants, while the evaluation team conducted follow-up outreach. Conversely, the evaluation team kicked off initial nonparticipating vendor interview outreach before NYSERDA program staff lent additional legitimacy to the outreach efforts by following up with less responsive nonparticipants.

During staff interviews with NYSERDA, the evaluation team discovered that the multifamily sector for the RTEM program was concentrated to a few large vendors rather than the wider reach of the program's commercial sector. Based on these findings, the evaluation team and NYSERDA decided to focus evaluation efforts on areas where the program expected to have the most significant impact. In particular, the team focused on getting the best coverage through vendor interviews.

Using the data collected from the above interviews, the evaluation team, in accordance with NYSERDA's Indirect Benefits framework[1], determined three potential sources of indirect benefits, as shown in Table ES-3.

Table ES-32. Indirect Benefits Framework and Data Collection Methods by Market Actor

Indirect Benefit Sources	Indirect Benefit Framework	Market Actors
Source A: Additional operations and maintenance activities or capital upgrades done at	Direct influence participant adoption: Additional energy savings enabled by RTEM technology	Interviews with participating vendors and participating

[1] **Measuring and Evaluating Indirect Benefits (NYSERDA Indirect Benefits Framework)**

participating buildings (not captured through direct impacts)		building owners/managers
Source B: Operations and maintenance activities or capital upgrades done at nonparticipating buildings of a participating customer's portfolio	Direct influence participant adoption: Adoption of RTEM (and resulting energy savings projects) through portfolio without program incentives, but with program influence	Interviews with participating building owners/managers
Source C: Operations and maintenance activities or capital upgrades done at nonparticipating buildings of a participating or nonparticipating vendor's portfolio	Nonparticipant adoption: Adoption of RTEM (and resulting energy savings projects) among building owners/managers with no direct support from NYSERDA program	Interviews with participating vendors and nonparticipating vendors

Direct Benefits Approach

The evaluation team used the following data collection methods to inform the direct benefits analysis.

Table ES-3. Direct benefits framework and data collection methods by market actor

Market actor	Direct benefits	Data collection methods
Participating buildings (i.e., buildings that received program funding for the installation of eligible EM technology and are owned by participating organizations)	Direct involvement participant adoption: savings from NYSERDA-funded projects identified by program vendors *through vendor service reports and interviews with building owners/managers and vendors*	• Vendor service report AI data extraction for engineering reviews • Building consumption data • When possible, data collected from indirect benefits in-depth interviews with participating vendors and participating building owners/managers

The evaluation team applied a savings over time approach for RTEM which incorporates all new 1st year savings that occur within the current evaluation period, both for newly completed projects within the evaluation period and for previously completed projects that have 1st year savings from new measures verified by the evaluator as recommended and installed within the current evaluation period .

Results

Indirect Benefit Results

Indirect benefits from the NYSERDA RTEM program stem from building owners and managers using a program-eligible EM technology to identify operational changes or capital upgrades, which are then implemented at their facilities. To count as evaluated indirect benefits, these changes or upgrades must have been influenced by NYSERDA's RTEM program efforts and not included in vendor service reports.[2] Indirect benefits were assessed against NYSERDA's published framework on measuring and evaluating indirect benefits.[3] This framework defines what indirect benefits are and how they'll be evaluated for all NYSERDA programs.

Of the three indirect benefit source categories, participating buildings (Source A) saw the largest indirect benefit, accounting for over half of indirect electricity savings and roughly three-quarters of natural gas savings. Nonparticipating customers' buildings (Source C) was the next most common, and accounted for approximately one-quarter of both electricity and natural gas savings. The fewest indirect benefits were measured at the nonparticipating buildings of a participating customer (Source B), with no measured natural gas savings and minimal electricity savings reported. From the interviews, the team surmised that while most multifamily customers appreciated the RTEM system, available budget made it difficult for them to implement similar systems at additional buildings without the program incentive. Table ES-5 below shows the total indirect benefits from each source.

Table ES-4. Indirect Benefits by Source (Q1 2018-Q4 2023)

Indirect Benefit Sources	Electricity indirect benefits				Natural gas indirect benefits	
	Program-estimated (MWh)	**Evaluated indirect (MWh)**	**Evaluated percent of estimate (%)**	**Program-estimated (MMBtu)**	**Evaluated indirect (MMBtu)**	**Evaluated percent of estimated (%)**
Source A: Additional Operations and Maintenance activities done at ***participating buildings*** (not captured through direct impacts)	N/A	5,691	N/A	N/A	50,595	N/A
Source B: Operations and Maintenance activities done at ***nonparticipating buildings of a***	N/A	630	N/A	N/A	0	N/A

[2] In contrast, the program team classified savings that occurred at participating sites as direct benefits, regardless of whether these savings were captured in vendor service reports. This difference in classification partially explains why evaluation estimates for indirect benefits are much higher than program-reported values.

[3] **https://www.nyserda.ny.gov/-/media/Project/Nyserda/Files/Publications/PPSER/Program-Evaluation/PM-indirectben-gm-v4-acc.pdf**

participating customer's portfolio						
Source C: Operations and Maintenance activities done at completely ***nonparticipating customer's buildings***	N/A	2,166	N/A	N/A	9,208	N/A
Overall Indirect Impacts	**10,835**	**8,487**	**78%**	**33,553**	**59,803**	**178%**

Direct Benefit Results

Any measures listed in the vendor reports as both recommended and implemented were evaluated as direct benefits.[4] When possible, the team leveraged information gathered from the indirect benefits in-depth interviews with building owners and managers participating in the RTEM program to verify the installation of recommended and implemented actions.

There were some cases of incomplete data or data uncertainty. In two cases, interviews revealed that some measures listed in the vendor reports as both recommended and implemented had not actually been implemented. These savings were deducted from the evaluated direct benefits totals. In some instances, vendors did not report savings. The decision criteria for review of these cases is defined in Section 3.3.1, Vendor report savings review. The direction of this bias is uncertain – incomplete reporting does not necessarily mean fewer savings occurred, nor does more detailed reporting necessarily mean greater savings.

As shown in Table ES-6, during the current evaluation period (Q1 2022–Q2 2024), the RTEM program achieved a 9% VGSRR for electric direct savings and 3% for gas direct savings.

Table ES-5. Summary of Q1 2022–Q2 2024 RTEM program verified direct impacts to the multifamily sector

Program-estimated electricity savings, gross annual (MWh)	Verified electricity savings, gross annual (MWh)	Electric VGSRR	Program-estimated natural gas savings, gross annual (MMBtu)	Verified natural gas savings, gross annual (MMBtu)	Natural gas VGSRR
23,724	2,008	9%	47,762	1,288	3%

The prior RTEM Program Impact Evaluation, published in September 2023, presented realization rates for evaluated sites that had been installed from Q4 2017 through Q4 2021[5].

[4] For direct benefits, the program team's methodology included savings at participating sites, regardless of whether they were recorded in vendor reports. Because the evaluation team classified participating site savings as indirect if they were not included in vendor reports submitted to NYSERDA, the evaluated estimates for direct benefits are somewhat lower than program-reported values. Even if all participating site savings were reclassified as direct within the evaluation framework, realization rates would remain below 100%, though they would be marginally higher than currently reported.

[5] The prior study calculated two separate VGSRRs for the program to account for its calculation update to claimed savings before and after Q4 2020. The prior study used the same sample of sites in each estimation, with the method of program savings differing to simulate each period savings method across all sites.

Table ES-7 summarizes the VGSRR across the current and prior studies, as well as overall, for electric and non-electric fuel types. Note that the VGSRRs reported for the prior evaluation periods are consistent with prior reporting and were not modified by this evaluation's analysis.

Table ES-6. Summary of current, prior, and overall RTEM evaluated direct benefits VGSRR by fuel type for the multifamily sector

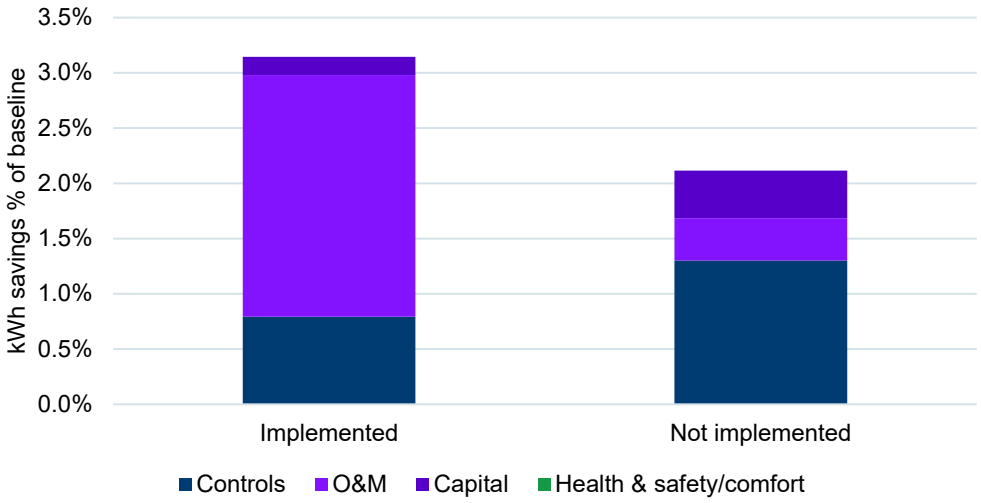
Program period	Program-estimated electricity savings, gross annual (MWh)	Verified electricity savings, gross annual (MWh)	Electric VGSRR	Program-estimated natural gas savings, gross annual (MMBtu)	Verified natural gas savings, gross annual (MMBtu)	Natural gas VGSRR
Q1 2017-Q4 2020	19,035	6,091	32%	32,557	10,744	33%
Q4 2020-Q4 2021	9,452	5,766	61%	29,898	10,165	34%
Q1 2022-Q2 2024	**23,724**	**2,008**	**9%**	**47,762**	**1,288**	**3%**
Overall	52,211	13,865	27%	110,217	22,198	20%

same With the benefit of AI and enhanced data collection approaches in this evaluation, the evaluation team also reviewed the recommended measure quantities and energy savings. Key takeaways include the following:

- **HVAC controls:** Of the strategic focus areas, the HVAC controls measure category was recommended at multifamily buildings in the RTEM program the most, at 557 measures or 45% of all recommended measures. The most common measures in this category include temperature setpoint adjustments, occupancy-based controls, installing or calibrating sensors, and equipment runtime adjustments. HVAC controls represent 31% of the recommended electric savings, and 27% of the recommended gas savings.
- **Hot water control:** Another strategic focus area shows promise in the RTEM program with the largest gas savings impact at 70% of recommended gas savings at only 9% of the recommended measure count. The most common measures in this category include hot water supply temperature adjustment, reducing or eliminating makeup water volume, and equipment staging or runtime adjustment.
- **Motors, pumps, VFDs:** Although not directly a strategic focus area, the total recommended electric savings is 17% from just 6% of the measures. The most common measures in this category include installing VFD controls on existing motors, replacing motors with electronically commutated (EC) motors, and adjusting motor speed setpoints of pumps with existing VFD controls.

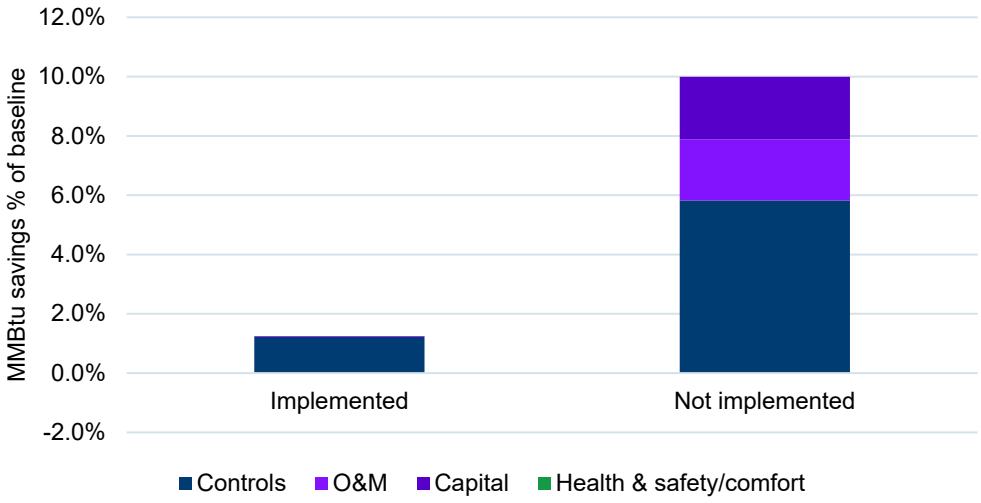
As Figure ES-3 shows, implemented measures have an average electric savings of 0.2% of baseline for capital measures, 0.8% of baseline for controls measures, and 2.2% of baseline for O&M measures. The not-implemented measures have an average electric savings of 0.4% of baseline for capital measures, 1.3% of baseline for controls measures, and 0.4% of baseline for O&M measures. This figure includes the first year savings for all measures from both the previous and current evaluations.

Figure ES-1. Implemented and not implemented average first year electric savings by measure type



As Figure ES-4 shows, implemented measures have an average gas savings of less than 0.01% of baseline for capital measures, 1.2% of baseline for controls measures, and 0.03% of baseline for O&M measures. The not-implemented measures have an average gas savings of 2.1% of baseline for capital measures, 5.8% of baseline for controls measures, and 2.1% of baseline for O&M measures. This figure includes the first year savings for all measures from both the previous and current evaluations.

Figure ES-2. Implemented and not implemented average first year gas savings by measure type



The evaluation was limited by non-random sample response. While the primary sites to be included in this analysis were based on a random sample, several sites were excluded for missing information or because the AI process was unable to extract information from certain project types. This may result in biased population estimates.

Findings and Recommendations

Indirect Benefit Findings and Recommendations

Finding 1

In the multifamily sector, the largest source of indirect benefits was from participating building owners/managers implementing additional operation/maintenance upgrades and changes at participating buildings (Source A), which resulted in 5,691 MWH and 50,595 MMBtu. The second largest source of indirect benefits came from participating vendors also introducing RTEM to some of their customers without receiving NYSERDA incentives (Source C), resulting in 2,166 MWH and 9,208 MMBtu.

Recommendation 1: In future programs, NYSERDA could continue to support these sources of indirect benefits by making sure that projects have strong "energy champions" that continue to push the potential for energy savings that RTEM enables. Several of the vendors who shared evidence of indirect benefits also mentioned that they had specifically had someone who pushed for using RTEM to generate additional energy saving ideas.

NYSERDA Response to Recommendation: Implemented. Programs maintain the importance of onsite energy champions to enhance uptake and persistence of energy efficiency measure savings, in addition to non-energy benefits from NYSERDA program engagement.

Finding 2

There is not enough evidence yet to indicate that the program has transformed the New York EM market for the multifamily sector. Rather, it appears that a large swath of the New York multifamily market still needs some sort of support to adopt RTEM. Of the five participating customers who managed buildings in their portfolio that did not receive a NYSERDA incentive, only one decided to implement RTEM at these other buildings. As a result, Source B only generated 630 MWH and 0 MMBtu. Furthermore, only one-third of participating vendors had replicated RTEM projects with customers that did not receive incentives. Among the four vendors that also completed both multifamily and commercial projects through the program, there was a consensus that while multifamily projects tended to be smaller, multifamily building owners often expressed a greater need for financial support due to more limited resources.

Recommendation 2: NYSERDA could consider follow-up outreach with customers that did not adopt RTEM at all the properties in their portfolio to better understand multifamily owners/managers' decision-making process.

NYSERDA Response to Recommendation: Pending. NYSERDA will consider follow-up outreach with RTEM MF customers to collect additional direct and subsequent indirect benefits.

Finding 3

Participating vendors and customers frequently lauded the non-energy benefits of RTEM systems. Vendors described improvements to temperature control and regulation, improving occupancy comfort, while also highlighting improved building management efficiency. RTEM systems allowed for quicker troubleshooting of operational issues, and the remote monitoring of building systems by smartphone made fault detection and repair easier and faster.

Recommendation 3: In future programs, NYSERDA could consider working with affiliated vendors to make non-energy benefits a bigger selling point for potential customers. All interviewed customers reported using RTEM for non-energy benefits despite their initial focus on energy savings. NEBs could serve as a gateway towards greater adoption of EM technology if they were more frequently communicated.

NYSERDA Response to Recommendation: Implemented. Non-energy benefits are incorporated into programs where relevant.

Direct Benefit Findings and Recommendations

Finding 1

Among multifamily facilities, the RTEM program achieved electric direct energy savings of 2,008 MWh, with a realization rate of 9%, and non-electric direct energy savings of 1,288 MMBtu, with a realization rate of 3%, during the current evaluation period (Q1 2022–Q2 2024). Since inception (Q1 2017–Q2 2024), the RTEM program achieved electric and non-electric direct energy savings of 13,865 MWh, with a realization rate of 27%, and 22,198 MMBtu, with a realization rate of 20%, respectively among multifamily facilities. The program influenced owners and managers of participating buildings to complete additional actions outside of those reported in vendor service reports, and those actions were associated with notable energy savings accounted for as indirect benefits.

Recommendation 1a: To better capture the full scope of program impacts, consider requiring vendors to report implemented savings, or establishing another systematic method for capturing savings attributable to RTEM systems. Direct savings estimates from vendors who provided this information were higher than those from sites without such reporting, while indirect savings estimates often rely on customer-reported actions that can be affected by recall bias. More consistent documentation of implemented actions and associated savings would reduce underestimation risk and provide a clearer picture of the program's influence on operational practices and decision-making in the market.

NYSERDA Response to Recommendation: Pending. NYSERDA will revisit during future iterations of the program.

Recommendation 1b: Consider requesting, at program intake, key technical details for equipment monitored by the RTEM system - for example, manufacturer spec sheets, system capacity, square footage or space served, and other relevant characteristics (e.g., for HVAC units, whether they are connected to other systems). While some of this information has been collected during application submission, it has not been part of the program process to identify site-by-site specific savings. Having these details readily available would be valuable during future evaluations that follow a similar process, as it would help evaluators determine what actions customers took because of the RTEM system and better understand the magnitude of associated savings. Collecting this information at intake is generally more efficient and less burdensome than attempting to gather it retrospectively during evaluation.

NYSERDA Response to Recommendation: Pending. NYSERDA will consider this feature for future program iterations.

Finding 2

Electronic Data Interchange (EDI) data were successfully obtained for 40 sites. For the remaining sites, no usable data were returned from the EDI request. In addition, while the program collected some pre-installation consumption data, these data were only sufficient for 2 sites, as the vast majority included just a single month of consumption. The lack of complete, standardized baseline data significantly limited opportunities to conduct billing analysis to derive savings.

Recommendation 2: To support robust evaluation and long-term market insights, the program could consider requesting EDI data for all participating sites for each program year. If adopted, the program could extract account numbers and points of delivery (PoDs) from applications and submitted bills/proof of account upon program intake then immediately attempt to acquire baseline data to confirm the accuracy of the account numbers and PoDs in the tracking data. This will ensure data is available for savings estimation and

evaluation. Note: there are some measures where billing data may be unable to provide direct quantification of savings, for example early identification of a system needing repair will often not have a period operating in poor condition to support billing or even advanced metering infrastructure–based estimation of savings because the increase in usage was avoided. Despite this risk, having more of the consumption data can enable better savings estimates even when used indirectly and can provide better baseline consumption estimates than the current square footage estimates provide. This, in turn, strengthens the program's ability to demonstrate its role in transforming market practices and decision-making over time.

NYSERDA Response to Recommendation: Pending. Some, but not all NYSERDA programs will have this feature moving forward.

Finding 3

Vendor service reports provide the best available information for measure installation and savings verification for the RTEM program and thus are the primary source for evaluation of direct savings. This is a key risk for the program, as vetting of the savings claims with engineering and baseline assessments was not possible. As described previously, customer reports suffer from recall bias, and billing data was largely unavailable or incomplete. The evaluation team confirmed that vendor-reported implementations were completed, but where savings magnitudes were not reported, evaluator estimates of these savings may be lower than actual savings.

Recommendation 3: Continue to assess available methods for evaluation of the RTEM program. For instance, concurrent evaluation of targeted sites with large estimated savings and multi-site projects within two years of EM system installation would have much higher likelihood of capturing measure-level post-installation information and participating organization intentions for future installations, associated savings data, and non-routine events such as major equipment upgrades. Similarly, utility billing data would be more readily available through EDI request. Customer and vendor interviews at this early stage would provide feedback to vendors on the critical importance of vendor service report data for evaluation of program direct benefits and capture more real-time indirect benefits as they are planned and occur.

NYSERDA Response to Recommendation: Implemented. NYSERDA is implementing pre-install interviews on select programs.

Finding 4

Vendor reports often included activities that might incur cost-savings through diagnostics and fault detection events, but did not report any annual energy savings from such measures. NYSERDA assumes modeled energy savings for all fuels serving a site, so the presence of these activities can substantially depress realization rates and projected savings as a percentage of estimated baseline.

Recommendation 4: Consider including a post-installation verification step to confirm actual vendor-reported and installed energy-saving measures upon project completion or as part of the acquired savings process. This step will help verify actual baseline energy consumption and vendor-reported energy savings from installed measures. Post-installation verification will also identify instances where only diagnostics or fault-detection activities were implemented, which result in cost savings for a site but not significant annual energy savings.

NYSERDA Response to Recommendation: Implemented. NYSERDA is implementing a post-installation verification on select programs.

1 Introduction

This report is a comprehensive program evaluation for the NYSERDA Real-Time Energy Management (RTEM) program, verifying both the direct and indirect benefits for the multifamily sector from January 2018 through December 2023 (indirect) and January 2022 through June 2024 (direct). For energy savings, the evaluation focuses on the savings generated by actions influenced by program incentivized real-time Energy Management (EM) technologies. Other than energy savings, the report also includes findings around the non-energy benefits of the program and an examination on how the program has helped transform the New York multifamily building market. This report covers the results for these direct and indirect benefits for the multifamily sector along with how the program has impacted the market. It begins with a description of the program and research objectives, followed by the results and findings, the methodology, and the detailed analysis.

1.1 Program Description

The NYSERDA RTEM program helped support and encourage the use of advanced, real-time energy management technologies in New York commercial and multifamily buildings. Energy Management is an enabling technology that allows for the management of building energy consumption from a combination of building data collection and control systems (e.g., meters, sensors, equipment feeds, local/supervisory controllers), analytics, and building data information services. EM systems and services that meet the unique needs of building owners help catalyze private investment to improve energy performance.

NYSERDA partnered with qualified vendors to operate either as a full system provider or as just a service provider. Full system providers helped the customer develop, install, and integrate the RTEM software and additional hardware that would track and analyze energy information, while service providers acted primarily as energy consulting services to recommend and implement energy saving actions from an existing RTEM system. In addition, customers' RTEM systems could be focused on automated system optimization (ASO), fault detection diagnostics (FDD), or a combination of the two depending on their vendors. Vendor systems that are focused on ASO specializes in optimal start/stop measures, whereas those who specialized in FDD focus on identifying faults in equipment.

To support the adoption of RTEM, the program provided cost-share incentives based on project cost (30% for up to a five-year vendor contract), although this was adjusted to 20% for up to three-year contracts for market rate multifamily projects effective January 12th, 2021. Project costs included both the installation of RTEM hardware as well as the provision of software and ongoing services. After RTEM had been integrated into a building's operations, participating vendors were required to submit a semi-annual service report to NYSERDA in order to track progress through actionable insights that address operational stray and identify capital upgrades and other energy conservation measures.

For the multifamily sector specifically, the NYSERDA RTEM program enrolled a total of 371 project sites through 223 unique projects, served by 22 unique participating vendors. NYSERDA spent $14.8 million and impacted more than 61.6 million square feet of building space on these projects. Multifamily projects primarily fell into two categories, projects that occurred in buildings with only a central boiler system and projects that had full central HVAC to the apartments, which operated more similarly to commercial buildings.

1.2 Evaluation Objectives

The overall goal of this evaluation is to assess the indirect and direct benefits that resulted in the multifamily sector due to NYSERDA's RTEM program. The evaluation team divided this goal into two main objectives, summarized below in Table 1-1, along with their purpose and data collection methodology.

Table 1-1. Evaluation Objectives, Purpose, and Methodology

Objective	Purpose	Method
Assess indirect impacts and market effects achieved by NYSERDA's RTEM Program	Determine program influence on market actors, including participating building owners/managers, participating vendors, and non-participating vendors	Interviews with building owners/managers[6], participating vendors[7], non-participating vendors
Continue collection of direct impacts of Energy Management Technology installed through RTEM Program[8]	Verify first year gross savings for program participants: evaluated savings as a percent of evaluated baseline, realization rate	Vendor service report engineering reviews and interviews Building consumption data review, with IPMVP Option C: Whole Building Verification attempted for each site[9]

[6] While primarily focused on indirect impacts, when possible, information pertinent to direct benefits were gathered and utilized to assess those impacts.

[7] While primarily focused on indirect impacts, when possible, information pertinent to direct benefits were gathered and utilized to assess those impacts.

[8] Previous evaluation report found here: https://www.nyserda.ny.gov/-/media/Project/Nyserda/Files/Publications/PPSER/Program-Evaluation/2023-09-22-Matter-No-16-02180-NYSERDA-CEF-RTEM-Phase-III-Impact-Report.pdf

[9] In all cases, data gaps prevented full Option C analysis; however, available building-level consumption data were used as a reasonableness check on measure-level reported savings, rather than to confirm the presence or absence of additional savings.

2 Results and Findings

This section documents results, findings, and recommendations for indirect and direct impacts to the multifamily sector. Figure 2-1 summarizes the key results across direct and indirect impacts.

Figure 2-1. Overall Results by Vendor Type

Software Overlay Only

Indirect savings ratio (electric): **11%**	Indirect savings ratio (gas): **36%**	Direct verified savings (% of baseline energy consumption, electric): **0.56%**	Direct verified savings (% of baseline energy consumption, gas): **0.54%**

Overall commentary: Most vendors in the software overlay category were also classified under the ASO reporting focus. These vendors recommended more HVAC controls measures and HW controls measures than other vendor types. HW controls measures led to higher-than average direct gas

Software Overlay + Controls Install

Indirect savings ratio (electric): **2%**	Indirect savings ratio (gas): **7%**	Direct verified savings (% of baseline energy consumption, electric): **0.88%**	Direct verified savings (% of baseline energy consumption, gas): **0.00%**

Overall commentary: Most software overlay + controls vendors frequently installed HVAC controls and whole building monitoring measures, with whole building monitoring measures contributing to higher-than average direct electric impacts.

ASO Reporting Focus Only

Indirect savings ratio (electric): **11%**	Indirect savings ratio (gas): **36%**	Direct verified savings (% of baseline energy consumption, electric): **0.56%**	Direct verified savings (% of baseline energy consumption, gas): **0.54%**

Overall commentary: ASO Reporting Focus Only vendors recommended more HVAC controls and HW controls measures than other vendor types; and recommended the largest proportion of energy savings from HVAC controls measures with 70.0% direct electric and 99.6% direct gas savings of the total recommended HVAC controls savings. The HW controls measures led to higher-than-average

FDD Reporting Focus Only

Indirect savings ratio (electric): **N/A**	Indirect savings ratio (gas): **N/A**	Direct verified savings (% of baseline energy consumption, electric): **N/A**	Direct verified savings (% of baseline energy consumption, gas): **N/A**

Overall commentary: There were no FDD reporting focus only vendors.

ASO + FDD Reporting Focus

Indirect savings ratio (electric): **2%**	Indirect savings ratio (gas): **7%**	Direct verified savings (% of baseline energy consumption, electric): **0.88%**	Direct verified savings (% of baseline energy consumption, gas): **0.00%**

Overall commentary: Vendors who focused on both ASO and FDD recommended fewer HVAC control measures than those who focused solely on ASO. However, HVAC control measures constituted a larger proportion of the measures implemented by this group, leading to a higher percentage of electric savings relative to baseline consumption.

OEM Controls

Indirect savings ratio (electric): **N/A**	Indirect savings ratio (gas): **N/A**	Direct verified savings (% of baseline energy consumption, electric): **N/A**	Direct verified savings (% of baseline energy consumption, gas): **N/A**

Overall commentary: There were no OEM controls vendors.

Overall

Indirect savings ratio (electric): **6%**	Indirect savings ratio (gas): **20%**	Direct verified savings (% of baseline energy consumption, electric): **0.76%**	Direct verified savings (% of baseline energy consumption, gas): **0.20%**

Overall commentary: Vendor reports often included cost-savings activities through FDD events, but did not report annual energy savings, leading to reduced direct savings as a percentage of baseline.

2.1 Indirect Benefit Results

The program's estimated indirect benefits were estimated as a percentage of total direct benefits. Since program estimated direct benefits included all savings at participating buildings regardless of whether they were present in vendor reports. For this evaluation, indirect benefits were classified as any savings not included in vendor service reports, which means that evaluated indirect benefits will be higher on average that program estimated values. Evaluated indirect benefits for the program came from three potential sources. First, participating building owners and managers could have made additional operations or capital upgrades at buildings that already received NYSERDA incentives (Source A). Second, participating building owners and managers could have replicated the scope of their participating building projects at other nonparticipating buildings within their portfolio (Source B). Finally, vendors (participating or nonparticipating) could have sold RTEM or RTEM-like systems to nonparticipating customers (Source C). The evaluation team mapped these three pathways to each of the market actors that the team contacted, as summarized in Table 2-1. To delineate indirect benefits from direct benefits, any of these changes or upgrades must not have appeared in the vendors' official service reports that were uploaded to NYSERDA.

Table 2-1. Sources of Indirect Benefits vs Market Actor Interviews

Indirect Benefit Sources	Participating Vendors	Participating Owners and Managers	Nonparticipating Vendors
Source A: Additional operations and maintenance activities or capital upgrades done at ***participating buildings*** (not captured through direct impacts)	X	X	
Source B: Operations and maintenance activities or capital upgrades done at ***nonparticipating buildings of a participating customer's portfolio***		X	
Source C: Operations and maintenance activities or capital upgrades done at completely ***nonparticipating customer's buildings***	X		X

In total, the evaluation team conducted in-depth interviews with nine participating vendors, seven participating owners/managers, and four non-participating vendors to inform the three sources of indirect benefits. The evaluation team defined participating vendors as vendors that completed at least one multifamily project through the NYSERDA program within the agreed upon time frame; when conducting outreach, the team categorized them as more active (top seven by impacted square footage) and less active (the remaining 15 vendors). The evaluation team also categorized participating customers into two groups based on building type, described above in Section 1.1. For nonparticipating vendors, the evaluation team restricted the population to only include vendors that had at least contacted NYSERDA about potentially participating in the program, but never completed a project.

To calculate the indirect benefits, the evaluation team conducted in-depth interviews with each of the market actors about the potential sources indicated in Table 2-2. Once the team identified energy savings actions, engineering analyses were conducted when possible, depending on the interviewee's level of detail in their responses. When the interviewee was unable to give sufficient detail, the team relied on estimates and proxy savings information based on program estimated direct benefits or similar measures at similar buildings, scaled

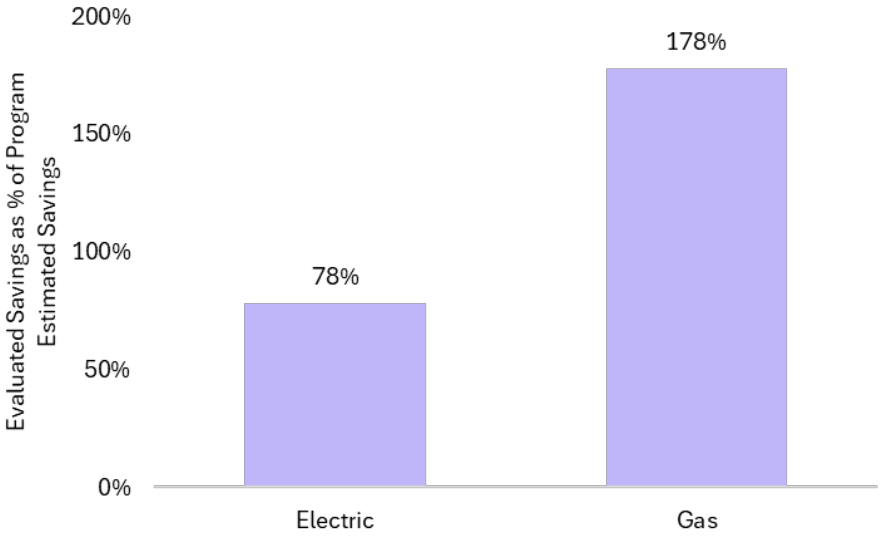
to project size by impacted square footage. Overall indirect benefit calculations by source shown against program estimated indirect savings are summarized in Table 2-2[10]. The rest of this section provides a high-level summary of savings from each indirect benefit category. For more detailed calculations, please refer to Section 3.2.

Table 2-2. Indirect Benefits by Indirect Benefit Source

Indirect Benefit Sources	Program Estimated Savings, Annual (MWH)	Evaluated Electricity Savings, Annual (MWh)	Program Estimated Savings, Annual (MMBTu)	Evaluated Natural Gas Savings, Annual (MMBtu)
Source A	N/A	5,691	N/A	50,595
Source B	N/A	630	N/A	0
Source C	N/A	2,166	N/A	9,208
Overall Indirect Impacts	**10,835**	**8,487**	**33,553**	**59,803**

Additionally, Figure 2-1 shows the total evaluated indirect benefits as a percent of program estimated indirect savings. Overall, the evaluation found a higher incidence of gas savings than electric savings compared to the programs' initial estimates both by the raw value (as seen above) and the ratio (seen below). This is driven by the focus on gas measures for multifamily buildings in general, but also by a couple of the biggest vendors that showed signs of indirect benefits *only* offering gas-saving equipment.

Figure 2-2. Evaluated Indirect Benefits as % of Program Estimated Savings



[10] Program estimated indirect savings are calculated by using the 2020 NYSERDA indirect methodology (8% of program estimated direct benefits).

2.1.1 Source A: Indirect benefits from participating buildings

Building owners and managers received program funding for the installation of eligible EM technology by program affiliated vendors. The participating vendor generally used the RTEM system to make periodic recommendations in service reports that would help their customers save energy at their participating buildings. However, both participating vendors and customers reported that not all of their RTEM-influenced energy savings actions at participating buildings were included in those service reports. To estimate indirect impacts at participating buildings, the impact evaluation team interviewed participating vendors along with the participating customers to get a better understanding of the quantity and magnitude of the energy saving activities that they completed at participating buildings beyond what had been reported in the vendor service reports. The evaluation team asked vendors whether they had recommended any additional energy savings actions installed in their participating customers' buildings that they did not report to NYSERDA in vendor service reports. The team then asked customers separately whether they could identify any energy saving actions motivated by their RTEM project that their vendor did not include in their official service reports submitted to NYSERDA. In both interviews with customers and vendors, the evaluation team heard a common theme: a strong "energy champion" for a customer's building was often the deciding factor for whether customers used RTEM for additional energy saving actions. This energy champion could be either vendor staff or in-house staff from the customer's organization. For more qualitative detail on this finding, please refer to Section 2.2.2.

Participating Vendors

In total, the evaluation team found that two of the nine (22%) interviewed participating vendors confirmed evidence of indirect benefits at their participating customers' buildings. They reported the following actions as having energy savings value that did not appear in the service reports:

- "**Soft value,"** including:
  - Heat complaint checklist and support
  - Estimated bill resolution
  - Instructions on how and why to monitor make up water usage
  - Visual inspections on-site
  - Deep dives in combined heat and power (CHP) operation
  - Holding contractors accountable
- **Steam distribution balancing** – Rebalancing the steam distribution system allowed heating setpoints to be lowered, resulting in reduced natural gas usage
- **Steam pressure setpoint reduction** – Lowering the steam system pressure setpoint results in reduced natural gas usage
- **Steam leak repair** – Fixing steam leaks yields a reduction in makeup water, which results in reduced natural gas usage
- **Initial controls installation** – One of these two vendors also mentioned that they did not include the savings obtained from the first year's installation of controls in their service reports. The evaluation team counted them as indirect benefits in a manner consistent with NYSERDA's Indirect Benefits Framework, since the claimed recommendations or ECM actions were not included in vendor service

reports. [11]

Participating Customers

In total, the evaluation team found that one of the seven (14%) interviewed participating customers confirmed evidence of indirect benefits at their participating buildings. This customer mentioned the following actions as having energy savings value that did not appear in the service reports:

- **Fixing an underground water leak**
- **Adjustments to the stack temperature**, leading to immediate fossil fuel savings that the RTEM system tracked year over year
- **Performing annual maintenance on equipment,** specifically their boiler

2.1.2 Source B: Indirect benefits from nonparticipating buildings owned by participating organizations

Following their participation in the NYSERDA RTEM program, building owners and managers could choose to replicate their RTEM projects at other buildings within their portfolio. Indirect benefits for this group are based on the energy savings generated by EM technology at buildings/sites without program funding, since this decision was influenced by program participation. The evaluation team determined the results of these indirect benefits through interviews with participating customers.

Participating Customers

In general, the evaluation team found that participating customers preferred to follow through with projects only if they received NYSERDA incentives, leading to very low incidence of indirect benefits through this pathway. In total, only one of the seven interviewed customers showed evidence of Source B indirect benefits. This customer confirmed that they had replicated the exact scope of their participating building at one other building in their portfolio, and that they did so after the NYSERDA RTEM program was no longer offering incentives for multifamily buildings. The evaluation team calculated indirect benefits using the participating building's direct benefits, then adjusted the value based on the square footage of the nonparticipating building.

2.1.3 Source C: Indirect benefits from nonparticipating buildings owned or managed by nonparticipating organizations

Some nonparticipating building owners and managers also installed RTEM-like systems in their buildings without receiving any NYSERDA incentives. These projects could be considered indirect benefits if they were enabled by the NYESRDA RTEM program. Based on program theory, the RTEM program could have helped increase customers' awareness and confidence in RTEM, thus increasing demand. Likewise, the RTEM program could have helped vendors develop and market their RTEM offering, thus affecting the supply. Through these impacts, both participating and nonparticipating vendors could have expanded their sales even when customers did not receive a direct incentive from NYSERDA.

[11] The evaluation team will be counting this one customer's responses as indirect benefits since the actions were not noted as recommended in service reports and the vendor confirmed through an interview that no additional actions were implemented at the site. Subsequent discussions with the vendor were successful at revealing savings through installation of the RTEM system, but without sufficient detail required to assign as direct savings.

Participating Vendors

In total, the evaluation team found that three of the nine (33%) interviewed participating vendors confirmed evidence of indirect benefits at other nonparticipating customers' properties. Since many of these additional projects were in fairly early stages of the process, vendors could not give specific examples of energy savings actions in these buildings, but were able to confirm that they replicated the scope of their participating customers. The evaluation team was able to use this information along with the nonparticipating buildings' square footage to create adjusted savings estimates for these properties.

Nonparticipating Vendors

Of the four interviewed nonparticipating vendors, none indicated evidence of indirect benefits. In accordance with the agreed upon interview guide, the team asked nonparticipant vendors whether they had implemented any RTEM-like multifamily projects in the years since the multifamily program kicked off (2019While vendors generally praised NYSERDA's incentives for encouraging some multifamily customers to install RTEM systems and some had completed similar RTEM-like projects[12], none reported completing any RTEM-like projects that were influenced by the NYSERDA RTEM program.

2.1.4 Indirect benefits by year

To show how program indirect benefits changed over time, the evaluation team created Table 2-3 to show the total indirect benefits by year. The team defined "year" as the calendar year in which the measure or operations were implemented at a customer site by the vendor. While multifamily indirect benefits had peaks and valleys in various years, the team did not identify a specific pattern. Based on interviews with vendors, the team concluded that vendors generally implemented measures at customer sites within a year of the initial system installation.

Table 2-3. Indirect Benefits by Year

Year	Program Estimated Electric indirect benefits (MWh)	Program Estimated Gas indirect benefits (MMBtu)	Evaluated Electric indirect benefits (MWh)	Evaluated Gas indirect benefits (MMBtu)
2018	0	0	411	5,066
2019	742	2,299	1,472	11,856
2020	3,505	10,855	2,169	13,572
2021	2,507	7,765	574	10,781
2022	3,276	10,144	97	5,181
2023	228	707	839	4,324
2024	576	1,782	2,925	9,025
Total	**10,835**	**33,553**	**8,487**	**59,803**

[12] These vendors that completed RTEM-like multifamily projects reported that they would have done so regardless of whether the NYSERDA RTEM program had existed.

2.1.5 Indirect benefits by vendor type

The evaluation team also grouped indirect benefits by vendor types, looking at the services and focus of projects completed by multifamily vendors for the RTEM program. Table 2-4 shows the indirect savings ratios by each of the vendor types agreed upon with the NYSERDA programs team. Indirect savings ratios are calculated by taking the evaluated indirect benefits and dividing them by the project reported direct benefits.

Table 2-4. Indirect Benefits by Vendor Type

Vendor Type	Number of interviewed vendors	Indirect savings ratio (electric)	Indirect savings CI (electric)	Indirect savings ratio (gas)	Indirect savings CI (gas)
Software Overlay Only	4	11%	±35%	36%	±67%
Software Overlay + Controls Install	5	2%	±6%	7%	±19%
ASO Reporting Focus Only	4	11%	±35%	36%	±67%
FDD Reporting Focus Only	N/A	N/A	N/A	N/A	N/A
ASO + FDD Reporting Focus	5	2%	±6%	7%	±19%
OEM Controls Only	N/A	N/A	N/A	N/A	N/A
Overall	**9**	**6%**	**±11%**	**20%**	**±25%**

2.2 Market Indicators and Non-Impact Findings

Besides asking market actors to help the evaluation team estimate indirect benefits, the evaluation team also asked interviewees about their program experiences along with various program market indicator questions that helped the team understand how the NYSERDA RTEM program has influenced the EM market in New York. The rest of the chapter provides more detailed findings and quotes from each of the market actor groups.

2.2.1 Market Indicators

To better understand the impact of the RTEM program on the multifamily energy management market, the evaluation team estimated a number of market indicators tied to the program's logic model outcome indicators, as shown in Table 2-4. Given the relatively small number of interviews completed, these indicators should be considered as qualitative insights into how NYSERDA achieved the indirect impacts above.

Table 2-5. Program Market Indicators

Outcome and (Market Actor)	Indicator	Result
Increased awareness of using EM to support capital project planning (Participating Customer)	Percent of building owners/managers aware/knowledgeable of RTEM long-term capital project planning	57%
	Percent of owners/managers participating in NYSERDA Training courses	Training originally targeted for summer of 2024, but never happened
Awareness and use of EM technology, and RTEM program (Participating and Nonparticipating Vendors)	Percent of providers aware of RTEM program resources, programmatic criteria, and standards by providers	100%, although nonparticipating vendors included in study by definition at least had contact with NYSERDA about qualifying for the program
	Number of EM providers	49 confirmed multifamily vendors that either participated in the program or were at least in contact with NYSERDA (27 nonparticipating vendors)
	Percent of offerings with RTEM	92%
Increased use of EM (Participating Customer)	Percent of owners/managers implementing optimal start/stop	71%
	Percent of owners implementing fault detection and diagnostics (FDD)	57%
Customer confidence in EM results (Participating Customer)	Percent (or number) of implemented measures installed after NYSERDA engagement	86%
Increased use of EM for non-energy benefits (Participating Customer)	Percent of tenants including RTEM/EM stipulations within lease requests	0%
	Percent reduction in tenant hot/cold calls	71%
	Percent of owners/managers implementing occupancy-based management	29%

Outcome and (Market Actor)	Indicator	Result
Variables affecting persistence of RTEM service contracts (Participating Vendor)	Percent RTEM service contracts at least 5 years in duration	14% (but most vendors reported that while customers are generally signing 12-month renewable contracts, most wanted to renew their service contracts indefinitely)
Percent of RTEM projects that use services for non-energy benefits (Participating Customer)	Number of RTEM projects that use services for non-energy benefits after NYSERDA engagement	100%
Utilization of RTEM data sets to advance efforts at demand reduction & peak load shaving (Participating Vendor)	Percent of vendors implementing demand reduction and peak load shaving for replication sites and other projects within the vendor portfolio	33%
Demonstrated energy savings/O&M benefits from RTEM activities (Participating Vendor)	Ratio of efficiency control measures (ECM) identified: ECMs implemented in addition to those recommended during NYSERDA engagement	44%
RTEM providers identify & act on energy efficiency opportunities (Participating Vendor)	Number/type of additional energy efficiency opportunities identified by RTEM providers (current and former)	See section 2.1

2.2.2 Participating Contractor Program Experience

This section presents additional insights into vendors' program experiences and non-energy benefits from the nine interviewed vendors that had completed at least one multifamily project through the NYSERDA RTEM program.

Program Influence

Participating vendors generally reported a very positive experience participating in the NYSERDA multifamily RTEM program. They saw NYSERDA's RTEM program as straightforward and easy to participate in and found the NYSERDA staff supportive. Vendors found there to be no major barriers to participation, and that the requirements reflected the kind of practices that were already part of their energy management work. In particular, vendors praised the size and availability of the incentives in helping them to get an opening with customers to promote energy management. Among the four vendors that also completed commercial projects through the program, there was a consensus that while multifamily projects tended to be smaller, multifamily building owners often expressed a greater need for financial support due to more limited resources.

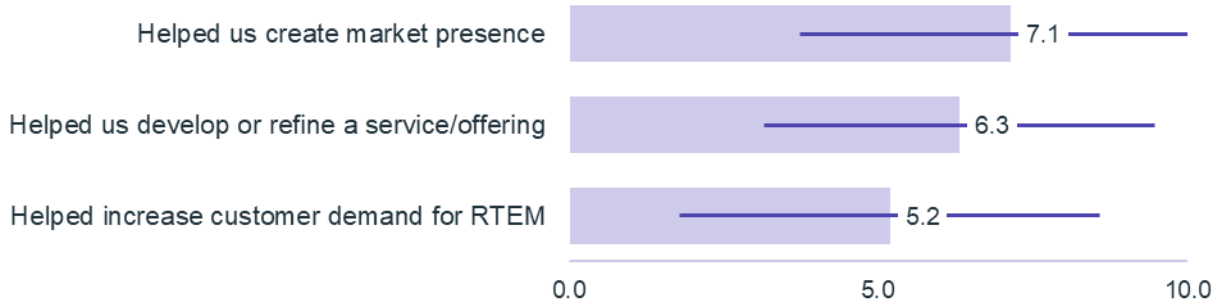
Besides the incentives themselves, vendors felt that the RTEM program and the NYSERDA label lent a degree of credibility and trust. Three of the vendors mentioned that they had worked for years to promote energy

management, and NYSERDA's RTEM program gave the practice a stamp of approval. For instance, one vendor said that the program:

> **"helped buildings who were previously unsure of the technology. It helped validate that the technology itself was going to be valuable to a building." (PV)**

This stamp of legitimacy also extended to vendors' view on how the RTEM program impacted their energy management business as a whole. As seen in Figure 2-1, when asked to rate NYSERDA's influence on each of the following statements, vendors felt most strongly that the program had helped them create a better market presence in the energy management space within New York.

Figure 2-3. Participating Vendor Responses to Market Impacts of RTEM, on a scale of 1–10 (n=9)



Note: Error bars shown to illustrate standard deviation of responses.

While vendors clearly approved of the program, a majority (six of nine) were quick to point out that the ultimate effectiveness of the RTEM system was largely dependent on customer staff using the equipment properly. After the initial installation, vendors made recommendations to help customers save energy, but many customers would only implement the lowest hanging fruit. It was clear that multifamily customers varied greatly in their technical familiarity with energy management and energy efficiency, leading to an inconsistent willingness to dig into the RTEM data to improve efficiency. For instance, one vendor claimed:

> **"It really comes down to how tech-savvy the Super is. If they're not tech-savvy, they get overwhelmed. But if they are tech-savvy, this is a really nice tool." (PV)**

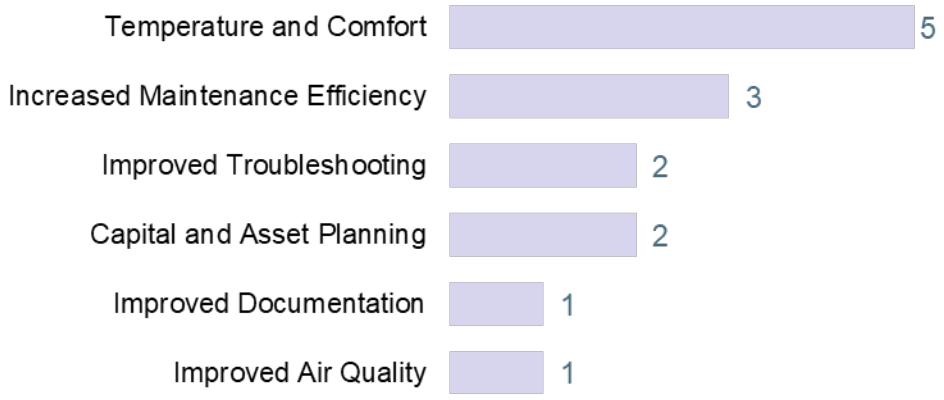
This vendor went on to say that building staff who are familiar with RTEM will work closely with the technology and install upgrades to maximize benefits, whereas those who are less familiar will override the system and make changes that are not optimal. While a couple of the vendors were able to train building staff to become more familiar with EMS technology on their own, others felt the program did not offer enough support for staff training to ensure equipment operators were familiar with the technology, had adequate buy-in, and developed good habits to use the technology to its full potential.

Non-Energy Benefits

Vendors universally reported that, other than energy savings, RTEM systems also provided enormous value to customers through non-energy benefits (NEBs). However, they found it difficult to sell customers on this value during the initial phases of a potential project. As mentioned previously, multifamily customers relied heavily on the monetary incentives, meaning that much of the vendors' communication focused on the energy savings customers could expect to see. Therefore, rather than using non-energy benefits as part of the initial sales pitch, vendors were instead able to use non-energy benefits as a way to encourage customers to continue their service contracts year after year.

During interviews, participating vendors mentioned a variety of NEBs they either noticed firsthand in their own projects or were made aware of by customers or other sources, as shown in Figure 2-2. Among the most commonly reported NEBs were improvements to building temperature and comfort as a result of RTEM. Notably, several vendors expressed that they had heard this was a common NEB for building management systems, but they had not heard this directly from customers. This may suggest that good temperature conditions and comfort in buildings are seen by occupants as expected, whereas poor temperature and comfort would warrant a complaint.

Figure 2-4. Count of RTEM-influenced NEBs mentioned by Participating Customers



Vendors were able to share firsthand accounts of improved building manager job efficiency after RTEM installation. A primary benefit of installed RTEM systems was the ability of building managers and operational staff to access system information directly on their smartphone. “Getting an alert on your phone is huge in terms of staff time savings, and being able to respond to an issue inside of equipment is important,” even if it is hard to quantify. Similarly, improved troubleshooting capabilities was cited as an important NEB. One vendor described an instance where a tenant was complaining about a sound in their building. Using the RTEM system, the building staff was able to vary pump speeds and make other mechanical tweaks, allowing them to pinpoint the issue and resolve it quickly. Several other NEBs were mentioned in participating vendor interviews, including improved capital planning ability associated with fault detection, increased property value from an RTEM system, and ability to monitor air quality.

2.2.3 Participating Owners/Managers Program Experience

In this section of the report, the evaluation team describes detailed findings related to participating customers’ experiences of the program and with non-energy benefits.

Program Influence

All of the interviewed customers confirmed that they first became aware of the program through suggestions from their vendor and also reported positive experiences working with them. Despite the vendors being the ones to introduce the customers to the NYSERDA program, all of the customers also reported that they had already been aware of some version of energy management technology prior to participation, although only two claimed to be aware of cloud-based controls more similar to RTEM. Additionally, while all were aware of the technology, only four were familiar enough with it to use it for long term capital planning and decision-making. Only one of these seven customers (14%) signed up for a five-year commitment from the outset; the rest (86%) chose 12-month commitments, although only one had stopped using their RTEM system (after four years).

As mentioned before, customers' RTEM systems could be focused on ASO, FDD, or a combination of the two depending on their vendors. As systems that include FDD can lead to larger scale savings, the evaluation team specifically checked whether the NYSERDA program had influenced customers to install systems that emphasized and found that four customers (57%) implemented fault detection diagnostics. For instance, one of the customers described their vendor putting in modules on their electric panel to watch for electricity flow. The modules oversaw several different equipment for the customer, including their building's hot water pumps and elevators, revealing whenever there was a need for maintenance.

Non-Energy Benefits

All of the interviewed customers expressed that RTEM provided non-energy benefits to their buildings. In particular, five of the seven (71%) customers anecdotally noticed a reduction in hot/cold calls from their tenants. They feel that RTEM has allowed them to anticipate any issues with equipment that would cause uncomfortable fluctuations in temperature for tenants. However, only two of the customers (29%) reported using occupancy-based management to help save energy. Overall, customers were very satisfied with the non-energy benefits that RTEM provided, even though their initial focus during the sales/installation phase was focused on savings and the financial benefits.

While participating customers generally believe that these non-energy benefits have helped contribute to higher satisfaction levels among their tenants, actual tenant awareness of RTEM or the NEBs of energy management technology in general is still very low. None of the interviewees recalled hearing any stipulations from tenants in their lease requests and none noticed any changes in occupancy/vacancy rates after installing RTEM. However, several customers qualified that observation by pointing out that their vacancy rates, and vacancy rates in New York City in general, is so low that it would be difficult to see any change.

2.2.4 Nonparticipating Vendors Program Experience

In this section of the report, the evaluation team will discuss nonparticipating vendors' awareness of RTEM and why they chose not to participate despite having been in contact with NYSERDA. The evaluation team interviewed four of these nonparticipant vendors, all of which had either qualified as a NYSERDA vendor, but chose not to run any projects through the RTEM program or attempted to qualify as a vendor, but were rejected. Other possible sources of identifying non-participants such as AI-enabled web data collection were not utilized for the multifamily indirect benefits evaluation.

As expected, all the vendors were very familiar with implementing RTEM and cloud-based building controls, although awareness of the NYSERDA RTEM program itself was less consistent.

Table 2-6. Vendor Program and Technology Awareness

Vendor ID	RTEM Technology Awareness	NYSERDA RTEM Program Awareness
NPV–1	High awareness	Low awareness
NPV–2	High awareness	High awareness
NPV–3	High awareness	High awareness
NPV–4	High awareness	Low to moderate awareness

Generally, these nonparticipating vendors had positive impressions of NYSERDA, with all four indicating good communication with NYSERDA staff and praising the size of the incentives available to customers.

Their reasons for not participating were less to do with the concept of the program itself, and more with administrative challenges that arose during their initial phase of interest. Broadly, their main challenges were with the program application and competing business priorities. Two vendors found the application process cumbersome, though they were unable to expand on specific elements. For instance, one respondent felt that he did not know enough about the program to determine if it would be a good fit for their offerings and abandoned the application process. Another vendor who produced energy monitoring software forecasted that his business's technology would be a good fit to be involved with the RTEM program in the coming years but encountered difficulty with the application process and felt NYSERDA did not provide him with enough support to enroll. Ultimately, he decided he may not be a good fit for the program as a small technology company rather than an established energy industry company.

Vendors also pointed to competing business priorities as a main reason for deciding not to participate in the NYSERDA RTEM program. One mentioned Local Law 97, which aims to reduce greenhouse gas emissions from buildings. As a result of Local Law 97 going into effect, building owners' priorities shifted towards reporting and compliance with the law and away from building management and efficiency gains associated with RTEM, and the vendor's focus similarly shifted.

> **"There's so much focus on reporting for Local Law 97 right now. Everybody is freaking out. […] The Local Law 97 reports have clogged everybody up." (NPV–1)**

While nonparticipating vendors felt that NYSERDA's incentives were adequate, they reported low awareness of RTEM technology and practices among their client base of multifamily customers, even after the program's existence. They believe that though awareness may have increased some over the years among large C&I customers, awareness of the technology remains low among multifamily customers. One respondent estimated that only around 5% of multifamily customers were aware of RTEM technology before the contractor discussed it with them.

As a result, none of the nonparticipating vendors interviewed reported that NYSERDA's RTEM program had a significant impact on projects they completed since the sunsetting of the program. Likewise, none felt that NYSERDA's program has influenced their business's current offerings.

2.3 Direct Benefit Results

Any measures listed in the vendor reports as both recommended and implemented were accrued as evaluated direct benefits. For direct benefits, the program team's methodology included savings at participating sites, regardless of whether they were recorded in vendor reports. Because the evaluation team classified participating site savings as indirect if they were not included in vendor reports submitted to NYSERDA, the evaluated estimates for direct benefits are somewhat lower than program-reported values. Even if all participating site savings were reclassified as direct within the evaluation framework, realization rates would remain below 100%, though they would be marginally higher than currently reported. When possible, the team leveraged information gathered from the indirect benefits in-depth interviews with building owners and managers participating in the RTEM program to verify the installation of recommended and implemented actions. In two cases, interviews revealed that some measures listed in the vendor reports as both recommended and implemented had not actually been implemented. These savings were deducted from the evaluated direct benefits totals.

In some instances, vendors did not report savings. Due to the inconsistency in reporting across vendors, this could be because: 1) the vendor did not provide an estimate of the savings that did occur from reported actions or 2) because no savings occurred from reported actions. For example, since most participation came from a small number of vendors with incomplete reporting, the resulting VGSRR were adversely affected and, in some cases, resulted in 0% evaluated savings. The decision criteria for review of these cases (defined in Section 3.3.1, Vendor report savings review) seeks to identify which of these outcomes is indicated by the

report, capture zero savings values where they occurred, and drop sites with inconclusive resulting savings. This approach helps ensure that unverified actions are still reflected in the overall assessment, but the variation in reporting detail and reliance on customer recollection of actions taken years earlier introduces potential bias. The direction of this bias is uncertain – incomplete reporting does not necessarily mean fewer savings occurred, nor does more detailed reporting necessarily mean greater savings.

As shown in Table 2-6, for the current evaluation period (Q1 2022–Q2 2024), the program achieved a 9% verified gross savings realization rate (VGSRR) for electric direct savings and 3% for gas direct savings.

Table 2-7. Summary of Q1 2022–Q2 2024 RTEM program verified direct impacts to the multifamily sector

Program-estimated electricity savings, gross annual (MWh)	Verified electricity savings, gross annual (MWh)	Electric VGSRR	Program-estimated natural gas savings, gross annual (MMBtu)	Verified natural gas savings, gross annual (MMBtu)	Natural gas VGSRR
23,724	2,008	9%	47,762	1,288	3%

Overall, the majority (78%) of MF sites did not have any reported savings. Of the 22% of MF sites with savings, on average, only 35% of the recommended measures were implemented. Nearly 99% of the total electric savings were realized at 11% of MF sites. Additionally, 100% of total gas savings were realized at 6% of MF sites. There were no savings from MF sites in the large site stratum.

Table 2-8. Summary of Q1 2022–Q2 2024 RTEM program direct benefits VGSRR by fuel type to the multifamily sector - weighted

Benefits	VGSRR	VGSRR 90% CI	Evaluated savings as a percentage of estimated consumption baseline (%)	Percentage of estimated consumption baseline 90% CI	Sample size (n)	Population size
Direct electric	9%	±9%	0.76%	±0.81%	18	42
Direct gas	3%	±3%	0.20%	±0.27%	18	42

Table 2-8 and Table 2-9 summarize the direct verified savings gross realization rates (VGSRRs) by size domain based on the sampling stratification. Table 2-10 provides the program-estimated and verified gross annual energy savings overall, and by fuel type. Evaluated savings and realization rates are not available as a percentage of evaluated consumption—this data was not available for the population or the complete sample.

Table 2-9. Q1 2022–Q2 2024 direct benefits participant realization rates by size domain – electric – weighted

Stratum	VGSRR	VGSRR 90% CI	Evaluated savings as a percentage of estimated consumption baseline (%)	Percentage of estimated consumption baseline 90% CI	Sample size (n)	Population size
Small	17%	±22%	1.56%	±2.07%	6	17
Medium	8%	±12%	0.73%	±1.09%	7	17
Large	0%	±0%	0.00%	±0.00%	5	8
Overall	9%	±9%	0.76%	±0.81%	18	42

Table 2-10. Q1 2022–Q2 2024 direct benefits participant realization rates by size domain – gas – weighted

Stratum	VGSRR	VGSRR 90% CI	Evaluated savings as a percentage of estimated consumption baseline (%)	Percentage of estimated consumption baseline 90% CI	Sample size (n)	Population size
Small	0%	±0%	0.00%	±0.00%	6	17
Medium	8%	±9%	0.81%	±1.01%	7	17
Large	0%	±0%	0.00%	±0.00%	5	8
Overall	3%	±3%	0.20%	±0.27%	18	42

Table 2-11. Q1 2022–Q2 2024 reported and evaluated direct savings from participating buildings by size domain[13]

Stratum	Estimated electric gross savings (MWh)	Verified electric gross savings (MWh)	Estimated natural gas gross savings (MMBtu)	Verified natural gas gross savings (MMBtu)
Small	2,730	462	5,760	0
Medium	13,797	1,124	25,265	2,111
Large	7,197	0	16,737	0
Overall	23,724	2,008	47,762	1,288

[13] Note that verified savings by size will not sum to overall verified savings, and in some cases may be higher than the overall verified savings, since the estimated weighted VGSRR is being applied to population savings estimates, versus verified savings being estimated directly from the weighted sample.

2.3.1 Comparison of VGSRRs to prior evaluations

The prior RTEM Program Impact Evaluation, published in September 2023, presented realization rates for evaluated sites that had been installed from Q4 2017 through Q4 2021. The prior study calculated two separate VGSRR for the program to account for the Program's calculation update to claimed savings before and after Q4 2020. The table below shows the VGSRR for each of these two separate periods. Prior to Q4 2020, the program estimate was approximately 15% of the baseline. After Q4 2020, the program estimate was adjusted to approximately 8%. For the prior study, the same sample of sites was used in each estimation, with the method of program savings differing to simulate each period savings method across all sites. Table 2-12 outlines the first-year[14] kWh and MMBtu verified gross savings realization rates from 2017 through Q4 2021.

Table 2-12. Prior RTEM program impact evaluation VGSRR

Installation dates:		Q1 2017-Q4 2020		Q4 2020-Q4 2021	
Year	**Sample size**	**Electric VGSRR**	**Non-electric VGSRR**	**Electric VGSRR**	**Non-electric VGSRR**
1	218	21%	14%	40%	15%
2	153	11%	17%	21%	17%
3	86	0%	2%	0%	2%
4	8				
5	1				
Total	N/A	32%	33%	61%	34%

Table 2-12 summarizes the VGSRR across the current and prior studies for electric and non-electric fuel types, as well as overall. In the prior studies, the evaluation team excluded vendor reports with incomplete information, such as missing savings values. This method may have introduced an upward bias in savings verification, because more complete reports were used and incomplete reports were dropped from the analysis. In the current evaluation, the evaluation team sampled all reports, resolved missing or unreported savings through interviews and proxy estimates, and verified that measures assigned zero savings were accurate, rather than unknown. Note that the VGSRRs reported for the prior evaluation periods are consistent with prior reporting and were not modified by this evaluation's analysis.

[14] Years 1-5 in the table do not align with calendar years, rather, they represent the sum of first-year savings for each site and first-year savings for successive measures installed at each site.

Table 2-13. Summary of current, prior, and overall RTEM evaluated direct benefits VGSRR by fuel type for the multifamily sector

Program period	Program-estimated electricity savings, gross annual (MWh)	Verified electricity savings, gross annual (MWh)	Electric VGSRR	Program-estimated natural gas savings, gross annual (MMBtu)	Verified natural gas savings, gross annual (MMBtu)	Natural gas VGSRR
Q1 2017-Q4 2020	19,035	6,091	32%	32,557	10,744	33%
Q4 2020-Q4 2021	9,452	5,766	61%	29,898	10,165	34%
Q1 2022-Q2 2024	**23,724**	**2,008**	**9%**	**47,762**	**1,288**	**3%**
Overall	52,211	13,865	27%	110,217	22,198	20%

2.3.2 Realization rates by vendor type

The evaluation team grouped the sites by vendor categories on the services and focus of projects completed by vendors for the RTEM program. These categories include software overlay only, automated system optimization (ASO) focus, fault detection and diagnostics (FDD) focus, both ASO and FDD focus, and vendors who develop building automation systems to customers, which the team is categorizing as OEM controls only vendors. Table 2-13 and Table 2-14 show the direct benefits realization rates by the different vendor classification categories. Note that results for FDD only are reported as "N/A," since all multifamily vendors in the sample had an ASO focus. The OEM controls domain is also reported as "N/A," since none of the sites in the current-evaluation-period sample worked with an OEM control vendor.

Table 2-14. Q1 2022–Q2 2024 direct benefits participant realization rates by vendor type – electric

Domain	VGSRR	VGSRR 90% CI	Verified savings as a percent of baseline energy consumption (%)	Confidence interval at 90% confidence	Sample size (n)
Software Overlay Only	6%	±9%	0.56%	±0.82%	7
Software Overlay + Controls Install	10%	±13%	0.88%	±1.17%	11

ASO Reporting Focus Only	6%	±9%	0.56%	±0.82%	7
FDD Reporting Focus Only	N/A	N/A	N/A	N/A	0
ASO + FDD Reporting Focus	10%	±13%	0.88%	±1.14%	11
OEM Controls	N/A	N/A	N/A	N/A	0
Overall	9%	±9%	0.76%	±0.81%	18

Table 2-15. Q1 2022–Q2 2024 direct benefits participant realization rates by vendor type – gas

Domain	VGSRR	VGSRR 90% CI	Verified savings as a percent of baseline energy consumption (%)	Confidence interval at 90% confidence	Sample size (n)
Software Overlay Only	6%	±7%	0.54%	±0.71%	7
Software Overlay + Controls Install	0%	±0%	0.00%	±0.00%	11
ASO Reporting Focus Only	6%	±7%	0.54%	±0.71%	7
FDD Reporting Focus Only	N/A	N/A	N/A	N/A	0
ASO + FDD Reporting Focus	0%	±0%	0.00%	±0.00%	11
OEM Controls	N/A	N/A	N/A	N/A	0
Overall	3%	±3%	0.20%	±0.27%	18

2.3.3 Comparison of recommended measures to strategic focus areas

The evaluation contractor team reviewed both the AI-extracted and manual vendor report extracted recommendations to see how many align with the strategic focus areas per the New York TRM. The evaluation contractor team considered the following strategic focus area categories in this review:

- Agriculture equipment
- Agricultural equipment controls
- Building shell
- Compressed air
- DHW control
- HVAC
- HVAC control
- Other (including refrigeration and refrigeration controls)

Table 2-16 summarizes the quantity, direct electric savings, and direct gas savings for all recommended measures from the sample vendor reports that the evaluation team reviewed using AI-extraction and manual methods. The measure data includes all vendor report data analyzed, which includes projects from the prior evaluation periods. Note that this table summarizes only the recommended savings for all reporting periods found in vendor reports, and not the final verified implemented first year savings or program claimed savings.

Table 2-16. Recommended measures from vendor reports by measure category

Measure category	Number of measures	Electric direct savings (MWh)	Gas direct savings (MMBtu)
HVAC control[a]	557	3,179	2,637,308
Other	175	266	8,424
HW control (BMS)[a]	117	1,224	6,712,190
Whole building monitoring	88	3,808	6,809
Motors, pumps, VFDs	74	1,794	123
HVAC tune-up[a]	57	17	48,372
Comfort, health, safety	47	0	0
HW equipment tune-up[a]	33	11	209,498
Lighting	23	283	0
Solar	18	126	0
HVAC[a]	9	11	0
Insulation - hot water and steam pipe	8	136	535
Demand response	6	37	0
Elevator	4	0	0
Behavioral	4	0	0
Duct sealing	3	11	0
HW equipment	3	-559	7,400
HVAC equipment tune-up	2	0	0
Building shell[a]	2	0	0

HW control (low-flow fixtures)	2	0	706
Overall	**1,232**	**10,344**	**9,631,364**

a Strategic focus area measure or related to a strategic focus measure

The evaluation contractor team reviewed the recommended measure quantities and energy savings. Key takeaways include the following:

- **HVAC controls:** Of the strategic focus areas, the HVAC controls measure category was recommended at multifamily buildings in the RTEM program the most, at 557 measures or 45% of all recommended measures. The most common measures in this category include temperature setpoint adjustments, occupancy-based controls, installing or calibrating sensors, and equipment runtime adjustments. HVAC controls represent 31% of the recommended electric savings, and 27% of the recommended gas savings.
- **Hot water control:** Another strategic focus area shows promise in the RTEM program with the largest gas savings impact at 70% of recommended gas savings at only 9% of the recommended measure count. The most common measures in this category include hot water supply temperature adjustment, reducing or eliminating makeup water volume, and equipment staging or runtime adjustment.
- **Motors, pumps, VFDs:** Although not directly a strategic focus area, the total recommended electric savings is 17% from just 6% of the measures. The most common measures in this category include installing VFD controls on existing motors, replacing motors with electronically commutated (EC) motors, and adjusting motor speed setpoints of pumps with existing VFD controls.

Figure 2-5. Graph of recommended electric savings and measure count per measure category

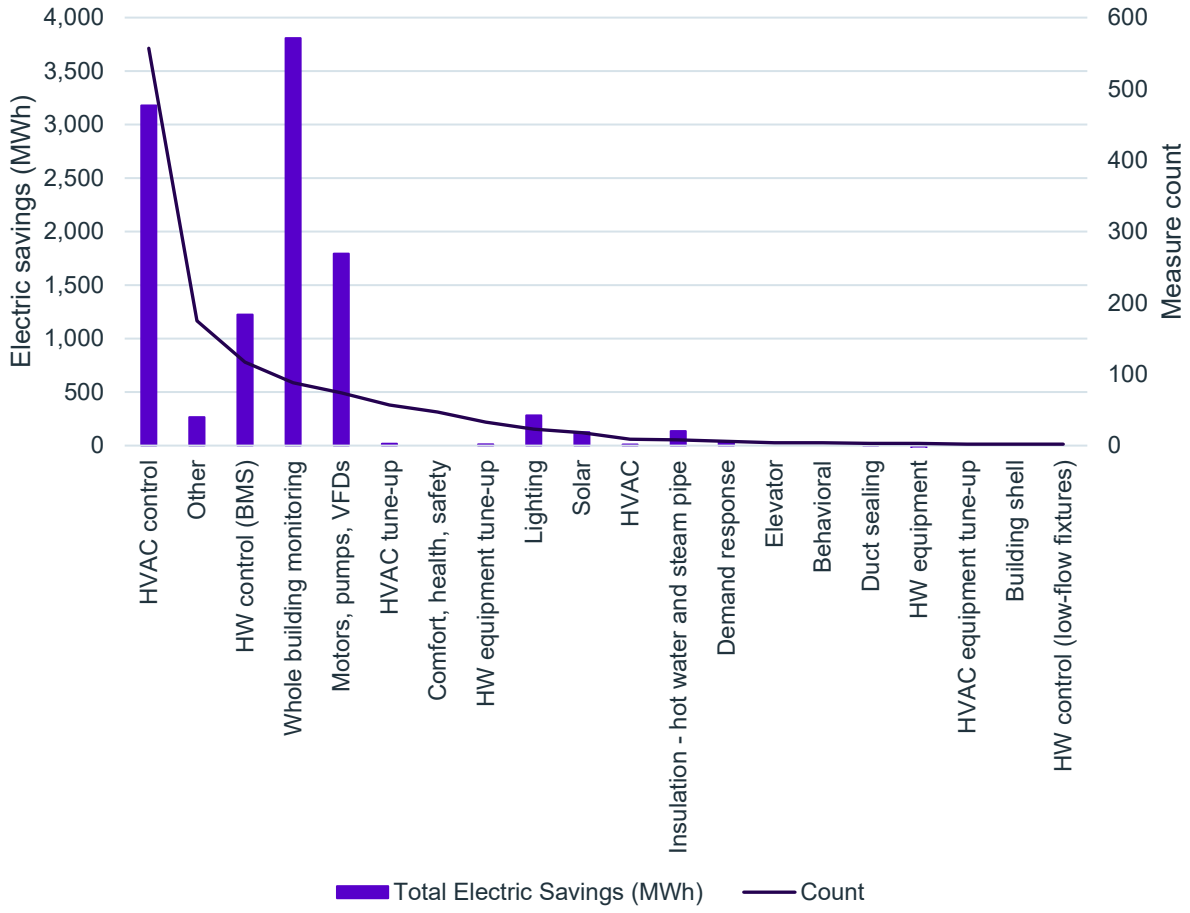
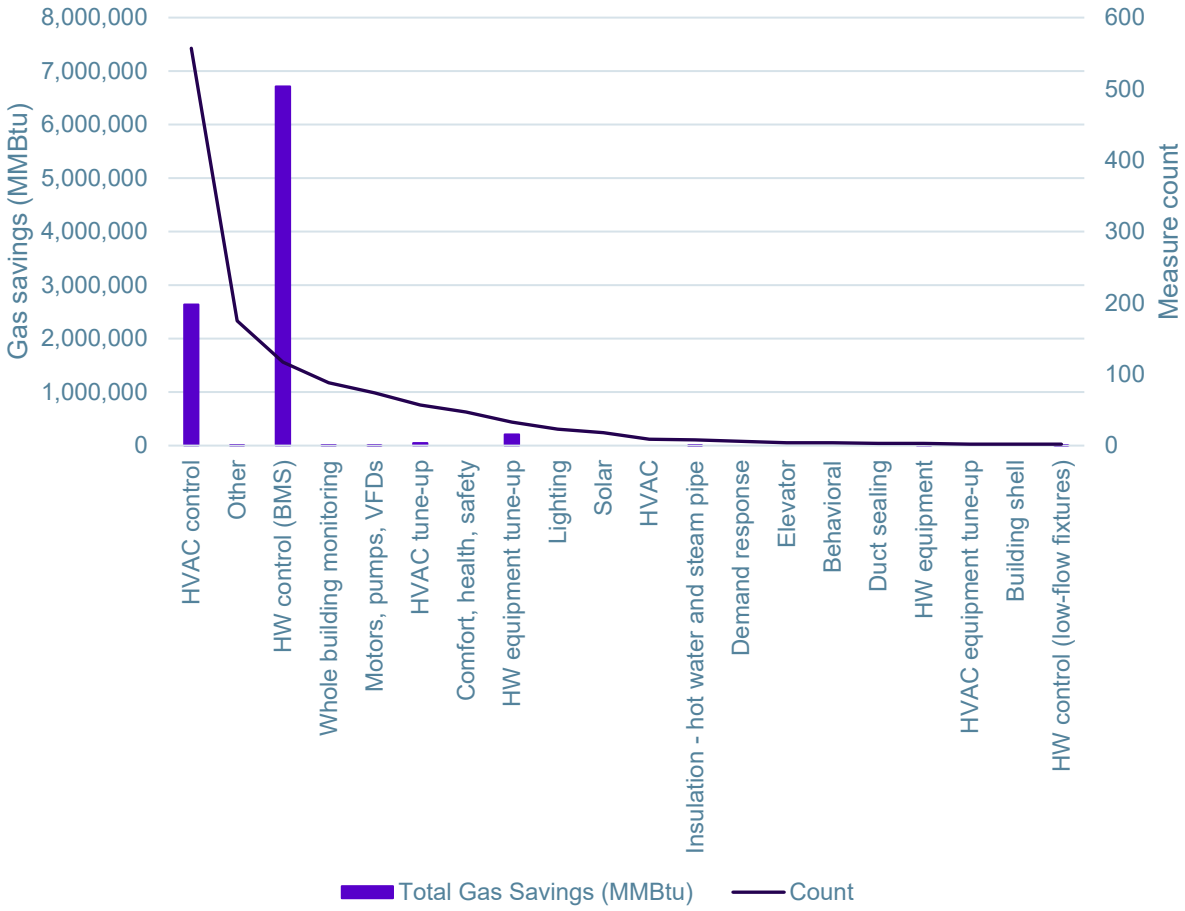


Figure 2-6. Graph of recommended gas savings and measure count per measure category



Vendor classification for HVAC control measures

The evaluation contractor team reviewed and assigned vendor classifications based on the primary services they provide to participants of the RTEM program. The primary vendor classification groups include a focus on fault detection and diagnostic (FDD) services, automated system optimization (ASO), or both. Table 2-15 provides a breakdown of vendor classification for HVAC controls projects and the recommended electric and gas savings. Vendors who focus on automatic system optimization (ASO) achieve the largest proportion of energy savings for the HVAC controls measures, with 85.1% of the direct electric savings and 52.7% of the direct gas heating savings, while only representing about 47.8% of the HVAC controls measures.

Table 2-17. Vendor characterization summary of recommended HVAC controls measures

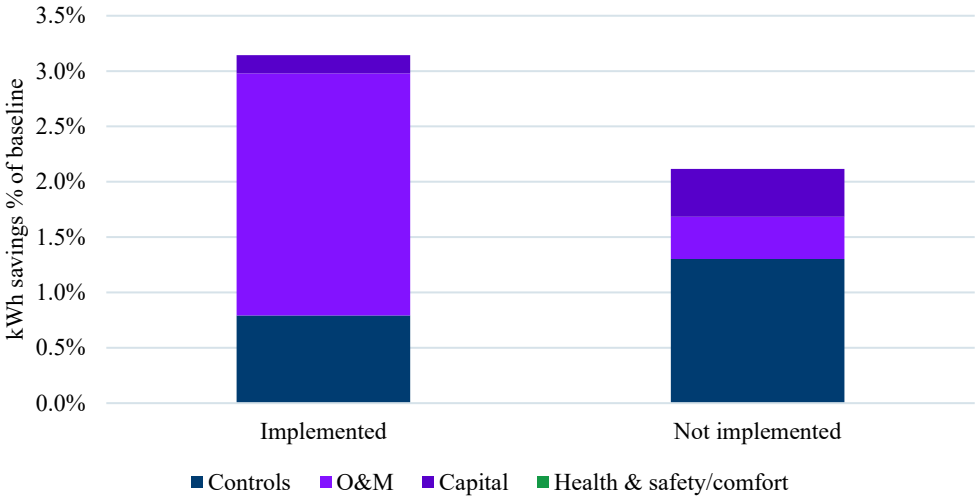
Vendor classification	N	Electric direct savings (MWh)	Percent of electric direct savings (%)	Gas direct savings (MMBtu)	Percent of gas direct savings (%)
ASO	429	2,226	70.0%	2,626,373	99.6%
FDD	0	0	0.0%	0	0.0%

Vendor classification	N	Electric direct savings (MWh)	Percent of electric direct savings (%)	Gas direct savings (MMBtu)	Percent of gas direct savings (%)
Both	128	953	30.0%	10,935	0.4%
Total	**557**	**3,179**	**100%**	**2,637,308**	**100%**

Implemented measure savings by measure type

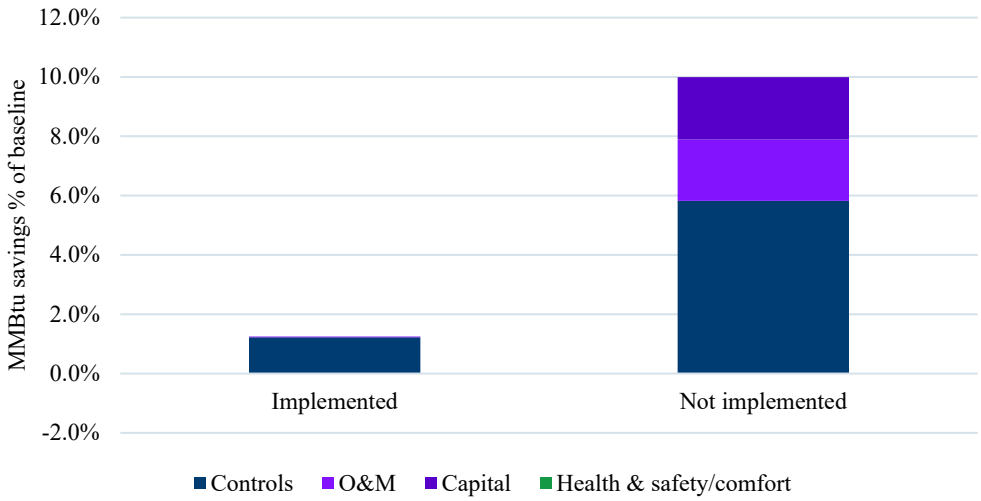
Finally, the evaluation contractor team examined the savings relative to baseline by measure type for the reviewed vendor reports and the prior evaluation sites. The measure categories were grouped into Controls, O&M, Capital, and Health & Safety/Comfort measure types. Figure 2-5 and Figure 2-6 compare implemented and not-implemented average first-year electric energy and average first-year gas energy savings relative to baseline consumption by measure type. These figures include measures for energy savings from measures that were committed and acquired with completion readiness dates provided. Additionally, they include installed and acquired savings across the current and prior evaluation sites. These savings values per measure are unweighted. The evaluation contractor team removed any outliers with greater than 100% savings relative to baseline for these comparisons.

Figure 2-7. Implemented and not implemented average first year electric savings by measure type



Implemented electric measures achieved average electric savings of 0.8% of baseline for control measures, 2.2% of O&M measures, and 0.2% for capital measures. Not-implemented electric measures had average electric savings of 1.3% of baseline for control measures, 0.4% for O&M measures, and 0.4% for capital measures. Not implemented measures had lower average unweighted first year savings as a percentage of baseline consumption overall and specifically for O&M measures, compared to implemented measures. On average, controls and capital measures that were not implemented had larger first-year savings relative to baseline consumption when compared to implemented controls and capital measures.

Figure 2-8. Implemented and not implemented average first year gas savings by measure type



The evaluation contractor team found that more gas measures across all measure groups were not implemented compared to implemented. Implemented gas measures achieved average electric savings of 1.2% of baseline for control measures, 0.03% of O&M measures, and less than 0.01% savings for capital measures. Not-implemented measures had average electric savings of 5.8% of baseline for control measures, 2.1% for O&M measures, and 2.1% for capital measures.

Fifteen measures were categorized under Health & Safety/Comfort across gas and electric savings, with three measures implemented and twelve measures not implemented. However, none of these measures had reported electric or gas savings values. While these measures are being recommended, vendors are not currently attributing any energy savings to them or reporting them as implemented. This trend underscores the importance of continued tracking and evaluation to better understand their impact over time.

2.4 Conclusions and Recommendations

2.4.1 Indirect benefit conclusions and recommendations

Conclusion 1

In the multifamily sector, the largest source of indirect benefits were from participating building owners/managers implementing additional operation/maintenance upgrades and changes at participating buildings (Source A), which resulted in 5,691 MWH and 50,595 MMBtu. The second largest source of indirect benefits came from participating vendors also introducing RTEM to some of their customers without receiving NYSERDA incentives (Source C), resulting in 2,166 MWH and 9,208 MMBtu.

Recommendation 1: In future programs, NYSERDA could continue to support these sources of indirect benefits by making sure that projects have strong "energy champions" that continue to push the potential for energy savings that RTEM enables. Several of the vendors that shared evidence of indirect benefits also mentioned that they had specifically had someone that pushed for using RTEM to generate additional energy saving ideas.

NYSERDA Response to Recommendation: Implemented. Programs maintain the importance of onsite energy champions to enhance uptake and persistence of energy efficiency measure savings, in addition to non-energy benefits from NYSERDA program engagement.

Conclusion 2

There is not enough evidence yet to indicate that the program has transformed the New York EM market for the multifamily sector. Rather, it appears that a large swath of the New York multifamily market still needs some sort of support to adopt RTEM. Of the five participating customers who managed buildings in their portfolio that did not receive a NYSERDA incentive, only one decided to implement RTEM at these other buildings. As a result, Source B only generated 630 MWH and 0 MMBtu. Furthermore, only one-third of participating vendors had replicated RTEM projects with customers that did not receive incentives. Among the four vendors that also completed both multifamily and commercial projects through the program, there was a consensus that while multifamily projects tended to be smaller, multifamily building owners often expressed a greater need for financial support due to more limited resources.

Recommendation 2: NYSERDA could consider follow-up outreach with customers that did not adopt RTEM at all the properties in their portfolio to better understand multifamily owners/managers' decision-making process.

NYSERDA Response to Recommendation: Pending. NYSERDA will consider follow-up outreach with RTEM MF customers to collect additional direct and subsequent indirect benefits.

Conclusion 3

Participating vendors and customers frequently lauded the non-energy benefits of RTEM systems. Vendors described improvements to temperature control and regulation, improving occupancy comfort, while also highlighting improved building management efficiency. RTEM systems allowed for quicker troubleshooting of operational issues, and the remote monitoring of building systems by smartphone made fault detection and repair easier and faster.

Recommendation 3: In future programs, NYSERDA could consider working with affiliated vendors to make non-energy benefits a bigger selling point for potential customers. All interviewed customers reported using RTEM for non-energy benefits despite their initial focus on energy savings. NEBs could serve as a gateway towards greater adoption of EM technology if they were more frequently communicated.

NYSERDA Response to Recommendation: Implemented. Non-energy benefits are incorporated into programs where relevant.

2.4.2 Direct benefits findings and recommendations

Finding 1

Among multifamily facilities, the RTEM program achieved electric direct energy savings of 2,008 MWh, with a realization rate of 9%, and non-electric direct energy savings of 1,288 MMBtu, with a realization rate of 3%, during the current evaluation period (Q1 2022–Q2 2024). Since inception (Q1 2017–Q2 2024), the RTEM program achieved electric and non-electric direct energy savings of 13,865 MWh, with a realization rate of 27%, and 22,198 MMBtu, with a realization rate of 20%, respectively among multifamily facilities. The program influenced owners and managers of participating buildings to complete additional actions outside of those reported in vendor service reports, and those actions were associated with notable energy savings accounted for as indirect benefits.

Recommendation 1a: To better capture the full scope of program impacts, consider requiring vendors to report implemented savings, or establishing another systematic method for capturing savings attributable to RTEM systems. Direct savings estimates from vendors who provided this information were higher than those from sites without such reporting, while indirect savings estimates often rely on customer-reported actions that can be affected by recall bias. More consistent documentation of implemented actions and associated savings

would reduce underestimation risk and provide a clearer picture of the program's influence on operational practices and decision-making in the market.

NYSERDA Response to Recommendation: Pending. NYSERDA will revisit during future iterations of the program.

Recommendation 1b: Consider requesting, at program intake, key technical details for equipment monitored by the RTEM system - for example, manufacturer spec sheets, system capacity, square footage or space served, and other relevant characteristics (e.g., for HVAC units, whether they are connected to other systems). While some of this information has been collected during application submission, it has not been part of the program process to identify site-by-site specific savings. Having these details readily available would be valuable during future evaluations that follow a similar process, as it would help evaluators determine what actions customers took because of the RTEM system and better understand the magnitude of associated savings. Collecting this information at intake is generally more efficient and less burdensome than attempting to gather it retrospectively during evaluation.

NYSERDA Response to Recommendation: Pending. NYSERDA will consider this feature for future program iterations.

Finding 2

Electronic Data Interchange (EDI) data were successfully obtained for 40 sites. For the remaining sites, no usable data were returned from the EDI request. In addition, while the program collected some pre-installation consumption data, these data were only sufficient for 2 sites, as the vast majority included just a single month of consumption. The lack of complete, standardized baseline data significantly limited opportunities to conduct billing analysis to derive savings.

Recommendation 2: To support robust evaluation and long-term market insights, the program could consider requesting EDI data for all participating sites for each program year. If adopted, the program could extract account numbers and points of delivery (PoDs) from applications and submitted bills/proof of account upon program intake then immediately attempt to acquire baseline data to confirm the accuracy of the account numbers and PoDs in the tracking data. This will ensure data is available for savings estimation and evaluation. Note: there are some measures where billing data may be unable to provide direct quantification of savings, for example early identification of a system needing repair will often not have a period operating in poor condition to support billing or even advanced metering infrastructure–based estimation of savings because the increase in usage was avoided. Despite this risk, having more of the consumption data can enable better savings estimates even when used indirectly and can provide better baseline consumption estimates than the current square footage estimates provide. This, in turn, strengthens the program's ability to demonstrate its role in transforming market practices and decision-making over time.

NYSERDA Response to Recommendation: Pending. Some, but not all NYSERDA programs will have this feature moving forward.

Finding 3

Vendor service reports provide the best available information for measure installation and savings verification for the RTEM program and thus are the primary source for evaluation of direct savings. This is a key risk for the program, as vetting of the savings claims with engineering and baseline assessments was not possible. As described previously, customer reports suffer from recall bias, and billing data was largely unavailable or incomplete. The evaluation team confirmed that vendor-reported implementations were completed, but where savings magnitudes were not reported, evaluator estimates of these savings may be lower than actual savings.

Recommendation 3: Continue to assess available methods for evaluation of the RTEM program. For instance, concurrent evaluation of targeted sites with large estimated savings and multi-site projects within two years of

EM system installation would have much higher likelihood of capturing measure-level post-installation information and participating organization intentions for future installations, associated savings data, and non-routine events such as major equipment upgrades. Similarly, utility billing data would be more readily available through EDI request. Customer and vendor interviews at this early stage would provide feedback to vendors on the critical importance of vendor service report data for evaluation of program direct benefits and capture more real-time indirect benefits as they are planned and occur.

NYSERDA Response to Recommendation: Implemented. NYSERDA is implementing pre-install interviews on select programs.

Finding 4

Vendor reports often included activities that might incur cost-savings through diagnostics and fault detection events, but did not report any annual energy savings from such measures. NYSERDA assumes modeled energy savings for all fuels serving a site, so the presence of these activities can substantially depress realization rates and projected savings as a percentage of estimated baseline.

Recommendation 4: Consider including a post-installation verification step to confirm actual vendor-reported and installed energy-saving measures upon project completion or as part of the acquired savings process. This step will help verify actual baseline energy consumption and vendor-reported energy savings from installed measures. Post-installation verification will also identify instances where only diagnostics or fault-detection activities were implemented, which result in cost savings for a site but not significant annual energy savings.

NYSERDA Response to Recommendation: Implemented. NYSERDA is implementing a post-installation verification on select programs.

3 Methodology

This section details the methodology, including data collection and analysis methods, that informed both the direct and indirect savings calculations. Table 3-1 shows the program logic model with outcomes, indicators, and the relevant benefit category.

Table 3-1. Program logic model

Market actor	Outputs/outcomes	Indicators	Benefits category
Building owner/manager, (current or former RTEM vendor customer)	Increased awareness of using EM to support capital project planning	Percent of building owners/managers aware/knowledgeable of RTEM long-term capital project planning Percent of owners/managers participating in NYSERDA training courses	Indirect/direct
	Increased use of EM	Percent of owners/managers implementing optimal start/stop Percent of owners implementing fault detection and diagnostics (FDD)	Indirect/direct
	Customer confidence in EM results	Percent (or number) of implemented measures installed after NYSERDA engagement	Indirect
	Increased use of EM for non-energy benefits	Percent of tenants including RTEM/EM stipulations within lease requests Percent reduction in tenant hot/cold calls Percent of owners/managers implementing occupancy-based management	Indirect
RTEM Participant/Vendor	Variables affecting persistence of RTEM service contracts	Percent RTEM service contracts at least 5 years in duration	Indirect/direct
	Percent of RTEM projects that use services for non-energy benefits (e.g., long-term asset management, capital investment strategies, risk mitigation analyses)	Number of RTEM projects that use services for non-energy benefits after NYSERDA engagement	Indirect
		Number of RTEM projects that use services for non-energy benefits during NYSERDA engagement	Direct
	Utilization of RTEM data sets to advance efforts at demand reduction & peak load shaving	Percent of vendors implementing demand reduction and peak load shaving for replication sites and other projects within the vendor portfolio	Indirect/direct

Market actor	Outputs/outcomes	Indicators	Benefits category
		Percent of vendors implementing demand reduction and peak load shaving within RTEM sites/projects	
	Demonstrated energy savings/O&M benefits from RTEM activities	Ratio of efficiency control measures (ECM) identified: ECMs implemented in addition to those recommended during NYSERDA engagement	Indirect/direct
RTEM Participant/Vendor	RTEM providers identify & act on energy efficiency opportunities	Number/type of additional energy efficiency opportunities identified by RTEM providers (current and former)	Indirect
	Variables affecting persistence of RTEM service contracts	Percent RTEM service contracts at least 5 years in duration	Indirect/direct
	Demonstrated energy savings/O&M benefits from RTEM activities	Ratio of efficiency control measures (ECM) identified: ECMs implemented in addition to those recommended during NYSERDA engagement	Indirect/direct
RTEM participating vendors and building sites	Verified gross energy impacts	kWh, MMBtu	Direct
	Verified gross savings realization rate (VGSRR)	Ratio (%)	
	Verified savings as a percent of baseline energy consumption	Ratio (%)	
	Savings per incentive and/or program participant unit of measure	Ratio (%)	
Nonparticipating EM provider	Awareness and use of EM technology, and RTEM program	Percent of providers aware of RTEM program resources, programmatic criteria, and standards by providers	Indirect
		Number of EM providers	
		Percent of offerings with RTEM	

Vendors provide service reports to program staff either quarterly, twice annually, or annually. These reports recommended operational improvements and capital projects that can achieve energy savings and other non-energy benefits, and, when feasible, also record the installation or execution of recommended actions.

Program methodology - direct benefits:

- All savings that occurred at participating sites were counted as direct benefits, regardless of whether they were documented in vendor service reports.

Evaluation methodology - direct benefits:

- Direct benefits were limited to energy savings measures at participating sites recommended by vendors and reported as implemented to NYSERDA through service reports.
- Measures were also counted as direct if interviews with customers or vendors confirmed installation of vendor-recommended actions, even if not documented as implemented in the reports[15].

Table 3-2 details the approach for quantifying the direct benefits.

Table 3-2. Direct benefits framework and data collection methods by market actor

Market actor	Direct benefits	Data collection methods
Participating buildings (i.e., buildings that received program funding for the installation of eligible EM technology and are owned by participating organizations)	Direct involvement participant adoption: savings from NYSERDA-funded projects identified by program vendors *through vendor service reports*	• Vendor service report AI data extraction for engineering reviews • Building consumption data • When possible, data collected from indirect benefits in-depth interviews with participating vendors and participating building owners/managers

Conversely, the evaluation team expected to find **indirect benefits** in energy savings actions influenced by the NYSERDA program that did not appear in any of the participating vendor service reports. This included:

- Source A: Additional operations and maintenance activities or capital upgrades done at participating buildings (not captured through direct impacts)
- Source B: Operations and maintenance activities or capital upgrades done at nonparticipating buildings of a participating customer's portfolio
- Source C: Operations and maintenance activities or capital upgrades done at nonparticipating buildings of a participating or nonparticipating vendor's portfolio

In this chapter, the team described the sampling and data collection methodology used to quantify indirect and direct benefits, along with a high-level discussion of the analysis.

3.1 Sampling and Data Collection

This section provides a description of the multifamily RTEM program projects and vendors included by the evaluation team in the sample frame for this study. While this section contains a high-level overview of the sample design for data collection activities, the detailed methodology can be found in Appendix B: Sampling Memo.

The multifamily project data includes installations from January 1, 2018, through January 1, 2024. In total, the sample frame for the multifamily sector of the NYSERDA RTEM program consisted of a total of 371 project sites from 223 unique projects, served by 22 unique vendors. The NYSERDA program spent $14,789,015 and

[15] While interviews were primarily focused on indirect impacts, when possible, information pertinent to direct benefits were gathered and utilized to assess those impacts.

impacted 61,627,988 of multifamily building square footage. Together, this resulted in the evaluation team's sample frame, shown in Table 3-3 below.

Table 3-3. NYSERDA RTEM Program Multifamily Sample Frame

Market Sector	Number of applications	Number of sites	Number of Vendors	Total NYSERDA funding	Total impacted square footage
Multifamily	223	371	22	$14,789,015	61,627,988

3.1.1 Indirect Benefits Data Collection

Using the sample frame established above, the evaluation team conducted four separate data collection activities (in-depth interviews) to assess the indirect impacts of the program, shown in Table 3-4. When relevant, information from indirect benefit data collection also informed some of the analysis for direct benefits.

Table 3-4. Overview of Indirect Benefits Data Collection Activities

Target Group/ Population (In-Depth Interviews)	Evaluation period	Pop. Size	Square Footage	Target Completes	Completes as % of Targets	Completes as % of Square Footage	Stratification
Program Staff	Q4 2020 to present	2	N/A	2	100%	N/A	N/A
RTEM Participating Building Owners/ Managers	Program inception to Q1 2024	119	47,137,219*	10	70%	82%*	Building System Type (boiler vs complex HVAC)
RTEM Participating Vendors	Program inception to Q1 2024	22		10	90%		Vendor activity (more active vs less active)
Non-Participating EM vendor	Program inception to Q1 2024	27	N/A	6	67%	N/A	RTEM qualified vs. not

The team conducted in-depth interviews with NYSERDA program staff, program participating customers, participating vendors, and nonparticipating vendors to understand the energy savings actions not captured in existing program service reports. The data collection included:

- **NYSERDA Program Staff Interviews:** The evaluation team asked NYSERDA program staff to describe how NYSERDA program activities could lead to indirect benefits for each of the following market actors.
- **Participating Building Owners/Manager Interviews:** The evaluation team asked participating building owners about additional energy saving activities they had taken at participating buildings, but

that had not been reported in vendor service reports, along with whether they implemented similar projects at any nonparticipating buildings in their portfolios.

- **Participating Vendor Interviews:** The evaluation team asked participating vendors whether they had made any additional recommendations to participating customers that had not been previously reported in program service reports, along with whether they had implemented RTEM for any of their other multifamily customers that did not receive NYSERDA program incentives.
- **Nonparticipating Vendor Interviews:** The evaluation team asked nonparticipating vendors to describe their awareness of RTEM technology and the NYSERDA RTEM program, why they ultimately chose not to participate, and whether the NYSERDA RTEM program had any influence on their RTEM-like multifamily projects.

The evaluation team contacted participating vendors, customers, and nonparticipant vendors a minimum of three times. For participating vendors and customers, NYSERDA program staff conducted the initial outreach attempt due to their familiarity with participants, while the evaluation team conducted follow-up outreach. Conversely, the evaluation team kicked off initial nonparticipating vendor interview outreach before NYSERDA program staff lent additional legitimacy to the outreach efforts by following up with less responsive nonparticipants. For all interviews, the evaluation team offered a $250 e-gift card incentive to interviewees.

Primary data collection began in March and ended in June of 2025. Table 3-5 below shows the completes and response rates by market actor. While the evaluation team was able to approach our target completes for all three market actors, the team had the most difficulty reaching participating customers. The evaluation team expanded the initial sample size three separate times while attempting to achieve ten target completes. Ultimately, while the overall response rate for participating customers was low, the team secured sufficient completes (7) for the purposes of this evaluation.

Table 3-5. Response Rates by Market Actor

Market Actor	Target completes	Sample	Completes	Completes as % of Target	Response rate
Participating Vendors	10	22	9	90%	41%
Participating Customers	10	74	7	70%	9%
Nonparticipating Vendors	6	27	4	67%	15%
Total	**29**	**18**	**20**	**69%**	**16%**

Participating Vendor Interview Sample Design

A total of 22 participating vendors completed at least one multifamily project through the program. As shown in Table 3-6, the evaluation team completed 9 interviews[16], including 6 with "more active" vendors and 3 with

[16] The team completed 11 interviews in total, but two vendors were removed from consideration in the population due to never having installed their RTEM system in their multifamily properties. One additional vendor was removed from the population due to poor quality interview responses.

"less active" vendors, as measured by the average number of square feet addressed by the vendors' multifamily projects. In the TRC Sampling Memo (Appendix B), the evaluation team categorized the "more active" vendors as the top 7 most active vendors by square footage of completed projects. The team attempted a census for the "more active" vendors and randomly sampled from the "less active" vendors. Vendor interviews were the main driving factor of indirect benefit calculations because they were able to speak to the decisions made for a much larger portion of the population than customers.

Across the entire vendor population, the team completed interviews included vendors representing 82% of the square footage of multifamily projects done in the program. While a full census was not achieved, the evaluation team interviewed all but one of the top 7 vendors, and the interviewed vendors represented 87% of the project square footage covered by these more active vendors.

Table 3-6. Vendor Interview Completes vs Population

Vendor Type	Interview Completes Vendor Count	Population Vendor Count	Interview Completes Square Footage	Population Square Footage	Interview Completes Square Footage % of Population
More Active (Average 4.9M SF per vendor)	6	7	30,125,027	34,485,015	87%
Less Active (Average 1.2M SF per vendor)	3	11	7,722,378	12,652,204	61%
Total	**9**	**18**	**37,847,405**	**47,137,219**	**82%**

Participating Customer Interview Sample Design

There was a total of 365 project sites mapped onto 222 multifamily projects and 119 unique owners/managers. While the evaluation team initially attempted to reach out to a smaller subset of these owners, due to low response rates, the team ultimately conducted outreach to 74 unique owners. The team primarily used customer interviews for directional clues on indirect benefits, confirmation of results from vendor interviews, and information on the most common equipment types.

NYSERDA reported that the main driver of differences in RTEM project scopes for multifamily was the existing building system type, making this the key segment for sampling stratification. Most MF projects occurred in buildings with only a central boiler system, whereas the rest occurred in MF buildings that have full central HVAC to the apartments, which would operate more similarly to commercial buildings.

Ultimately, the evaluation team interviewed seven customers (property managers and owners) who participated in the NYSERDA RTEM program. These customers worked with five of the interviewed vendors, including three that were "more active" and two that were "less active" vendors.

Table 3-7 below shows the completes vs population by customer type. Ultimately, with outreach attempted to 74 unique owners, the evaluation team achieved nearly a 10% response rate on the customer survey, with 3% square footage coverage.

Table 3-7. Customer Interview Completes vs Population

Customer Type (Building System)	Interview Completes Project Count	Population Project Count	Interview Completes Square Footage	Population Square Footage	Interview Completes Square Footage % of Population
Central Boiler System	4	165	1,338,409	27,062,671	5%
Full Central HVAC to Apartments	3	57	2,154,783	21,671,956	1%
Total	**7**	**222**	**1,338,409**	**47,137,219**	**3%**

Nonparticipating Vendor Interview Sample Design

For nonparticipating vendors, the evaluation team focused on vendors that went through the steps to become an RTEM-qualified vendor but either were rejected as a vendor or were accepted but never completed a RTEM project. The team, in discussions with NYSERDA program staff determined that this population of nonparticipant vendors were:

- Most likely to have been impacted by the program in some manner,
- Most able to articulate the influence of the RTEM program, and
- Easier to contact than vendors with no affiliation with the RTEM program.

To acquire the sample frame for nonparticipant vendors, the evaluation team used documentation provided by NYSERDA staff on all vendors that had applied to be a qualified NYSERDA vendor. The team then filtered the list to include only vendors that had never completed a project through the program and were likely to work with multifamily customers. Ultimately, a list of 27 nonparticipant vendors remained, forming the sample frame. The evaluation team reached out to all 27 vendors and were able to complete four interviews, shown in Table 3-8.

Table 3-8. Nonparticipating Vendor Interview Completes vs Population

Nonparticipating Vendor Type	Interview Completes Vendor Count	Population Vendor Count
Qualified	2	18
Rejected	2	9
Total	**4**	**27**

Of the four nonparticipant interviewees, all of them still worked on multifamily projects in New York, but varied significantly in how much, as shown in Table 3-9 below. This allowed the evaluation team to get multiple different perspectives of vendors that worked with a wide range of client types.

Table 3-9. Nonparticipating Vendor Firmographics

Vendor ID	Proportion of work done in NY	Proportion of work on multifamily
NPV–1	95%	Primarily multifamily
NPV–2	80%	60%
NPV–3	20%	Some multifamily
NPV–4	Limited work in NY	Limited multifamily

3.1.2 Direct Benefit Data Collection

Table 3-10 summarizes the project and vendor population in the RTEM multifamily sample frame with installation dates ranging from January 1, 2017, through January 1, 2024. The sample frame includes sites across 222 project applications in the High-Rise, LMI, and Low-Rise Multifamily market sectors. These projects were served by 32 unique vendors, receiving approximately $15 million in incentives from NYSERDA and impacting 62 million square feet.

Table 3-10. RTEM population of multifamily application numbers and distinct vendors

Market sector	Number of project applications	Number of sites	Number of primary contractors	Total NYSERDA funding amount	Total impacted site square footage
High-Rise Multifamily (4 stories or more)	176	237	21	9,400,324	41,586,470
LMI Multifamily (Low-Moderate income)	41	114	8	5,222,123	19,403,177
Low-Rise Multifamily (3 stories or less)	5	14	3	166,568	638,341
Total	222	365	32	$14,789,015	61,627,988

Data collection activities

The evaluation contractor team conducted a variety of data collection activities to assess the direct impacts of the program. Data collection methods leaned on the insights of participating building owner/manager interviews as well as vendors, when possible, alongside reviews of the vendor service reports. The evaluation's data collection methods were:

- **Participating vendor service report review** to provide the primary source of direct impact savings

verification information, as well as the indirect benefits at participant sites. The evaluation contractor team designed an AI-driven document extraction tool to retrieve information on measured energy savings, cost savings, vendor-recommended measure descriptions and savings information, and installation status. All AI data extraction was based on vendor reports submitted on or before May 14, 2025.

- **Participant building owner/manager interviews,** when possible, the team leveraged information gathered from the indirect benefits in-depth interviews with building owners and managers participating in the RTEM program to verify the installation of recommended and implemented actions. In a limited number of cases, interviews revealed that some measures listed in the vendor reports as both recommended and implemented had not actually been implemented. These savings were deducted from the evaluated direct benefits totals.
- **Participating vendor interviews**, when possible, the team leveraged information gathered from the indirect benefits in-depth interviews with vendors participating in the RTEM program to verify the installation of recommended and implemented actions. In a limited number of cases, interviews revealed that some measures listed in the vendor reports as both recommended and implemented had not actually been implemented.

Table 3-11 provides an overview of these activities, the period of program activity evaluated within the target group, and sampling methods for those groups, where relevant. Subsections describe the sample designs for direct data collection.

Table 3-11. Overview of data collection activities and sampling methods

Target group	Population	Sampling method	Stratification	Complete	Target confidence/ precision
Vendor service report engineering reviews	222 applications covering 365 sites	Non-random data collection with post-stratification	Funding received, Evaluation (Prior/ Current)	345 sites AI, and 77 prior sites	90/10
Building consumption data				362	-

Direct benefits sample design

The direct benefits evaluation was based on non-random data collection. It used a sample of convenience based on what data the AI was able to extract from vendor reports. The evaluation team conducted post-stratification, described in the direct benefit analysis section.

3.2 Indirect Benefit Methodology

The evaluation team, in accordance with NYSERDA's Indirect Benefits Framework[17], determined three potential sources of indirect benefits. Using the interviews described above, the evaluation team calculated the final indirect benefits as the sum of direct influence participant adoption (Source A and Source B) and nonparticipant adoption (Source C), as shown in Table 3-12.

Table 3-12. Indirect Benefits Framework and Data Collection Methods by Market Actor

Indirect Benefit Sources	Indirect benefit framework	Market actors
Source A: Additional operations and maintenance activities or capital upgrades done at participating buildings (not captured through direct impacts)	Direct influence participant adoption: Additional energy savings enabled by RTEM technology	Interviews with participating vendors and participating building owners/managers
Source B: Operations and maintenance activities or capital upgrades done at nonparticipating buildings of a participating customer's portfolio	Direct influence participant adoption: Adoption of RTEM (and resulting energy savings projects) through portfolio without program incentives, but with program influence	Interviews with participating building owners/managers
Source C: Operations and maintenance activities or capital upgrades done at nonparticipating buildings of a participating or nonparticipating vendor's portfolio	Nonparticipant adoption: Adoption of RTEM (and resulting energy savings projects) among building owners/managers with no direct support from NYSERDA program	Interviews with participating vendors and nonparticipating vendors

3.2.1 Direct Influence Participant Adoption

The evaluation team along with the NYSERDA RTEM program staff defined direct influence participant adoption as indirect benefits from RTEM participating customers who made qualifying changes or upgrades that were not claimed as direct benefits by the program through vendor service reports. These changes or upgrades could include:

- (Source A): additional savings from operations and maintenance activities or capital upgrades enabled by RTEM (at buildings that received NYSERDA incentives) or
- (Source B): adoption of RTEM and the resulting savings from operations and maintenance activities or capital upgrades done activities done at other buildings within the participant's portfolio that did *not* receive any NYSERDA incentives.

For Source A, the evaluation team relied on participating vendors and customer accounts of additional energy savings actions that took place in participating buildings that did not appear in the service report. The

[17] https://nysemail.sharepoint.com/sites/nyserda-ext/ExternalCollaboration/Contractors/RFQL4162/Resources/Guidance%20Documents/PM-Indirect%20Benefit%20Framework.pdf

evaluation team found that participating customers were able to directly verify all the energy savings actions that they had taken as a result of their RTEM system. In addition, participating vendors described recommendations they made to their participating customers that did not make it into their vendor service reports. These recommendations the ones participating customers described along with actions with "soft value" that perhaps did not result in immediate energy savings in the short term, but would lead to energy savings in the long term. For instance, one vendor mentioned developing a heat complaint checklist, supporting estimated bill resolution (to help customers avoid high adjusted bills when utility companies stopped reading meters for months during the initial COVID-19 outbreak), and conducting visual inspections on-site for the durability and functionality of their HVAC equipment.

In instances where the evaluation team received specific, detailed information about energy saving actions from the interviewee, the team took the following approach to estimate the savings associated with each reported indirect benefit:

- Compiled the appropriate energy balance equations
- Determined a representative baseline condition for evaluation
- Gathered the required inputs and assumptions for each equation
- Performed calculations for baseline and proposed conditions
- Adjusted the final value based on program influence (described below)

The evaluation team initially applied the calculations to generate a normalized percentage savings value that that could be used more broadly to estimate savings for other facilities. The percent savings value was then compared to site energy use intensity (EUI) data from ASHRAE Standard 100 to arrive at an annual kBTU/ft^2-yr savings value. Once the evaluation team confirmed the energy savings per square footage for each energy saving action, we were able to extrapolate to the overall energy savings for each building by using NYSERDA's "total impacted square footage" variable along with any adjustments informed by interviewees.

In instances where the vendor or customer was unable to give specific, detailed information about their energy savings actions, the evaluation team used our own estimates on energy savings along with the verified savings of other similar measures at similar buildings. For instance, one vendor provided high-level examples of several energy savings actions along with an estimate of the total energy savings from those actions as related to the verified direct benefit savings at the same building.

With Source A, the evaluation team assumed 100% program influence, since all additional operations and maintenance activities or capital upgrades were completed at participating buildings. Through our interviews, these activities where either (1) confirmed by customers to have been a direct result of information from the RTEM system, or (2) confirmed by vendors to have been the result of additional recommendations that they made using RTEM that did not make it into the service reports.

For Source B, the evaluation team asked participating customers whether they had installed RTEM at any other buildings in their portfolio that did not receive any NYSERDA incentives. In these situations, customers valued RTEM at their participating buildings and replicated the scope of those projects at nonparticipating buildings. Therefore, to quantify the savings for Source B, the evaluation team used verified energy savings from participating buildings, then adjusted the value based on the number of nonparticipating buildings where the customer replicated the scope, and the estimated square footage impacted at each of these nonparticipating buildings.

With Source B, the evaluation did not assume 100% program influence and instead asked participating customers to rate the NYSERDA RTEM program's influence on their decision to replicate the scope of their projects using a scale of zero to ten. The team asked customers to rate three separate statements of potential program influence, as agreed upon with NYSERDA program staff, and used the highest value to calculate

program influence. For instance, if the highest value of program influence from an interviewee was nine, then their indirect benefit savings from Source B would receive an adjustment by multiplying the original value by 90%. These statements were as follows:

- NYSERDA's RTEM program helped increase our awareness of RTEM options
- NYSERDA's RTEM program helped us understand the impact of RTEM to our business
- NYSERDA's RTEM program helped support decisions to invest in energy management or energy savings opportunities

For more detailed analysis of direct influence participant adoption from individual vendors or customers, please refer to Appendix A: Indirect Benefit Detailed Analysis.

3.2.2 Nonparticipant Adoption

The evaluation team, along with NYSERDA staff, defined "nonparticipant adoption" as the adoption of RTEM or RTEM-like systems by building owners/managers who had not received any NYSERDA incentives at all for any of their buildings. This included:

- Source C: operations and maintenance activities or capital upgrades done at nonparticipating buildings of a participating or nonparticipating vendor's portfolio

For Source C, the evaluation team relied on interviews with both participating and nonparticipating vendors. Participating vendors were able to describe instances in which they offered RTEM services to their customers without receiving any NYSERDA incentives to do so. In theory, nonparticipating vendors also could have described instances in which they sold RTEM-like services to their customers as a result of NYSERDA RTEM program influences on the EM market in New York, but the evaluation team found no evidence of this during data collection.

To quantify the Source C savings from participating vendors, the evaluation team followed a similar process to our calculations for Source B, as outlined in the previous section. The evaluation team used existing savings information from participating buildings as the baseline indirect benefits amount. Then, the team asked vendors to compare the scope of their projects with nonparticipating customers with the scope of the participating customer projects. For example, one vendor described a nonparticipating customer's project as a condominium, which differed from their participating customers' multifamily-style buildings due to fewer occupancy spaces and therefore fewer available energy savings. The team then used this information, along with the estimated square footage of the nonparticipating customers' projects, to quantify energy savings for Source C.

With Source C, the evaluation team also attempted to assess program influence by asking vendors to rate the program's influence on their decision to sell RTEM-like services to nonparticipating customers. As with Source B, the team gave vendors three statements to rate program influence on a scale from zero to ten and took the highest value of the three. These statements were as follows:

- NYSERDA's RTEM program helped us develop or refine a service offering to take to other customers
- NYSERDA's RTEM program helped us create market presence and/or reputation that helped us win additional projects
- NYSERDA's RTEM program helped increase customers' demand for RTEM

For more detailed analysis of direct influence participant adoption from individual vendors or customers, please refer to Appendix A: Indirect Benefit Analysis.

3.2.3 Indirect Benefit Savings Extrapolation

Since the indirect benefit results garnered from in-depth interviews only represented a sample of the overall population of projects, the evaluation team needed to extrapolate the savings to the population, as described for participating vendors and customers below. The evaluation team determined that there was no risk of double counting savings and that indirect benefits confirmed from participating vendors and customers could purely be additive because vendor and customer project sites from the in-depth interviews did not overlap.

Participating Vendors

As covered in Section 3.1, the evaluation team split participating vendors into two main groups for sampling purposes ("more active" vs. "less active"). In total, the team completed interviews with six of the seven "more active" vendors and three of the twelve "less active" vendors. This accounted for most of the "more active" vendors' total program impacted square footage (87%) and a majority of the "less active" vendors' total impacted square footage (61%). However, only the "more active" vendors showed any evidence of indirect benefits. To extrapolate savings for participating vendors, the evaluation team calculated adjustment factors by taking the program population participating building square footage and dividing by the participating square footage of sampled vendors (by strata). The team then multiplied sample-level gross indirect benefits by this adjustment factor to calculate extrapolated population-level indirect benefits, as shown in Table 3-13 and Table 3-14.

Table 3-13. Participating Vendor Indirect Benefit Extrapolation (Electric)

Vendor Type	Sample Indirect Benefits (MWH)	Sampled Square Footage	Population Square Footage	Adjustment Factor	Population Indirect Benefits (MWH)
More Active	6,938	30,125,027	34,485,015	1.14	7,943
Less Active	0	7,722,378	12,652,204	1.64	0

Table 3-14. Participating Vendor Indirect Benefit Extrapolation (Gas)

Vendor Type	Sample Indirect Benefits (MMBtu)	Sampled Square Footage	Population Square Footage	Adjustment Factor	Population Indirect Benefits (MMBtu)
More Active	30,435	30,125,027	34,485,015	1.14	34,840
Less Active	0	7,722,378	12,652,204	1.64	0

Participating Customers

As detailed in Section 3.1.1, the evaluation team stratified participating customers into two categories: (1) owners/managers of buildings whose HVAC system relied primarily on a boiler and (2) owners/managers of buildings that had a more complex HVAC system similar to larger commercial buildings. In total, the evaluation team completed four interviews with "boiler" customers and three interviews with "complex HVAC" customers. These interviews accounted for 6.5% and 8.1% of the overall population for the "boiler" and "complex HVAC" categories, respectively. Only one customer from each category type indicated evidence of indirect benefit savings. To extrapolate savings for participating customers, the evaluation team calculated

adjustment factors by taking the program population participating building square footage and dividing by the participating square footage of sampled customers (by strata). The team then multiplied sample-level gross indirect benefits by this adjustment factor to calculate extrapolated population-level indirect benefits, as shown in Table 3-15 and Table 3-16.

Table 3-15. Participating Customer Indirect Benefit Extrapolation (Electric)

Customer Type	Sample Indirect Benefits (MWH)	Sampled Square Footage	Population Square Footage	Adjustment Factor	Population Indirect Benefits (MWH)
Boiler	0	1,338,409	20,678,059	15.44	0
Complex HVAC	47	2,154,783	26,559,160	12.23	575

Table 3-16. Participating Customer Indirect Benefit Extrapolation (Gas)

Customer Type	Sample Indirect Benefits (MMBtu)	Sampled Square Footage	Population Square Footage	Adjustment Factor	Population Indirect Benefits (MMBtu)
Boiler	218	1,338,409	20,678,059	15.44	3,365
Complex HVAC	0	2,154,783	26,559,160	12.23	0

3.3 Direct Benefit Methodology

This section details the direct benefits methodology for service report savings review, billing analysis, participant interviews, and expansion analysis.

3.3.1 Vendor Report Savings Review

The AI tool was used to extract vendor information from all available service reports. The goal of this review was to understand the scope of the projects and to extract information pertaining to the energy savings resulting from the RTEM system observations. Vendor reports were pre-screened using an AI model to extract energy savings and manually reviewed to confirm the accuracy of the extraction.

The evaluation contractor developed an AI data extraction application that automatically extracts unstructured data from participating vendor service reports and outputs them in a structured format for downstream analysis. The data extraction application takes PDFs that were converted to plain text and prompt engineering of a large language model (LLM) to produce structured output data. The output data was subsequently validated manually against the previous RTEM study and against the source documents. Much of the data extraction and collation effort was accomplished by the AI tool. A key part of the work was to develop an output containing metadata on the data extraction process so that it was easier to validate the outputs. This was accomplished by getting the LLM to validate its own work implementing heuristic measures of data quality and by manual review. Approximately 90% of all the data extracted is pulled correctly. Where data is

inaccurate, we typically see that the report has an unusual reporting format or uses atypical language to refer to site and measure level savings.

The extracted information from vendor service reports included, where available:

- Site-level energy savings
- Recommended measure description and type (capital, controls, and O&M)
- Measure installation status and installation date
- Energy and cost savings resulting from the measure (electric, gas, oil, or steam)
- Facility and vendor type

This information was collected for all service reports within a project. Service reports predominantly cover a period of six months, with a few exceptions covering quarters. The number of service reports provided depends on how long the RTEM system has been installed. The evaluation contractor team encountered one to ten service reports per site, covering three to five years of service.

Service reports varied in their level of detail; many reports provide detailed measure level descriptions and savings, while others lack this detail. Similarly, several vendors, constituting over 50% of the sites in the population, provide service reports that are less quantitative and more qualitative than the other vendors. The evaluation team reviewed report data to determine where reports provide inconclusive savings estimations, and established decision-making criteria for inclusion of vendor reports in the verified savings estimation. These criteria are:

- To eliminate duplicate savings estimations, where site-level and measure-level savings were reported, an engineering review determined whether overlap between those savings values was incurred and sorted between measure- and savings-level estimates.
- If zero savings were reported for some, but not all measures, those zero savings values were included in the verified savings analysis. Measures associated with non-energy benefits were assigned accordingly, where applicable.
- If there was evidence that some or all of the measures were installed, but no savings information was reported, savings values were imputed from an estimated of savings from similar sites based on a proportion of energy use.
- Sites were dropped from the analysis where no quantified savings information (or zero savings values) was reported and installation is not understood. Participant and vendor interviews confirmed these savings values, where possible:
    - If the vendor report has no savings and this is confirmed with the interview, then it is a zero, not dropped.
    - If the vendor report has no savings and this cannot be confirmed with the interview, then it is dropped.

To determine the first-year savings for a site, the evaluation contractor calculated a cumulative first year of service for all installed measures, where a site-specific service year is the 12-month increment period that follows the installation date. The cumulative first-year savings includes the first year of service for any installed measure. For example, if a project installs two measures in its first year in the program, and a third measure in its second year, then the cumulative first-year savings is the Year 1 savings for the first two measures, and Year 2 savings for the third measure. Savings for the first two measures may have continued in Year 2, but these savings would not be counted as first-year savings for those two measures.

The NYSERDA-approved Artificial Intelligence (AI) tools[18] were used to extract data from vendor reports very efficiently. Although it takes time to develop the methodology and capabilities, the scale of the effort is explained by a few key figures.

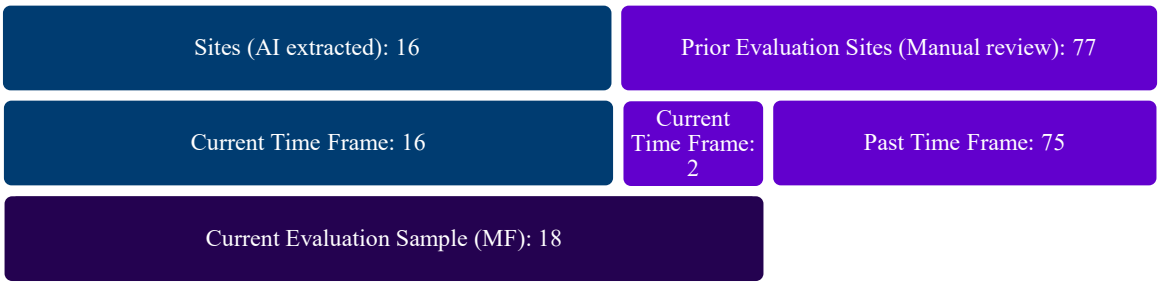
For analysis of vendor reports for the full RTEM program:

- AI extracts over 30 pieces of information from each vendor report for a site with just one measure-level recommendation and more for additional recommendations
- AI extracts information from approximately 30 vendor reports per hour
- Vendor reports processed for this study: 1,129
- An additional 1,421 other files were scanned to verify if the file was a service report

The AI data extraction tool was developed to extract data from reports that describe a single site. This precludes it from analyzing multi-site projects. Of the 345 sites from AI extraction, 298 were dropped from the analysis due to unverifiable savings from vendor reports, sites with sample status of "no incentives," sites outside of the current evaluation period, and sites with unacquired program savings. Additionally, 31 were commercial and industrial buildings which are out of scope for this evaluation, leaving 16 sites for analysis from the current evaluation from AI extraction. An additional 2 sites from the prior evaluation were included in the evaluation sample due to having completion dates within the current evaluation period bringing the total sample count to 18 sites. Since these sites had incorrectly been included in the prior evaluation, they were assigned a weighting factor of 1 when expanded to the population. Figure 3-1 summarizes the site counts and sources for the final count used in the analysis.

Figure 3-1. Summary of site counts for savings review.

Figure 3-2. Summary of site counts for savings review



When possible, the team leveraged information gathered from the indirect benefits in-depth interviews with vendors participating in the RTEM program to verify the installation of recommended and implemented actions. In a limited number of cases, interviews revealed that some measures listed in the vendor reports as both recommended and implemented had not actually been implemented.

3.3.2 Building Consumption Data Review

Using EDI requests to obtain customer consumption data is considered best practice, as utility-provided data are regarded as the most accurate and reliable source of truth. For this evaluation, EDI requests were made to ensure access to the most complete and authoritative information available. The team attempted an EDI request for 1,244 accounts: 225 gas and 999 electric. Of those, 163 gas accounts and 884 electric accounts successfully

[18] AI tool developed for NYSERDA received AI Governance approval in accordance with New York State policy "Acceptable Use of Artificial Intelligence Technologies" 3/11/25; **New York State "Acceptable Use of Artificial Intelligence"**

passed through NYSERDA's prEDI code (used to clean information prior to requesting consumption data) to complete an annual consumption analysis of pre- and post-installation data. Ultimately, the evaluation contractor team collected building electric consumption data for 394 EDI keys (362 sites) with installation dates available from the program's M&V process and where data were provided by customer utilities. The team reviewed the data and performed a quality check for completeness and usability.

Of the total EDI consumption data received, 40 sites were multifamily. Of the 40 multifamily sites with EDI data, 20 of these had both pre-installation and post-installation consumption data. Of these 20, 7 of the sites were from the prior evaluation study, 11 sites had no vendor reports, and 2 sites were part of the sampled sites with received vendor reports but with zero implemented savings. Of the other 20 sites, only pre or post data were received. Of those, 5 sites were from the prior evaluation study, and the other 15 sites were dropped from the analysis since the AI could not extract data. Pre-install data, primarily acquired from the NYSERDA program team, is discussed further in Section 3.4.1, Site baseline energy consumption.

3.3.3 Direct benefits analysis method limitations

The chosen program design and related tracking mechanism (aka typology) had the effect of limiting available direct benefits evaluation options that meet industry standards for energy use verification. The evaluation contractor team mitigated limitations posed by the program design through use of an AI extraction method that enabled a broad collection of this service report information across sites, with greater resolution than a pre-/post- billing analysis method would have permitted, since it involves a deeper review of site-specific documents. This results in categorizing measures and identifying how the savings are distributed within those measure type. On the other hand, the method also presents limitations and potential biases, which are described below.

- The evaluation contractor team was able to independently verify that savings occurred, but detailed verification of the savings calculations was not possible as various inputs, from trend data to equipment specific information, were missing since this was not a feature of the program design.
- The program approach relies on vendor-provided information, which presents multiple sources of potential bias:
    - Vendor reports varied in the level of detail provided. Vendors who reported measure-level savings to NYSERDA generally supplied more complete information than those who did not, which in turn allowed for more specific follow-up in customer and vendor interviews. In cases where detailed measure information was not available, interview questions had to be more open-ended, and customers often could not recall specifics for individual sites. This lack of uniformity in vendor reporting often carried through to unevenness in the data collected from participating customers. While this variation can introduce a potential bias in the results, the direction of that bias is not clear—incomplete reporting does not necessarily mean fewer savings occurred, only that they could not be confirmed as direct savings in this study. To address this, savings associated with actions lacking sufficient detail for direct attribution were categorized as qualitative indirect benefits.
    - In some instances, vendors did not report savings. Due to the inconsistency in reporting across vendors, this could be because: 1) the vendor did not provide an estimate of the savings that did occur from reported actions or 2) because no savings occurred from reported actions. For example, since most participation came from a small number of vendors with incomplete reporting, the resulting VGSRR were adversely affected and, in some cases, resulted in 0% evaluated savings. The decision criteria for review of these cases (defined in Section 3.3.1, Vendor report savings review) seeks to identify which of these outcomes is indicated by the report, capture zero savings values where they occurred, and drop sites with inconclusive resulting savings. In large part, the sorting of inconclusive reporting assumes these cases to have no direct savings, with incurred benefits instead

captured through customer interviews. This approach helps ensure that unverified actions are still reflected in the overall assessment, but the variation in reporting detail and reliance on customer recollection of actions taken years earlier introduces potential bias. The direction of this bias is uncertain – incomplete reporting does not necessarily mean fewer savings occurred, nor does more detailed reporting necessarily mean greater savings.

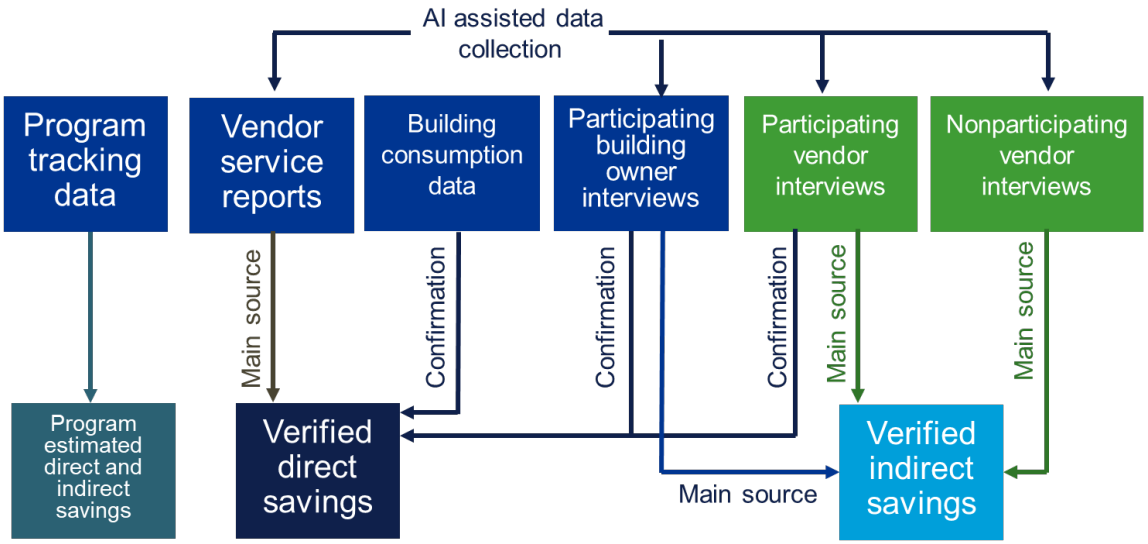
  - In some instances, vendors stopped providing reports to NYSERDA. In that event, the status of the relationship between the vendor and customer is unknown, and thus neither the long-term effect of the measures nor future recommendations and installations can be captured by evaluation. Since the assessment of the savings in this analysis is cumulative first-year savings, the implicit bias is that for some sites we may know direct savings from early years only and may underestimate cumulative first-year direct savings for measures installed in later years. The evaluation mitigated this bias by working through interviews to capture direct savings from the years since the last report. See Section 3.1.2, Data collection activities, for additional information about interviews.

- Non-routine events and COVID-19 occupancy change effects are not always easy to see or control for when looking at a service report. Few service reports addressed the issue, while the majority do not mention the matter altogether.

3.3.4 Direct Benefits Aggregate Analysis

The aggregate analysis expands post-installation energy usage and energy savings for the evaluated direct (site-level) samples and indirect (site- and vendor-level) samples to the sample frame. Figure 3-2 depicts these data flows, showing the connectivity of each primary data source with the indirect and direct benefits, they inform. The verified savings estimates are then compared to program-estimated direct and indirect savings through a set of factors, defined herein, and those factors are expanded to the program population to verify program performance.

Figure 3-3. Data Sources and Flows for Direct and Indirect Benefits Analysis



3.3.5 Site Baseline Energy Consumption

Site baseline energy consumption was taken from the prior evaluation program-reported baseline energy use when available for current evaluation sites. For sites without this data, the evaluation contractor team requested program-reported baseline data for projects completed in 2020 to the present. This evaluation considered only sites with acquired savings. The program determined baseline energy consumption for sites with acquired savings either using actual energy consumption, or estimated consumption based on energy intensity factors from CBECs by facility. Additionally, the evaluation contractors reviewed any provided baseline consumption data and utility bills from the project files. Approximately 88% of the site baseline consumption data provided in project files was unusable, consisting primarily of PDFs of utility bills for only 1 or 2 months. While approximately 12% of sites had a graph with 12 months of consumption data, none of those sites recorded any implemented measures in vendor reports.

3.3.6 Savings Extrapolation

To extrapolate the sampled participating sites to the sample frame, the evaluation team assigned each of the 117 sites a sample weight based on their customer segment and size. The quarterly savings report dataset is considered as the reference in the size weighting. For this evaluation's sample design and analysis, multifamily sites were assigned to size strata using stratified ratio estimation based on the amount of funding received from NYSERDA:

- **Small:** sites that received less than or equal to $34,500 from NYSERDA
- **Medium:** sites that received between $34,500 and $100,000 from NYSERDA
- **Large:** sites that received more than $100,000 from NYSERDA

The evaluation also included a fourth stratum containing all previously evaluated sites and not defined by size in the sample. These sites were not reevaluated and so enter the analysis with their existing result. They received a weight of 1 in the analysis to represent themselves but not the remaining unevaluated population. Based on this described segmentation, the weight is the ratio of the number of sites within a particular category in the sample to the number of sites in the same category in the population. Table 3-17 shows the weight calculations.

Table 3-17. Weight Calculation

Stratum	Size	Number of sites in sample	Number of sites in population	Weight
Previously evaluated sites	N/A	77	77	1.00
Sites not previously evaluated	Small	15	59	3.93
	Medium	13	34	2.62
	Large	10	13	1.30

Subsequently, the weight of each site was applied to both the evaluated savings and the program-level savings within the sample. The realization rate was then calculated as the ratio of the weighted evaluated savings to the weighted program savings. The evaluated program-level savings were obtained by applying the realization rates for each fuel type to the program reported savings.

Program claimed savings calculations

The claimed savings calculations changed over the course of the program. Therefore, to appropriately assess the performance of the program, the evaluation team calculated an "early" and a "late" realization rate that should be applied to the appropriate set of program participants. The early realization rate applies to participants that joined the program prior to Q4 of 2020 and the late realization rate applies to participants that joined after Q4 of 2020. Table 3-18 describes the two methodologies the program adopted to calculate claimed savings.

Table 3-18. Program claimed direct savings calculations

Prior to Q4 2020	After Q4 2020
Program-reported direct MWh savings	
Multifamily: 0.1548*Baseline Energy Use Commercial < 25,000 sq.ft: 0.096*Baseline Energy Use Commercial > 25,000 sq.ft: 0.159 *Baseline Energy Use	Multifamily: 0.087*Baseline Energy Use C&I: 0.082*Baseline Energy Use
Program-reported MMBtu savings	
Multifamily: 0.1548*Baseline Energy Use Commercial < 25,000 sq.ft: 0.096*Baseline Energy Use Commercial > 25,000 sq.ft: 0.159 *Baseline Energy Use Natural Gas to Oil split: MF 70/30, 100/0 Commercial	Program Reported MMBtu Savings - NG: Multifamily: 0.138*Baseline Energy Use C&I: 0.047*Baseline Energy Use Program Reported MMBtu Savings - #2 Fuel Oil: Multifamily: 0.138*Baseline Gallon Oil Use*0.141 C&I: 0.047*Baseline Gallon Oil Use*0.141

The program modified the energy savings factors applied and eliminated the size segmentation previously used.

To calculate indirect savings, the program multiplied each calendar year's gross electric and non-electric savings by an assumed 8% spillover rate.

Direct benefits expansion: verified gross savings realization rate calculations

The direct benefits achieved sample was expanded as two VGSRR ratios based on:

- All vendor service reports from which savings could be extracted
- All participating building interviews that could speak to direct savings

Once the evaluation team calculated direct savings for each of the sites within the sample, they then quantified the overall VGSRRs by fuel type and overall. The facility size (using incentive payment as a proxy), along with whether a site was part of a single- or multi-site application, was embedded in the weights assigned to sites of different sizes within a particular facility type. The VGSRR calculation is as follows.

$$VGSRR_{Initial} = \frac{\sum_{j=1}^{S} W_j * V_j}{\sum_{j=1}^{S} W_j * T_j}$$

$$IDI\ Adjustment = \frac{\sum_{j=1}^{S} W_j * I_j}{\sum_{j=1}^{S} W_j * V_j}$$

$$VGSRR_{Final} = VGSRR_{Initial} \times IDI\ Adjustment$$

Where:

T_j = Tracking estimate of gross savings for site j

V_j = Verified gross savings for site j

I_j = IDI verified gross savings for site j

W_j = Sample weight for site j

S = Number of sites in the sample

The final results presented in this report for Q1 2022–Q2 2024 are based on a domains analysis of that time period from among the full sample of sites reviewed for this analysis.

The overall IDI adjustment factor for multifamily buildings was estimated to be 0.89 for electric savings and 1.00 for gas savings, with relative precisions of 8% and 0% respectively. These overall adjustments were applied to the overall VGSRR results and all domain results prior to reporting and are reflected in the results tables.

Direct benefits expansion: rolling sample estimates

This report presents direct benefit realization rate estimates for the RTEM program since its inception among multifamily facilities, in addition to the current-evaluation-period specific realization rates. This was based on a weighted average of the realization rates from the current and prior evaluations and estimated as follows.

$$VGSRR_{a,b,c} = \frac{S_a VGSRR_a + S_b VGSRR_b + S_c VGSRR_c}{S_{a,b,c}}$$

Where:

S_a = Tracked savings estimate for Q1 2017 – Q4 2020

S_b = Tracked savings estimate for Q1 2021 – Q4 2021

S_c = Tracked savings estimate for Q1 2022 – Q2 2024

$S_{a,b,c}$ = Overall tracked savings estimate for Q1 2017 – Q2 2024

Relative precision and confidence intervals were estimated for this rolling estimate as follows:

$$RP_{a,b,c} = \frac{\sqrt{(S_a RP_a)^2 + (S_b RP_b)^2 + (S_c RP_c)^2}}{S_{a,b,c}}$$

Where:

S_a = Tracked savings estimate for Q1 2017 – Q4 2020

S_b = Tracked savings estimate for Q1 2021 – Q4 2021

S_c = Tracked savings estimate for Q1 2022 – Q2 2024

$S_{a,b,c}$ = Overall tracked savings estimate for Q1 2017 – Q2 2024

Variance estimation

The evaluation team performed variance estimation on the results using Taylor Series Linearization through SAS's PROC SURVEYMEANS.

Method limitations

The evaluation was limited by the following factor:

Non-random sample response: While the primary sites to be included in this analysis were based on a random sample, several sites were excluded for missing information or because the AI process was unable to extract information from certain project types (e.g., multi-site projects), requiring a different review procedure. This may result in biased population estimates.

Appendix A: Indirect Benefit Analysis

This appendix outlines TRC's approach for evaluating claims of estimated energy savings that were achieved through indirect impacts for each vendor and required additional engineering analysis.

Vendors

Vendor One

The first vendor claiming evidence of indirect benefits reported that about 75% of their participating properties benefited from additional "soft value" energy savings that were not represented in the official service reports provided to NYSERDA. These "soft value" recommendations included:

- Heat complaint checklist and support
- Estimated bill resolution
- Instructions on how and why to monitor make up water usage
- Visual inspections on-site
- Deep dives in CHP operation
- Holding contractors accountable

The vendor estimated that these recommendations were roughly equal to savings estimated in the direct service reports. In other words, the vendor estimated that these "soft value" energy savings accounted for half of the properties' total savings. To quantify the savings for the above recommendations, the evaluation team reviewed this vendor's service reports and calculated the relevant data for the calculation: annual median savings per square foot for all participating properties (0.033 kWh or 0.004 MMBtu), the median impacted square footage (205,000 SQ FT),the total number of participating properties (25), and the percentage of properties with indirect benefits (75%).

Equation A-1 below shows the evaluation team calculations.

Equation A-1. Vendor One – Participating Building Indirect Benefits

$$\begin{aligned} &Median\ Savings\ per\ Square\ Foot * Median\ Impacted\ Square\ Footage \\ &* \ Number\ of\ Participating\ Properties \\ &* Percentage\ of\ Properties\ with\ Indirect\ Benefits \end{aligned}$$

Where:

- Median Savings per Square Foot = 0.033 kWh OR 0.004 MMBtu
- Median Impacted Square Footage = 205,000
- Number of Participating Properties = 25
- Percentage of Properties with Indirect Benefits = 75%

Vendor One also estimated that they replicated the scope of their participating properties at 6 additional properties in their portfolio that did not receive any NYSERDA program incentives. When asked to rate the NYSERDA RTEM program's influence on their decision to replicate the scope at these additional properties from a scale of 0 to 10, the vendor reported an 8. The evaluation team again took the median kWh and MMBtu savings per square footage, multiplied it by the number of additional properties, and then adjusted it based on

the vendor's estimate of NYSERDA influence (80% of savings). Equation A- shows the evaluation team's calculations below.

Equation A-2. Vendor One – One Year of Nonparticipating Building Indirect Benefits

$$Median\ Savings\ per\ Square\ Foot * Median\ Impacted\ Square\ Footage * Number\ of\ Nonparticipating\ Properties * NYSERDA\ Influence$$

Where:

- Median Savings per Square Foot = 0.033 kWh OR 0.004 MMBtu
- Median Impacted Square Footage = 205,000
- Number of Participating Properties = 6
- NYSERDA Influence = 80%

Vendor Two

Vendor Two reported the following sources of indirect benefits through our in-depth interview:

- **Steam distribution balancing** – Rebalancing the steam distribution system allowed heating setpoints to be lowered by 1-2°F, resulting in reduced fossil fuel usage
- **Steam pressure setpoint reduction** – Lowering the steam system pressure setpoint from 5 psig (i.e., lb/in2 gauge pressure) to 2 psig reduced fossil fuel usage
- **Steam leak repair** – Fixing steam leaks reduced makeup water, which also reduced fossil fuel usage

The evaluation team estimated the savings associated with each reported indirect benefit as follows:

- Compiled the appropriate energy balance equations
- Determined a representative reference condition for evaluation
- Gathered the required inputs and assumptions for each equation
- Performed calculations for baseline and proposed conditions

The calculations were initially applied to generate a normalized percentage (%) savings value that that the evaluation team used to more broadly estimate savings at other facilities. The % savings value is then compared to site EUI data from ASHRAE Standard 100 to arrive at an annual kBTU/ft^2-yr savings value. For this effort, a baseline fossil fuel site EUI value of 26 kBTU/ft^2-yr is applied for apartment buildings in climate zone 5A[19], which represents the 40th bottom (low energy) percentile of energy use by building category.

Steam Distribution Balancing

"Steam distribution balancing" refers to the rebalancing of a steam piping system to ensure that steam is correctly distributed to each tenant. The interviewee described how building managers analyzed RTEM temperature data and used it to identify buildings with high variances across tenant spaces. The high temperature variances were a symptom of poor steam distribution balancing, where some tenants lacked adequate steam flow, while others had a surplus. The interviewee shared how tenants with a surplus of steam would open their windows during cold weather to compensate for the excess heat.

[19] Based on ASHRAE Standard 100-2024 Normative Appendix B

Rebalancing the steam piping system can achieve energy savings by minimizing overheating of tenant spaces and preventing the associated tenant reaction to open windows during cold weather. These energy savings are indirect benefits of RTEM because the recommendations did not directly come from RTEM service reports but instead were driven by additional data analysis that indicated a potential opportunity. The vendor estimated that lowering the occupant heating setpoints by 1°F to 2°F would generally reduce fossil fuel consumption by 5-15%.

The energy savings from steam distribution balancing are primarily driven by the following mechanisms:

- Reduced overall heat losses across the building envelope
- Reduced demand to heat incoming outdoor (ventilation) air
- Reduced infiltration loads

The energy balance equations used in this analysis are described in the numbered subsections that follow. After reviewing New York weather using Typical Meteorological Year 3,[20] TRC chose an outdoor air temperature of 45°F as a representative reference condition for heating system analysis. TRC gathered the following data inputs and assumptions to evaluate the claims of estimated energy savings:

- Typical heating setpoint adjustments:
- A heating setpoint of 72°F was applied as the baseline condition
- Heating setpoints of 71°F and 70°F were applied as proposed conditions #1 and #2, respectively, based on a 1-2°F typical reduction estimated from the vendor.
- Dwelling unit physical data was assumed based on common industry values for existing building construction, as follows:
- Dwelling unit with 50 ft length of exterior wall, 30% fenestration, 1000 ft^2 floor area
- Total exterior wall area = 600 ft2
- Total fenestration area = 180 ft2
- Wall U-value = 0.10 Btu/hr-°F-ft2
- Window U-value = 0.6 Btu/hr-°F-ft2
- Composite wall & window U-value = 0.25 Btu/hr-°F-ft^2
- Outdoor air ventilation rate of 50 cfm (based on 0.35 air changes per hour)
- Infiltration rate of 60 cfm (tight construction, 0.1 cfm per ft^2 of wall)
- Open window area = 0.5 ft^2 (based on 24" wide sash, raised 3" open)
- Window infiltration velocity = 50 ft/min (lower end of perceptible range)

The following calculations are aligned with the three primary energy savings mechanisms listed prior. The evaluation team combined the estimated savings of these three mechanisms to produce an overall estimated savings range that follows the forthcoming calculations.

1. **Reduced heat losses across the building envelope**
   In a heated tenant space, the heat loss across the exterior walls and windows is a function of the difference in temperature between the heated space and the outdoor ambient air. The primary equation used to evaluate the heat loss was:

[20] (TMY3, from https://doe2.com/Download/Weather/TMY3/) data for JFK International Airport

Equation A-1. Heat Loss

$$Q = Awall * \Delta T$$

Where:

- Q = heat loss in Btu/hr
- U = composite wall U-value in Btu/hr-°F-ft^2
- Awall = wall surface area in ft2
- ΔT = temperature difference between indoor and outdoor air in °F

Heat loss calculations for the baseline and two proposed conditions are tabularized as follows:

Table A-1. Temperature Difference Between Indoor and Outdoor Air

Condition	Outdoor Air Temp	Indoor Air Temp (°F)	Constant	OAcfm (ft3/min)	ΔT (°F)	Heat Load Q (Btu/hr)
Baseline: Setpoint = 72°F	45	72	0.25	600	27	4,050
Proposed 1: Setpoint - 1°F	45	71	0.25	600	26	3,900
Proposed 2: Setpoint - 2°F	45	70	0.25	600	25	3,750

2. **Reduced demand to heat incoming outdoor (ventilation) air**
   In an occupied space, fresh outdoor air must be distributed in the space for IAQ/ventilation purposes. This incoming outdoor air introduces a large heating load in the winter season. The primary equation used to evaluate the ventilation heating load was:

Equation A-2. Ventilation Heating Load

$$Q = 1.08 * \text{OAcfm} * \Delta T$$

Where:

- Q = heat load in Btu/hr
- 1.08 = constant
- OA_{cfm} = outdoor airflow in cubic feet per minute
- ΔT = temperature difference between indoor and outdoor air in °F

Heat loads for the baseline and two proposed conditions are tabularized as follows:

Table A-2. Reduced Demand Heat Loads

Condition	Outdoor Air Temp	Indoor Air Temp (°F)	Constant	OAcfm (ft^3/min)	ΔT (°F)	Heat Load Q (Btu/hr)
Baseline: Setpoint = 72°F	45	72	1.08	50	27	1,458

Proposed 1: Setpoint - 1°F	45	71	1.08	50	26	1,404
Proposed 2: Setpoint - 2°F	45	70	1.08	50	25	1,350

3. **Reduced infiltration loads**

"Infiltration" refers to the unconditioned outdoor air that enters the tenant space through leaks in the building envelope. In this analysis, the evaluation team considered two infiltration pathways: (a) unintentional infiltration through the envelope construction, and (b) intentional infiltration through opened windows.

The evaluation team calculated unintentional infiltration heat loads (e.g., through building cracks, aged window seals) using the same primary equation from the previous analysis (subsection/calculation #2) and tabularized them as follows:

Table A-3. Unintentional Infiltration Heat Loads

Condition	Outdoor Air Temp	Indoor Air Temp (°F)	Constant	OAcfm (ft^3/min)	ΔT (°F)	Heat Load Q (Btu/hr)
Baseline: Setpoint = 72°F	45	72	1.08	60	27	1,750
Proposed 1: Setpoint - 1°F	45	71	1.08	60	26	1,685
Proposed 2: Setpoint - 2°F	45	70	1.08	60	25	1,620

Intentional infiltration heat loads (i.e., windows opened to compensate for overheating) were evaluated using the same primary equation from the previous analysis (subsection/calculation #2) and are tabularized as follows:

Table A-4. Intentional Infiltration Heat Loads

Condition	Outdoor Air Temp	Indoor Air Temp (°F)	Constant	OAcfm (ft^3/min)	ΔT (°F)	Heat Load Q (Btu/hr)
Baseline: Setpoint = 72°F	45	72	1.08	25	27	729
Proposed 1: Setpoint - 1°F	45	71	1.08	25	26	702
Proposed 2: Setpoint - 2°F	45	70	1.08	25	25	675
Proposed 3: Setpoint - 2°F, Window sash closed	45	70	1.08	0	25	0

Steam Distribution Balancing Summary:

The combined savings from the three energy saving mechanisms are tabularized as follows:

Table A-1. Steam Distribution Balancing Summary

Condition	Heat Load Q (Btu/hr)	Heating Savings (Btu/hr)	Heating Savings (%)
Baseline: Setpoint = 72°F	7,987	0	0.0%
Proposed 1: Setpoint - 1°F	7,691	296	3.7%
Proposed 2: Setpoint - 2°F	7,395	592	7.4%
Proposed 3: Setpoint - 2°F, Window sash closed	6,720	1,267	15.9%

Based on these results, a typical heating setpoint reduction of 1-2°F would feasibly reduce the average heating load by about 300 to 1,300 Btu/hr per tenant space, or yield **about 3% to 16% heating energy savings**, which aligns well with the fossil fuel savings estimated by the vendor. These energy savings translate to a range of 0.8 to 4.1 kBTU/ft^2-yr fossil fuel savings. TRC cautions that the high side of the savings range, however, is contingent on the assumption that occupants are opening windows only to compensate for overheating.

Steam Pressure Setpoint Reduction

"Steam pressure setpoints reduction" refers to a decrease in the steam system pressure setpoint that is used to control the output of the central steam boiler(s). The interviewee shared that many client sites were operating at steam pressure setpoints of 5 psig (i.e., lb/in^2 gauge pressure), though only 2 psig was needed to adequately heat tenant spaces. The interviewee leveraged RTEM data to demonstrate that a reduced steam pressure setpoint of 2 psig did not compromise tenant space temperatures. In typical central steam systems, a steam system pressure setpoint higher than needed correlates to steam temperatures that are also higher than needed, contributing to increased heat transfer losses.

Reducing the steam pressure setpoint can achieve energy savings by minimizing heat transfer and steam losses. These energy savings are indirect benefits of RTEM because the recommendations did not directly come from RTEM service reports, but instead were driven by additional data analysis conducted by the interviewee that indicated a potential opportunity. The vendor estimated that lowering the steam pressure setpoint from 5 psig to 2 psig could likely yield fossil fuel savings of 2-5%.

The energy savings from steam pressure setpoint reduction were primarily driven by the following mechanisms:

4. Reduced flash steam loss
5. Reduced distribution system heat loss
6. Reduced boiler combustion, radiation, and convection loss

The energy balance equations used in this analysis are described in the numbered subsections that follow. After reviewing samples of bin weather data, the evaluation team chose an outdoor air temperature of 45°F as a representative reference condition for heating system analysis. The evaluation team gathered the following data inputs and assumptions to evaluate the claims of estimated energy savings:

- Steam system operating pressures:
  - Baseline steam pressure setpoint = 5 psig (from interviews)

- Proposed steam pressure setpoint = 2 psig (from interviews)
- Gravity condensates return operating pressure = 0 psig (typical for industry)

- Steam and condensate properties:
  - Specific enthalpy of water, h_{f1}, at 5 psig = 195.2 Btu/lb
  - Specific enthalpy of water, h_{f1}, at 2 psig = 186.5 Btu/lb
  - Specific enthalpy of water, h_{f2}, at 0 psig = 179.9 Btu/lb
  - Specific enthalpy of evaporation, h_{fg}, at 0 psig = 970.1 Btu/lb
  - Steam temperature at 5 psig = 227.4°F
  - Steam temperature at 2 psig = 218.5°F
- Dwelling unit physical data assumptions from the prior analysis on "Steam Distribution Balancing" were applied, with the following additional data points:
  - 50 dwelling units in this sample building
  - Ambient temperature near piping = 70°F (anticipated indoor temp)
  - Distribution = 350' of 4" steam piping with 2" insulation
  - Piping heat loss = 123 Btu/hr/ft for systems with good insulation, per data tables evaluated at 220°F pipe and 70°F ambient
    - Correction for 5 psig steam = 127 Btu/hr/ft
    - Correction for 2 psig steam = 122 Btu/hr/ft
  - Piping heat loss = 413 Btu/hr/ft for systems with negligible insulation, per data tables evaluated at 220°F pipe and 70°F ambient
    - Correction for 5 psig steam = 427 Btu/hr/ft
    - Correction for 2 psig steam = 410 Btu/hr/ft

The following calculations are aligned with the three primary energy savings mechanisms listed prior. The evaluation team combined the estimated savings of these three mechanisms to produce an overall estimated savings range using the following calculations

7. **Reduced flash steam loss:** Flash steam is produced when high temperature condensate (i.e., ≥ saturation temperature, ~212°F) experiences a sudden pressure reduction. In typical steam heating systems, the condensate is initially formed at the steam system pressure and then reduces to atmospheric pressure as it is discharged (via steam traps) to an atmospherically-vented condensate return system. The amount of flash steam vented is a function of the condensate/steam pressure upstream of steam traps. The primary equation used to evaluate flash steam loss is:

Equation A-1. Flash Steam Loss

$$\%\ \text{flash} \ = \ 100\% \times \frac{(h_{f1} \ - \ h_{f2})}{h_{fg}}$$

Where:

- % flash = % steam flashed & vented to atmosphere,
- h_{f1} = specific enthalpy of water upstream in Btu/lb,
- h_{f2} = specific enthalpy of water downstream in Btu/lb,
- h_{fg} = specific enthalpy of evaporation in Btu/lb

Because some condensate/steam may lose pressure before reaching the steam traps, this analysis has considered two conditions: (a) uniform steam pressure, and (b) nonuniform steam pressure.

Flash steam losses under uniform system steam pressure, where pressure drop through the system is negligible during off-peak conditions, were evaluated for the baseline and proposed conditions and tabularized as follows:

Table A-1.Baseline and Proposed Conditions for Flash Steam Loss

Condition	% Operating Steam at Pressure Setpoint	h_{f1} (Btu/lb)	h_{f2} (Btu/lb)	h_{fg} (Btu/lb)	% flash
Baseline: Setpoint = 5 psig	100%	195.2	179.9	970.1	1.6%
Proposed: Setpoint = 2 psig	100%	186.5	179.9	970.1	0.7%

Flash steam losses under nonuniform system steam pressure, where there is salient pressure drop through the system during peak conditions, were evaluated for the baseline and proposed conditions and tabularized as follows:

Table A-2. Flash Steam Losses Under Nonuniform System Pressure

Condition	% Operating Steam at Pressure Setpoint	h_{f1} (Btu/lb)	h_{f2} (Btu/lb)	h_{fg} (Btu/lb)	% flash
Baseline: Setpoint = 5 psig	50%	195.2	179.9	970.1	0.8%
Proposed: Setpoint = 2 psig	50%	186.5	179.9	970.1	0.3%

8. **Reduced distribution system heat loss**
   In a system producing dry, saturated steam, the steam temperature is a function of the steam system operating pressure. As the operating pressure is reduced, the steam temperature is also reduced, which impacts heat losses from the distribution system (i.e., piping risers and branches). The primary equation used to evaluate the distribution system heat loss is:

Equation A-2. Distribution System Heat Loss

$$Q = Piping\ Heat\ Loss\ Factor \times Pipe\ Length$$

Where:

- Q = heat loss in Btu/hr
- Piping Heat Loss Factor = constant in Btu/lb
- Pipe Length = total length of steam piping in ft

Because the quality of existing insulation varies considerably in existing buildings, this analysis has considered two conditions: (a) good insulation quality, and (b) no remaining insulation integrity (failed or no insulation).

Distribution heat losses for systems with good insulation integrity were evaluated for the baseline and proposed conditions and tabularized as follows:

Table A-3. Distribution Heat Loss with Good Insulation Integrity

Condition	Pipe Temperature (°F)	Ambient Temperature (°F)	Piping Heat Loss Factor (Btu/hr/ft)	Pipe Length (ft)	Piping Heat Loss Q (Btu/hr)
Baseline 1: Setpoint = 5 psig, good insulation	227.4	70	127	350	44,450
Proposed 1: Setpoint = 2psig, good insulation	218.5	70	122	350	42,700

Distribution heat losses for systems with no remaining insulation integrity were evaluated for the baseline and proposed conditions and tabularized as follows:

Table A-4. Distribution Heat Loss with No Insulation Integrity

Condition	Pipe Temperature (°F)	Ambient Temperature (°F)	Piping Heat Loss Factor (Btu/hr/ft)	Pipe Length (ft)	Piping Heat Loss Q (Btu/hr)
Baseline 1: Setpoint = 5 psig, failed insulation	227.4	70	427	350	149,450
Proposed 1: Setpoint = 2psig, failed insulation	218.5	70	410	350	143,500

To translate the piping heat loss to a percentage of annual energy savings, the evaluation team again chose an outdoor air temperature of 45°F as a representative reference condition for heating system analysis. The team applied data from the prior analysis on "Steam Distribution Balancing" which, demonstrated a dwelling unit heat load of ~8,000 Btu/hr at the reference condition. Applying this heat load across all 50 dwelling units yielded a total building heat load of 400,000 Btu/hr at the reference condition.

The equation used to evaluate the annual energy savings as a percentage is:

Equation A-3. Annual Energy Savings

$$\%\ Savings = 100\% \times \frac{(Q_b - Q_p)}{Q_t}$$

Where:

- % savings = % saved due to reduced piping heat loss
- Q_b = baseline piping heat loss
- Q_p = proposed piping heat loss
- Q_t = total building heat load

Heat losses for the two baseline and two proposed conditions are tabularized as follows:

Table A-5. Heat Loss Conditions

Condition	Piping Heat Loss Q_b (Btu/hr)	Piping Heat Loss Q_p (Btu/hr)	Total Heat Loss Q_t (Btu/hr)	% Savings
Proposed 1: Setpoint = 2psig, good insulation	44,450	42,700	400,000	0.4%
Proposed 1: Setpoint = 2psig, failed insulation	149,450	143,500	400,000	1.5%

9. **Reduced boiler combustion, radiation, and convection loss**

   The proposed changes described by the vendor are minor compared to the examples given by the U.S. DOE Technical Brief[21], and therefore the associated savings are estimated to be no more than about 0.25% and are considered negligible for this exercise.

***Steam Pressure Setpoint Reduction Summary**:*

The combined savings from the three energy saving mechanisms are tabularized as follows:

Table A-1. Steam Pressure Setpoint Reduction Energy Savings Summary

Condition	% Savings Low End	% Savings High End
Baseline: Setpoint = 5 psig	0.0%	0.0%
Proposed: Setpoint = 2 psig	0.9%	2.4%

Based on the above, a typical steam pressure setpoint reduction from 5 psig down to 2 psig would **feasibly save about 1% to 3% heating energy**, which falls just below the fossil fuel savings estimated by the vendor (2% to 5%). These savings translate to a range of 0.5 to 0.8 kBTU/ft^2-yr fossil fuel savings. TRC cautions that the high side of the savings range is contingent on the presence of failed insulation with minimal remaining integrity.

Steam Leak Repair

Steam leak repair refers to finding and fixing leaks in the steam system to avoid energy waste and maximize the return of hot, treated condensate to the central boiler plant. The vendor explained that RTEM data was useful for identifying steam leaks. When leaks are present, cold domestic makeup water must be introduced to the boiler system to "make up" for lost steam and/or condensate. That cold water must then be heated back up to the boiling point of the leaked fluid and treated to minimize risk of corrosion and fouling within the steam system.

Repairing steam leaks can yield energy savings by minimizing the amount of cold makeup water that must be heated by the steam plant. These energy savings are indirect benefits of RTEM because the recommendations did not directly come from RTEM service reports, but instead were driven by additional data analysis that

[21] A Best Practices Technical Brief on Steam, from the U.S. DOE (https://docs.nrel.gov/docs/fy06osti/37853.pdf), includes estimated boiler energy savings from reducing operating pressure and temperature

indicated a potential opportunity. The precise energy savings are difficult to quantify, as values will vary depending on the application and severity.

The energy savings from steam leak repair are primarily driven by the following two mechanisms:

10. Reduced heating load due to a reduction in cold makeup water consumption
    The energy balance equations used in this analysis are described in the numbered subsections that follow. The evaluation team chose two outdoor air temperature conditions for comparative analysis: 45°F and 0°F. The evaluation team gathered the following data inputs and assumptions to evaluate the claims of estimated energy savings:

    - Dwelling unit physical data assumptions from the prior analysis on "Steam Distribution Balancing" were applied, with the following additional data points:
        - 50 dwelling units in this sample building, 1,000 ft^2 each
        - Assumed peak steam load of 1500 lb/hr, or 1,455,000 Btu/hr (or 29 Btu/ft^2, falling within industry expectations)
    - Condensate and boiler feedwater conditions:
        - Incoming domestic cold water = 50°F
        - Boiler feedwater temperature = 210°F
        - Percentage of condensate returned in ideal conditions = 10% (assumes 10% lost to venting and boiler blowdown)

The following calculations are aligned with the primary energy savings mechanism listed prior. The calculations are intended to estimate a worst-case condition in which no condensate is effectively returned to the central boiler system, causing an increase in boiler load.

11. **Reduced heating load due to a reduction in cold makeup water consumption**
    In a typical steam heating system, the energy required to heat cold makeup water is a function of the difference in temperature between the incoming makeup water and the near-saturated boiler feedwater. The primary equation used to evaluate heat loss was:

Equation A-1. Heat Loss

$$Q = m \times c_p \times \Delta T$$

Where:

- Q = heat load in Btu/hr
- m = mass flowrate of boiler feedwater in lb/hr
- c_p = specific heat of water at constant pressure in Btu/lb-°F
- ΔT = temperature difference between incoming makeup water and heated boiler feedwater in °F

Heat loss calculations for the baseline and two proposed conditions are tabularized as follows:

Table A-1. Reduced Heating Load Baseline and Proposed Conditions

Condition	Out-door Air Temp (°F)	Steam Flow-rate (lb/hr)	% Make-up Water	Make-up Water Rate (lb/hr)	C_p (Btu/lb-°F)	Incoming Makeup Water Temp (°F)	Heated Feed-water Temp (°F)	ΔT (°F)	Heat Load Q (Btu/hr)
Baseline: 0% Cond Return	0	1500	100	1500	1.0	50	210	160	240,000
Proposed: 90% Cond Return	0	1500	10	150	1.0	50	210	160	24,000
Baseline: 0% Cond Return	45	415	100	415	1.0	50	210	160	66,400
Proposed: 90% Cond Return	45	415	10	41.5	1.0	50	210	160	6,640

Steam Leak Repair Summary:

The worst case (i.e., best savings) analysis for both outdoor air conditions yield 15% heating system savings:

Table A-1. Steam Leak Repair Summary

Condition	Outdoor Air Temp (°F)	% Savings Low End	% Savings High End
Baseline: 0% Cond Return	0	-	-
Proposed: 90% Cond Return	0	0.0%	14.8%
Baseline: 0% Cond Return	45	-	-
Proposed: 90% Cond Return	45	0.0%	14.8%

Based on the above, steam leak repair could **feasibly save about 0% to 15% heating energy**. These savings translates to a range of 0.0 to 3.9 kBTU/ft^2-yr fossil fuel savings. TRC cautions that the high side of the savings range is contingent on the severity of the leaks and is unlikely to be reached.

Vendor Three

Vendor Three reported the following sources of indirect benefits through our in-depth interview:

- **Domestic hot water recirculation pump setback**
- **Occupancy based lighting control**

Domestic Hot Water Recirculation Pump Setback

"Domestic hot water (DHW) recirculation (recirc) pump setback" refers to a control strategy that reduces the runtime of the DHW recirc pump based on a combination of building schedule and demand. An RTEM report provided by vendor three described a process of automatically shutting off the DHW recirc pump when the DHW return temperature meets or exceeds an adjustable setpoint value. Furthermore, the RTEM report described setting back the adjustable DHW return temperature setpoint during low demand hours from 12am – 5am.

The energy savings from steam distribution balancing are primarily driven by the following mechanisms:

1. **Reduced DHW recirc pump runtime**
   TRC gathered the following data inputs and assumptions to evaluate the estimated energy savings:
   - Pump sizing: The DHW recirc pump has been assumed to utilize a 1 hp motor. This is based on estimates of a 10-gpm flowrate with 100 ft of total dynamic head for the building DHW recirc system, with the motor size rounded up to 1 hp.
   - Pump runtime: In the baseline condition, the DHW recirc pump operates 24 hours/day, 7 days/week. For the proposed condition, the evaluation team has assumed that the DHW recirc pump turns off for 25% of the day, cumulatively.
   - Building physical data was gathered from NYSERDA as follows:
     - Total building area = 48,000 ft^2

The following calculation is aligned with the primary energy savings mechanism listed prior.

1. **Reduced DHW recirc pump runtime:**
   For the proposed DHW system savings measure, the electrical energy savings is a function of the reduced recirc pump runtime. The primary equation used to evaluate pump energy is:

Equation A-1 Pump Energy Evaluation

$$E = P \times 0.746 \times \text{runtime}$$

Where:

- E = pump energy consumption in kWh
- P = Pump power in hp
- 0.746 = conversion factor (hp to kW)

Pump electrical energy savings calculations for the baseline and proposed conditions are tabularized as follows:

Table A-1. Baseline and Proposed Pump Electrical Energy Savings

Condition	Runtime (%)	Runtime (hr)	Pump Power (hr)	Pump Energy (kWh)	% Savings
Baseline: 100% Runtime	100%	8,760	1	6,535	0%
Proposed: 75% Runtime	75%	6,570	1	4,901	25%

DHW Recirc Pump Setback Summary:

Based on the above, a 25% reduction in runtime will yield 25% pump electric energy savings, or **0.12 kBTU/ft^2-yr site electrical savings**. Using the baseline site electrical EUI value of 20 kBTU/ft^2-yr from ASHRAE Standard 100-2024 Normative Appendix B, the **total annual building electrical energy savings is estimated as 0.6%**.

Occupancy-based Lighting Control

"Occupancy-based lighting control" refers to a control strategy that automatically turns lighting off and on based on input from occupancy sensors. An RTEM report provided by Vendor Three identified utility rooms, mechanical rooms, boiler rooms, and other common gathering areas as key spaces that are vacant for extended periods of time.

The energy savings from occupancy-based lighting control are primarily driven by the following mechanisms:

1. **Reduced lighting runtime**

The evaluation team gathered the following data inputs and assumptions to evaluate the claims of estimated energy savings:

- Lighting power density: For the spaces where occupancy sensors were proposed, a lighting power density of 0.43 W/ft^2 was assumed based on published requirements of IECC – 2021 for electrical/mechanical rooms.
- Building physical data was gathered from NYSERDA as follows:
  - Total building area = 48,000 ft^2
- Impacted building area: 25% of the building was assumed to be impacted
- Lighting runtime: In the baseline condition, the lighting operates 24 hours/day, 7 days/week. For the proposed condition, the evaluation team has assumed that the impacted lighting turns off for 50% of the day, cumulatively.

The following calculation is aligned with the primary energy savings mechanism listed prior.

2. **Reduced lighting runtime:**
   For the proposed occupancy-based lighting control measure, the electrical energy savings of the impacted spaces is a function of the reduced lighting runtime. The primary equation used to evaluate lighting energy is:

Equation A-1. Lighting Energy Savings

$$E = \left(\frac{LPD}{1000}\right) \times area \times runtime$$

Where:

- E = lighting energy consumption in kWh
- LPD = lighting power density in W/ft^2
- 1000 = conversion factor (W to kW), area is the impacted building area in ft^2, runtime is the lighting runtime in hours
- Runtime = lighting runtime in hours

Lighting electrical energy savings calculations for the baseline and proposed conditions are tabularized as follows:

Table A-1. Baseline and Proposed Lighting Energy Savings

Condition	Runtime (%)	Runtime (hr)	W/ft^2	Area (ft^2)	Lighting Energy (kWh)	% Savings
Baseline: 100% Runtime	100%	8,760	0.43	12,000	45,202	0%
Proposed: 50% Runtime	50%	4,380	0.43	12,000	22,601	50%

***Occupancy-based Lighting Control Summary**:*

Based on the above, a 50% reduction in lighting runtime will yield 50% electric energy savings, or **0.47 kBTU/ft^2-yr site electrical savings**. Using the baseline site electrical EUI value of 20 kBTU/ft^2-yr from ASHRAE Standard 100-2024 Normative Appendix B, the **total annual building electrical energy savings is estimated as 2.4%**.

Vendor Four

Vendor Four reported that based on the insights gained from RTEM data and comprehensive on-site evaluations, they were able to develop a detailed scope of work to enhance building efficiency. The reported the following energy savings actions as indirect benefits:

- Installed new air-side controls with advanced sequences for scheduling and time-of-day operations to reduce building pressurization
- Upgraded boiler controls with parallel positioning, oxygen trim, and variable frequency drives (VFD)s for the boiler draft fan
- Implemented exhaust fan controls
- Replaced outdated Air Handling Units (AHUs) with modern, energy-efficient models

The evaluation team believes that these actions meet the definition of a direct benefit, given that they appear to be direct recommendations made by Vendor Four to their customers following installation of RTEM. However, none of these actions appeared in available service reports from the vendor. As a result, based on agreements with the NYSERDA program staff, the evaluation team is counting these savings as indirect savings.

Vendor Four showed detailed savings that collectively resulted from these actions. The evaluation team compared the claimed indirect benefits to the property site's program-estimated direct benefits and determined that the vendor's estimates were reasonable.

Vendor Four also reported that they replicated the scope of these energy saving actions at five additional nonparticipating projects, averaging 250,000 square feet in size. To calculate Vendor Four's nonparticipant adoption indirect benefits, the evaluation team calculated the average savings per square footage from their direct influence participation adoption results, then adjusted it based on the size of each nonparticipating building.

Customers

Customer One

The first customer did not reveal any evidence of indirect benefits at their buildings that received NYSERDA incentives, but did mention that they had replicated the scope of their projects at four additional nonparticipating properties.

The customer described two of the additional nonparticipating properties as similar buildings to their participating buildings, and the other two buildings were "condo" style properties, and the customer estimated that RTEM would save about 20% of the energy savings of the customer's participating from a savings per square footage standpoint. The evaluation team then asked the customer to provide the total impacted square footage for the nonparticipating properties and adjusted based on program influence.

Equation A-1. Customer One Nonparticipant Adoption

$$Nonparticipant\ Adoption = \left(\frac{Participating\ Building}{200{,}000} \times (630{,}000 + 421{,}000) + \frac{Participating\ Building}{200{,}000} \times (721{,}000 + 238{,}000) \times 0.20 \right) \times Program\ Influence$$

Where:

- Participating Building = 23,809 kWh
- Program Influence = 100%

Customer Two

The second customer, on the other hand, did not replicate the scope of their participating projects at any additional nonparticipating properties, but did report energy savings actions at participating buildings that had not make it into the vendor service reports. While the evaluation team counted these savings as indirect benefits (based on agreement with NYSERDA program staff), it is important to note that the evaluation team believes that these actions should have been included in service reports and counted as direct benefits.

This customer mentioned using their RTEM system to monitor their energy usage for any unusual fluctuations, leading to actions like:

- Fixing an underground water leak
- Adjustments to the stack temperature
- Annual maintenance to boiler systems

While the interviewee did not provide enough information for the evaluation team to use engineering analysis to calculate the above actions, they did provide building energy usage before and after RTEM installation. The evaluation used this as the basis for the estimate and found that the energy saving actions led to about 2,186 MMBtu in savings.

Appendix B: Sampling Memo

Sample Design

TRC assumes that there are three main sources of indirect benefits. Table B-1 shows each of the three sources mapped against the market actor interviewees. For sources of indirect benefits in which two market actor categories contribute to, we will triangulate results from the combined categories.

Table B-1. Sources of Indirect Benefits vs Market Actor Interviews

Indirect Benefit Sources	Participating Vendors	Participating Owners and Managers	Nonparticipating Vendors
Additional Operations and Maintenance Activities done at participating buildings (not captured through direct impacts)	X	X	
Capital Improvements enabled by RTEM data at participating buildings		X	
Operations and Maintenance Activities done at nonparticipating buildings	X	X	X

In the remainder of this memo, we will discuss the sample design for each of the market actor categories, including the key segments for each and the specific list of contacts that we would like to target. TRC primarily used the tracking data provided by program staff in November and December, individual service reports from AWS, and interviews with key NYSERDA program staff to inform this sample design creation. While the overall structure of the sample will stay consistent, once we get access to additional information about the project and vendor characteristics, the specific selections may change.

Participating Vendors

There are a total of 22 energy management vendors who completed at least one MF project through the RTEM program, 13 of which also completed commercial projects. To create our sample, we are excluding 3 of the 13[22] mixed vendors due to their greater focus on commercial projects, although we will still include their multifamily savings in the population for the purposes of extrapolation. We also assume that more active vendors will have a greater likelihood of installing energy management services at additional nonparticipating buildings. This will allow us to have a greater chance of capturing this source of report indirect benefits if they are present.[23] Because of this, we determined that the key segment for vendors is their participation level, by impacted square footage of participating projects.

For our vendor sample, we have created two strata, with one stratum focused on the seven most active vendors[24] by participating square footage and another stratum focused on the remaining vendors. We will attempt a census of the most active vendors, while we will randomly sample four less active vendors. This will

[22] NYSERDA program staff shared that Enertiv specializes on commercial sites. According to tracking data, InTech Energy and Carbon Lighthouse also worked primarily with commercial projects.

[23] TRC based this assumption on input provided by the NYSERDA team during our November check-ins.

[24] There was a natural cutoff point for vendor size by square footage after the top 7.

allow us to collect more information from the most active vendors (who are more likely to report indirect benefits), while still avoiding response bias by incorporating results from the less active vendors. When calculating the final indirect benefits from vendor interviews, the incidence from the more active vendor stratum will account for 78% of the final results, while the less active vendors will account for 22%.

Table B-2Table below shows the sample vendor targets compared to the population of vendors. Note that while we will attempt a census of the more active vendors, we have set the initial sample target at six, assuming that we will not be able to complete interviews with 100% of these vendors.

Table B-2. Sample Vendor Target vs Population

Vendor Type	Sample Vendor Count	Population Vendor Count	Sample Square Footage	Population Square Footage	Population Square Footage %
More Active	6	7	40,601,215	44,910,285	78%
Less Active	4	15	5,451,794	12,467,191	22%
Total	10	22	46,053,009	57,377,476	100%

Table B-3 presents the 7 more active vendors along with 4 randomly selected vendors from the less active category. The 4 less active vendors selected here represent TRC's first choice for interviews, but we will have 8 more backup options available.

Table B-3. Targeted Sample of Multifamily Participating Vendors[25]

Vendor	Vendor Type (more or less active)	Impacted Square Footage	% of Total Impacted Square Footage	MF Sites Completed	% of Total Projects
BPP MFNY Employer	More	12,893,361	21%	73	20%
Bright Power	More	9,400,521	15%	52	14%
Dual Fuel Corp	More	4,735,735	8%	90	25%
Trane US	More	4,477,000	8%	9	2%
Energy Technology Savings	More	4,359,988	7%	27	7%
Steven Winter Associates	More	4,309,070	7%	16	4%
Parity Inc	More	4,250,512	7%	15	4%
EN-POWER Group	Less	2,756,852	4%	10	3%

[25] "Large" vendors include the 7 highest vendors by impacted square footage, "small" vendors include the rest of the population.

Vendor	Vendor Type (more or less active)	Impacted Square Footage	% of Total Impacted Square Footage	MF Sites Completed	% of Total Projects
Albireo Energy	Less	1,403,047	2%	3	1%
David Energy Systems	Less	831,895	1%	20	5%
Delta Connects	Less	460,000	1%	1	0%
Total	N/A	46,053,009	81%	201	86%

Participating Building Owners and Managers

There a total of 365 project sites (according to the number of sites field from the tracking data) mapped onto 222 unique multifamily projects (unique application number). NYSERDA reports that the main driver of differences in the RTEM project scope for multifamily relied on existing building system type, making this the key segment for sampling. Most MF projects occurred in buildings with only a central boiler system, whereas the rest occurred in MF buildings that have full central HVAC to the apartments, which would operate more similarly to commercial buildings. While the tracking data does not have a field that directly informs on system type, TRC used a combination of the building type variable (high-rise, low-rise) and program staff context on vendor activities to create our own system type category. Specifically, we adhered to the following rules when determining building system type:

- All projects with Dual Fuel, ETS/Logical Buildings were categorized as "Central Heating/Hot Water Only" buildings.
- All projects with Trane or Enertiv as vendors were categorized as "Central HVAC" buildings.
- All projects not labeled as "High-Rise Multifamily" were considered low-rise buildings, and therefore, categorized as "Central Heating/Hot Water Only" buildings.
- All projects (besides Trane and Enertiv projects) with average gross square footage below 100,000 square feet were considered low-rise buildings and therefore, categorized as "Central Heating/Hot Water Only" buildings.

TRC used the new “system type” variable to serve to define our key segmentation variable. TRC then divided the sample evenly, with five interviews planned for each system type. Table B-4 shows our analysis of participating building owners for whom the RTEM impacted only the central heating and those for whom the RTEM impacted the full HVAC system. TRC will weight our final indirect benefits from building owner/manager interviews such that Buildings with central heating will account for 54% of the final results and full HVAC buildings will account for 46%[26]

[26] Determined by the total population impacted square footage by system type

Table B-4. Building Owner Sample Size Targets

System Type	Sample Project Target	Population Project Count	Sample Impacted Sq. Ft.	Population Impacted Sq. Ft.	Population Square Footage %
Only Central Heating	5	166	4,408,989	34,565,317	56%
Full HVAC	5	56	4,754,144	27,062,671	44%
Total Sample Size	**10**	**222**	**9,163,133**	**61,627,988**	**100%**

TRC will prioritize the "key sites" as outlined by NYSERDA program staff and separate those key sites by the "System Type." NYSERDA indicates that key sites received the largest amount of NYSERDA funding, had the highest impacted square footage, and likely produced the most direct savings for the project. The team also plans to include interviews with at least one randomly selected owner for each category that was responsible only for one project site to ensure a wider breadth of participant types. Finally, we will attempt to ensure that select projects reflect a variety of energy management vendors.

To extrapolate results to the population, TRC plans to develop an estimate of indirect impacts per participating square foot for each stratum that we can then apply to the population of participating square footage. While the focus on "key sites" has the potential to over-weight the impacts of these more active sites, TRC thinks this risk is worth the tradeoff to connect to building owners more likely to be able to articulate indirect impacts. First, the "key sites" account for 54% and 28% of population square footage for our two stratums, respectively, despite being just 10% of the total number of sites, so they have an outsize effect on what indirect impacts would be. Second, the addition of at least two single-project building owners will help make the results more representative of the overall population.

TRC has also listed the specific building owners that would be our first choice for interviews. If we are unsuccessful in any of the initial interview outreach attempts, TRC will provide backup options to the NYSERDA team. Table B-5 and Table B-6 below show the targeted building owners by system type.

Table B-5. Targeted Building Owners - Only Central Heating Systems

Building Owner	Vendor	System Type	Impacted Square Footage	Number of Sites
BPP MFNY Employer LLC	BPP MFNY Employer	Only Central Heating	3,473,067	19
Harborview Properties	Dual Fuel Corp	Only Central Heating	84,388	7
Rose Associates	Dual Fuel Corp	Only Central Heating	91,409	3
Winn Companies	Bright Power	Only Central Heating	205,000	3
Brookfield Properties	Energy Technology Savings	Only Central Heating	555,125	1

Table B-6. Targeted Building Owners – Full HVAC

Building Owner	Vendor	System Type	Impacted Square Footage	Number of Sites
Bettina Equities	David Energy Systems	Full HVAC	831,895	20
Selfhelp Community	Bright Power	Full HVAC	789,079	8
Rudin Management	Enertiv	Full HVAC	1,040,873	3
Sovereign Apartments	Albireo Energy	Full HVAC	1,142,297	3
Silverstein Properties	Trane	Full HVAC	950,000	1

Nonparticipating Vendors

TRC recommends focusing on nonparticipating vendor research on RTEM vendors that went through the steps to become an RTEM-qualified vendor but never completed a RTEM project, given TRC's understanding of the MF RTEM program. These qualified vendors filled out an application and are listed on NYSERDA's website as qualified vendors but never received incentives for a specific project. We recommend this population, as we assume that these nonparticipant vendors:

- are most likely to have been impacted by the program in some manner,
- will be most able to articulate the influence of the RTEM program, and
- will be easier to contact than vendors with no affiliation with the RTEM program.

The implication of this focus is that when we calculate nonparticipating vendor indirect impact, we will only extrapolate to the qualified vendor population. While we may miss some indirect impacts within the broader population, this will allow us to focus on the accuracy of results within the segment most likely to drive nonparticipating vendor indirect impacts.

Alternatively, we could broaden this to also include vendors that NYSERDA reached out to who did not go on to become qualifying vendors, either because they were ineligible or did not follow through with the steps to become qualified. This would broaden the population of nonparticipating vendors, but give us less robust information about the specific nonparticipating vendors (qualified vendors) expected to account for most of the nonparticipating vendor indirect impacts.

Based on our current understanding of the program and market, TRC does not recommend including nonparticipating vendors that have had no contact with the program. According to program staff, the vast majority of vendors approached during outreach or engagement, at minimum, would have submitted an application for the RTEM RFQ.

TRC found a total of 92 RTEM vendors that qualified for the program, including:

- 40 vendors that completed at least one project through the RTEM program,
  - 22 of these vendors completed at least one multifamily project
- 52 vendors that qualified for the program, but who did not ultimately participate in RTEM.

TRC initially considers the 52 vendors that qualified for the program, but who did not ultimately participate in RTEM as a starting point for the sample from of nonparticipating venders. TRC confirmed at least 7 of the 52 vendors worked in the multifamily space, while 4 more work in multiple sectors. Given these 11 vendors awareness of the NYSERDA RTEM program, TRC anticipates that they will be the most likely sources of nonparticipant adoption for indirect benefits. We will attempt a census with these 11 vendors, shown below in Table B-7, and aim to complete a total of 6 interviews. We will also work with the DNV evaluation team to ensure no nonparticipant vendors are contacted for both the multifamily and commercial indirect impact evaluation.

Table B-7. Targeted Nonparticipant Vendors

Vendor	Sector Focus
AECOM	Residential/Multifamily
Code Green Solutions	Residential/Multifamily
DSM Engineering Associates	Residential/Multifamily
Heat Timer Corporation	Residential/Multifamily
Logical Buildings	Residential/Multifamily
utiliVisor	Residential/Multifamily
Ecobee SmartBuildings	Multiple (incl. MF)
Datakwip Holdings	Multiple (incl. MF)
Enlightened Energy Consultants	Multiple (incl. MF)
Hatch Data	Multiple (incl. MF)
US Energy Group	Multiple (incl. MF)

If NYSERDA prefers to include both qualified nonparticipating vendors AND vendors contacted about the program who never became qualified vendors, TRC could also include the latter in our sampling efforts. In this case, we would like to increase our total target sample size to 10, including 5 qualified vendors and 5 non-

qualified vendors, to have a mix of vendors representing each segment. This may require tapping into contingency budget available for increasing sample sizes.

Appendix C: Participating Vendor In-Depth Interview Guide

Section A: Introduction/Firmographics

[Interviewers note: Section A is the introduction to the rest of the interview. It allows us to confirm our intention to focus on the multifamily sector with the vendor and to gather key information].

3. To start, could you please introduce yourself and describe your role at your company?
    a. What types of products or services do you provide to your customers?
2. What building types do you provide energy management services to?
   PROBE: Multifamily, commercial, industrial, healthcare, education, etc.

For the purposes of this interview, we want to focus on your experience working with multifamily customers. If there are experiences with other building types that you think are relevant, please feel free to discuss them.

[ASK A3 and A4 IF NO RESPONSE FROM INITIAL EMAILS]:

4. To your best estimate, how many employees work at your company?
5. To your best estimate, how many projects involving energy management technology in multifamily properties do you work on per year?
6. Are you familiar with the projects that your company completed that received incentives from the NYSERDA RTEM program? **[INTERVIEWER: PROVIDE EXAMPLES].**
7. In your own words, please talk me through the process of participating in NYSERDA's RTEM program for a typical project, including your company's specific role in each step:
    - Application process
    - Pre-installation commissioning
    - RTEM software & hardware integration
    - Post-installation commissioning
    - Reporting
    - Corrective actions to building systems
8. Before participating in NYSERDA's RTEM program, were you completing similar RTEM projects in New York multifamily buildings?
9. Did participating in the NYSERDA RTEM program change your energy management business, in terms of volume of projects, types of customers, project scope, etc.?
   [PROBE FOR DETAILS ON HOW NYSERDA PROGRAM INFLUENCED]
10. How long did the average RTEM contract with a customer last?
    a. What were the main factors affecting the persistence of RTEM service contracts?
    b. To your best estimate, how many of the RTEM projects that you worked on had service contracts that lasted beyond five years?

Section B: Additional Opportunities (for Participating Buildings)

[Interviewer Notes: Section B covers the indirect benefits from the pathway of additional operations and maintenance activities at participating buildings. We ask the vendor whether they made any additional recommendations at the participating building beyond what was in the service report for a specific project. If they confirm that there were additional recommendations, we loop through the most common equipment found in service report recommendations from multifamily projects in phase 3[27]. In each equipment loop, we ask the vendor for the key variables that will allow us to best estimate the indirect benefit savings that come from the additional recommendations. At the end of each loop, we ask vendors to help us estimate how similar their other participating buildings' additional recommendations were to the selected project site in order to help extrapolate to the vendor's portfolio.]

[Interviewer]: Now, we'd like to talk about the multifamily projects your company completed through the RTEM program. We've reviewed the service reports that you submitted to NYSERDA for each project.

11. Putting aside what you included in the service reports in general, what kind of services do you offer to your customers? I can provide a <LIST OF RECOMMENDATIONS> from a sample site if that would be helpful.
    [IF DIFFERENT THAN WHAT WAS IN THE SERVICE REPORTS]:
    If possible, since we already have the information you provided in the service reports, I'd like to focus on the recommendations that you made to customers that were outside of those reports.
12. What types of recommendations did you make that would not be in the service reports? **[PROBE]:** operations of
    a. air conditioners & furnaces,
    b. boilers,
    c. hot water pumps,
    d. chillers,
    e. ventilation & exhaust systems,
    f. air dampers,
    g. other.
13. Did any of these additional recommendations outside of service reports involve either replacing existing equipment or adding a completely new piece of equipment?
    a. **[IF YES]:** What equipment did you recommend the customer add?
14. How often did you make recommendations without including them in the service report?
    a. What were the most important factors that led to you making recommendations outside of the service report? Why were they not included in the official reports?
    b. Were these recommendations relatively consistent from site to site?
    c. Did your involvement with the NYSERDA RTEM program inform these additional recommendations?

[LOOP FOR EACH CONFIRMED MEASURE FROM B2]

15. What additional recommendations did you make to the building's <MEASURE> besides what was already mentioned in the official service report? **[IF B4b = not consistent from site to site]** Let's focus on this <SITE> which included < LIST OF RECOMMENDATIONS>.

    [FOR ALL, PROBE FOR COMMON RECOMMENDATIONS FOR EACH MEASURE]:

[27] Based on data shared by NYSERDA program staff in "RTEM Internal QAQC" folder provided in late January

Table C-1. Common Recommendations for Measures

Measure	Recommendations
Air Conditioners	• Changing temperature setpoints • Disengaging cooling mode • Verify occupancy schedules
Boilers	• Boiler cleaning • Change set points • Install Demarcation Box to Prevent Short Cycling • Fix leaks • Adjust Boiler Modulation Control to Prevent Short Cycling • System balancing • VFD ramp down speed in off hours • Boiler control settings • Boiler control upgrades
Hot Water Pumps	• Operate pumps in parallel
Chillers	• Fix temperature sensors – setpoints, calibration, temperature deviation
Ventilation and Exhaust	• Equipment cleaning
Air Dampers	• Fix simultaneous heating/cooling

[ASK B6 through B10 IF NOT COVERED IN INITIAL EMAIL]:

1. To your best estimate, what was the size of the <MEASURE>?
2. To your best estimate, what were the annual hours of use for the <MEASURE>?
   a. **[IF TEMPERATURE SETPOINTS MENTIONED]:** How were the temperature setpoints changed?
3. To your best estimate, what was the impacted square footage of these recommendations? Did it affect the entire building?
   a. **[IF <MEASURE> = HOT WATER PUMP]:** To your best estimate, how many occupants resided at this building?
   b. **[ASK IF B4b = NOT CONSISTENT FROM SITE TO SITE]**
   [B11a – c PERCENTS SHOULD ADD TO 100%]: Besides at this <SITE>, of all the other projects that you worked on through the NYSERDA RTEM program involving <MEASURE>, could you please give your best estimate on what percentage took:
   c. No additional energy saving actions besides what was in the service report.

d. Additional energy savings actions similar to what you just described for this <SITE>.

e. Additional energy savings actions different to what you just described for this <SITE>.

4. **[ASK IF B11c > 0]:** To your best estimate, on average, how much bigger or smaller were these additional energy savings actions compared to what you just described for this <SITE>?

Section C: Additional Opportunities (for Nonparticipating Buildings)

[Interviewer Notes: Section C covers the indirect benefits from pathway of operations and maintenance activities at nonparticipating buildings. We ask the vendor about the additional opportunities that they identified with buildings that did not participate in the NYSERDA RTEM program. We first ask whether they made any of the same recommendations at these nonparticipating buildings as what they had recommended in service reports for participating buildings. We anticipate that this will be the most likely source of indirect benefits from this pathway. Then, starting with C7, if they made additional recommendations that were different from those in the service reports, we loop back through asking them about the most common measures found in multifamily recommendations, just as we did in section B. In both situations, we ask the vendor to estimate the number of nonparticipating buildings and the total square footage.]

[Interviewer]: Now, I wanted to focus on energy management projects that you worked on at buildings that did not receive any NYSERDA funding, following your participation in the program.

5. Since you first started working with the NYSERDA RTEM program, have you helped multifamily customers implement RTEM systems in buildings without receiving incentives from the NYSERDA RTEM program?

   a. **[IF YES]** In general, how does the scope of those projects compare to the scope of projects that did receive NYSERDA funding?
   [PROBE: for details on scope differences and how that varies across customers]

[ASK IF C1a = Scope was the same, OTHERWISE SKIP to C4]:

   b. Which equipment and recommendations did you implement at these nonparticipating buildings? **[PROBE FOR MEASURES MENTIONED IN VENDOR'S SERVICE REPORT]:**

   c. How many buildings did your company implement these recommendations at?

   d. To your best estimate, what was the average square footage of these nonparticipating buildings that you implemented RTEM at?

6. We're interested in if NYSERDA's RTEM program helped support the RTEM market outside of direct incentives. Thinking of these projects that didn't receive NYSERDA incentives, could you rate the following statements on a scale from 0 to 10 where 0 means "no influence" and 10 means "very influential"

   a. NYSERDA's RTEM program helped us develop or refine a service offering we were able to take to other customers

   b. NYSERDA's RTEM program helped us create market presence and/or reputation that helped us win additional projects

   c. NYSERDA's RTEM program helped increase customers' demand for RTEM

[ASK IF C1a = Different scope]:

7. What types of recommendations did you make for your customers at these other buildings that did not receive a NYSERDA incentive?
   [PROBE FOR]:

   a. air conditioners

   b. boilers

c. hot water pumps

d. chillers

e. air dampers

f. exhaust and ventilation systems

g. other

[LOOP FOR EACH CONFIRMED MEASURE FROM C3]

8. What recommendations did you make for <MEASURE_NP> at these nonparticipating buildings? **[PROBE FOR COMMON RECOMMENDATIONS FOR EACH MEASURE]:**

Table C-2. Common Recommendations for Measures

Measure	Recommendations
Air Conditioners	• Changing temperature setpoints • Disengaging cooling mode • Verify occupancy schedules
Boilers	• Boiler cleaning • Change set points • Install Demarcation Box to Prevent Short Cycling • Fix leaks • Adjust Boiler Modulation Control to Prevent Short Cycling • System balancing • VFD ramp down speed in off hours • Boiler control settings • Boiler control upgrades
Hot Water Pumps	• Operate pumps in parallel
Chillers	• Fix temperature sensors – setpoints, calibration, temperature deviation
Air Dampers	• Fix simultaneous heating/cooling

[ASK C6-11 IF NOT COVERED IN INTIAL EMAIL]:

9. Were any of these recommendations aimed at helping the customer reduce their demand or lowering their peak energy consumption?

10. To your best estimate, what was the size of the <MEASURE_NP>?

11. To your best estimate, what were the annual hours of use for the <MEASURE_NP>?

12. To your best estimate, what were the average number of occupants at these nonparticipating buildings?

a. **[IF TEMPERATURE SETPOINTS MENTIONED]:** How were the temperature setpoints changed for this

<MEASURENP>?

13. To your best estimate, what was the impacted square footage of these recommendations?
14. How many buildings did you implement these recommendations for <MEASURE_NP> at?
15. To your best estimate, what was the average square footage of these nonparticipating buildings that you implemented these recommendations for <MEASURE_NP> at?
16. We're interested in if NYSERDA's RTEM program helped support the RTEM market outside of direct incentives. Thinking of these projects that didn't receive NYSERDA incentives, could you rate the following statements on a scale from 0 to 10 where 0 means "no influence" and 10 means "very influential"
    a. NYSERDA's RTEM program helped us develop or refine a service offering we were able to take to other customers
    b. NYSERDA's RTEM program helped us create market presence and/or reputation that helped us win additional projects
    c. NYSERDA's RTEM program helped increase customers demand for RTEM

Section D: Non-Energy Benefits

[Interviewer Notes: Section D allows us to qualitatively understand whether implementing RTEM has any non-energy benefits to building owners and occupants.]

Finally, we wanted to discuss whether RTEM projects also provided benefits to customers and their tenants besides energy savings.

17. Did you ever make recommendations to your customers that would've provided benefits that did not result in direct energy savings, such as long-term asset management, capital investment strategies, data logging, or more efficient staff time?
    A. Can you name any other non-energy savings related benefits to your customers as a result of implementing the RTEM system in their buildings?
    B. Can you estimate the portion of your RTEM projects that included recommendations which would lead to these non-energy benefits?

Section E: Closing

Those are all the questions that we have for you today.

18. Is there anything else you think is important for us to know that we did not discuss already?

Thank you again for taking the time to speak with us about your organization and experiences with NYSERDA. As a thank you for your time, we would like to offer you a $250 Tango gift card. This is a virtual gift card that you can redeem with participating retailers such as Amazon, Target, and Walmart.

Thank you again for sharing your experiences with the NYSERDA RTEM program. Have a great rest of your day.

[**END CALL]**

Appendix D: Participating Customer Interview Guide

Section A: Program Experience

[Interviewers note: Section A is the introduction to the rest of the interview. It allows us to confirm our intention to focus on the multifamily sector with the owner/manager and to gather key information].

1. To start, could you please introduce yourself and your role at <ORGANIZATION>?
2. Our records show that your organization completed <NUMBER OF PROJECTS> through the NYSERDA RTEM program. Were you involved in all of these projects or just a subset of them?
3. Do you own/manage any other buildings in New York besides those that participated in the NYSERDA program?
4. How did you first become aware of NYSERDA's RTEM program?
    a. **[IF THROUGH VENDOR]:** How did you first come into contact with <**VENDOR>?**
5. How would you describe your overall experience in installing the RTEM system through NYSERDA's program?
    a. How long was the RTEM service agreement you signed with **<VENDOR>?**
    b. Was the focus of the RTEM service on automated system optimization (ASO), fault detection and diagnostics (FDD) or both?
    c. What about your experience working with **<VENDOR>?**
6. How familiar were you with energy management technologies prior to participating in the NYSERDA program?
    a. What about with real time energy management technologies?
7. Since installing RTEM at <LIST OF SITES>, has your usage of energy management systems throughout your portfolio increased, decreased, or stayed about the same?
8. Thinking broadly, how do you (or your building manager, if owner) operate your building? Specifically:
    a. What actions do you take to drive energy savings?
    b. What actions do you take to improve tenant comfort?
    c. What kind of building data do you review on a daily basis?

Section B: Additional Opportunities (at Participating Buildings)

[Interviewer Notes: Section B covers the indirect benefits from the pathway of additional operations and maintenance activities at the customer's project sites. We ask the building owner/manager whether they installed any additional equipment at the participating building beyond what was in the service report for a specific project. If they confirm that there were additional installations, we loop through the most common equipment found in service report recommendations from multifamily projects in phase 3[28]. In each equipment loop, we ask the customer for the key variables that will allow us to best estimate the indirect benefit savings that come from the additional recommendations.]

[Interviewer]: Now we have a few questions digging into specifics of your participation in the RTEM program.

1. Through the RTEM program, **<CONTRACTOR>** made a number of recommendations. The ones that were implemented got submitted to NYSERDA by **<CONTRACTOR>** in a document called a service report. Do you know if there were other energy savings opportunities implemented in your building(s) that wouldn't have been included in that service report(s)? These could have been things **<CONTRACTOR>** told you about more

[28] Based on data shared by NYSERDA program staff in "RTEM Internal QAQC" folder provided in late January

informally, or opportunities that you were able to pursue on your own based on the information coming out of your energy management system. I can provide the **<LIST OF RECOMMENDATIONS>** if necessary or some examples of how you might have used the information from your energy management system.
[IF NO]: SKIP TO Section C
[IF YES]: CONTINUE

2. Did any of these additional opportunities involve changes to building operations or maintenance?
   a. **[IF YES]:** What equipment did these additional opportunities involve?
   b. Were these additional opportunities recommended by your contractor or were they actions taken on your own or by building staff after reviewing the information coming out of your energy management system?
3. Did any of these additional opportunities involve either replacing existing equipment or adding a completely new piece of equipment?
   a. **[IF YES]:** What equipment did these additional opportunities involve?
   b. Were these additional opportunities recommended by your contractor or were they actions taken on your own or by building staff after reviewing the information coming out of your energy management system?
4. **[ASK IF MULTIPLE SITES]:** Were these additional actions relatively consistent from site to site?
   a. **[IF NOT CONSISTENT]:** Could you describe how they differed?
   [IF B4 = NOT CONSISTENT, FOCUS QUESTIONS ON ONE <SITE>]:
5. For each additional action taken, including both changes to building operations/maintenance and capital improvements, I am going to ask a series of questions to try to quantify the associated impacts.

[LOOP FOR EACH CONFIRMED MEASURE FROM B3/B4]
[FOR ALL, PROBE FOR COMMON RECOMMENDATIONS FOR EACH MEASURE]:

Table D-1. Common Actions for Measures

Measure	Actions
Air Conditioners	• Changing temperature setpoints • Disengaging cooling mode • Verify occupancy schedules
Boilers	• Boiler cleaning • Change set points • Install Demarcation Box to Prevent Short Cycling • Fix leaks • Adjust Boiler Modulation Control to Prevent Short Cycling • System balancing • VFD ramp down speed in off hours • Boiler control settings

	• Boiler control upgrades
Hot Water Pumps	• Operate pumps in parallel
Chillers	• Fix temperature sensors – setpoints, calibration, temperature deviation
Ventilation and Exhaust	• Equipment cleaning
Air Dampers	• Fix simultaneous heating/cooling

a. To your best estimate, what was the size of the **<MEASURE>?**

b. What were the annual hours of use for the **<MEASURE>?**

c. **[IF TEMPERATURE SETPOINTS MENTIONED]:** How were the temperature setpoints changed?

d. What was the impacted square footage of these recommendations? Did it affect the entire building?

e. **[IF <MEASURE> = HOT WATER PUMP]:** To your best estimate, how many occupants resided at this building?

6. **[ASK IF FOCUSING ON ONE SITE]:** Since you mentioned that these additional actions were different from site to site, besides this **<SITE>,** of all the other sites that you own/manage that received NYSERDA funding to install an energy management system, could you please give your best estimate on what percentage took:

   a. No additional energy saving actions besides what was in the service report.

   b. Additional energy savings actions similar to what you just described for this **<SITE>.**

   c. Additional energy savings actions different to what you just described for this **<SITE>.**

7. **[ASK IF B2b/B3b = NOT ADDITIONAL RECOMMENDATIONS FROM CONTRACTORS]:** Since this additional energy saving opportunity was not a recommendation made from your contractor, could you describe how influential the information you received from your real time energy management system was in helping you make that decision? **[PROBE]:** If it would help, which of the following statements best reflect your decision-making process?

   i. I would have taken this action anyways without the information from the RTEM system

   ii. I would have taken this action eventually, but the information from the RTEM system helped quantify the benefits.

   iii. I would not have taken this action at all without the information I received from the RTEM system.

8. Once the subscription period with your contractor ended (during when NYSERDA helped provide funding), did you continue your RTEM service subscription?

   a. **[IF YES]:** How long do you plan to keep your RTEM service subscription?

Section C: Additional Opportunities (at Nonparticipating Buildings)

[Interviewer Notes: Section C covers the indirect benefits from pathway of operations and maintenance activities at nonparticipating buildings within the owner's or building manager's portfolio. We ask the customer to think of their overall portfolio and to explain their decision-making with all their properties since participating in the RTEM program. Then,

starting with C5, if they did additional things that were different from those in the service reports, we loop back through asking them about the most common measures found in multifamily recommendations, just as we did in section B. In both situations, we ask the customer to estimate the number of nonparticipating buildings and the total square footage.]

[Interviewer]: Now, I want to focus on any energy management projects that you worked on at any other buildings in your portfolio that did not receive any NYSERDA funding, following your participation in the program. Think of the **[NUMBER OF PROPERTIES MENTIONED in A6].**

1. Now thinking of your overall portfolio of multi-family buildings, how many properties (or buildings) do you own or oversee other than <SITE>s that received NYSERDA funding to install a real time energy management system?
   A. Of these other properties, how many have the following number of units?
      i. 1-20 units
      ii. 20-50 units
      iii. 50-100 units
      iv. More than 100 units
2. Of all the properties in your portfolio, since you first started working with the NYSERDA RTEM program, have you decided to adopt real time energy management systems or any other type of energy management system in a building, without NYESRDA support?
3. Thinking more broadly, did your experience with the RTEM program change how you've approached energy savings opportunities throughout your portfolio?
4. Can you give your best estimate as to the number of properties in which you made additional energy savings opportunities for each of the building sizes that you mentioned previously **<IN C1A>?**
      i. 1-20 units
      ii. 20-50 units
      iii. 50-100 units
      iv. More than 100 units
5. How many of the **[NUMBER OF BUILDINGS FROM C4]** projects at these properties received NYSERDA program support like the one at <SITE>?
   [IF C5 minus C4 = ALL, SKIP TO SECTION D]
6. In how many of the **[NUMBER OF BUILDINGS C5 minus C4]** properties did you install some kind of energy management system?
7. Of the **[NUMBER OF BUILDINGS C5 minus C4]** properties that did *not receive* any NYSERDA program support, could you give your best estimate as to the type of energy savings actions you took by building size?
   [IF YES, CONTINUE]

Table D-2. Owner Improvement Decision-making

Building Size	Capital Improvement	Process Improvement
1-20 units		
20-50 units		
50-100 units		
More than 100 units		

8. How does the scope of these projects where you made some kind of additional energy saving upgrade compared to the <SITE> that received NYSERDA funding?
   PROBE: How does the scope vary across buildings?
   [IF C8 = Different scope, SKIP TO C10]
   [IF C8 = Same scope, CONTINUE]

9. Which equipment and practices did you implement at these nonparticipating buildings?
   [PROBE FOR MEASURES MENTIONED IN VENDOR'S SERVICE REPORT]

   a. How many buildings did you implement these changes at?

   b. To your best estimate, what was the average square footage of these nonparticipating buildings that you implemented RTEM at?

10. **[ASK IF C8 = Different scope]:** What types of changes, installations, or upgrades did you implement at these other buildings that did not receive a NYSERDA incentive?
    [PROBE FOR]:

    a. air conditioners

    b. boilers

    c. hot water pumps

    d. chillers

    e. air dampers

    f. exhaust and ventilation systems

    g. other

11. I want to ask a few questions about what specific changes you made and how they impacted different systems in your facility. To help quantify these impacts, I will ask for some details about your buildings, building size, and occupancy.
    [LOOP C11 QUESTIONS FOR EACH CONFIRMED MEASURE FROM C8]
    What changes did you make for <MEASURE_NP> at these nonparticipating buildings?
    [PROBE FOR COMMON RECOMMENDATIONS FOR EACH MEASURE]:

Table D-3. Common Recommendations for Measures

Measure	Recommendations
Air Conditioners	• Changing temperature setpoints • Disengaging cooling mode • Verify occupancy schedules
Boilers	• Boiler cleaning • Change set points • Install Demarcation Box to Prevent Short Cycling • Fix leaks

	• Adjust Boiler Modulation Control to Prevent Short Cycling • System balancing • VFD ramp down speed in off hours • Boiler control settings • Boiler control upgrades
Hot Water Pumps	• Operate pumps in parallel
Chillers	• Fix temperature sensors – setpoints, calibration, temperature deviation
Air Dampers	• Fix simultaneous heating/cooling

a. Were any of these changes aimed at helping to reduce electricity demand or lowering peak energy consumption?

b. To your best estimate, what was the size of the <MEASURE_NP>?

c. What were the annual hours of use for the <MEASURE_NP>?

d. What were the average number of occupants at these nonparticipating buildings?

e. **[IF TEMPERATURE SETPOINTS MENTIONED]:** How were the temperature setpoints changed for this <MEASURENP>?

f. what was the average building square footage of the nonparticipating buildings you that you implemented changes for <MEASURE_NP> at?

g. what was the typical impacted square footage of these recommendations?

h. How many buildings did you implement these recommendations for <MEASURE_NP> at?

[ONCE LOOPED THROUGH ALL MEASURES, CONTINUE]

12. Thinking of these projects that didn't receive NYSERDA incentives, could you rate the following statements on a scale from 0 to 10 where 0 means "no influence" and 10 means "very influential"

a. NYSERDA's RTEM program helped increase our awareness of RTEM options

b. NYSERDA's RTEM program helped us understand the impact of RTEM to our business

c. NYSERDA's RTEM program helped support decisions to invest in energy management or energy savings opportunities

Section D: Non-Energy Benefits

[Interviewer Notes: Section D allows us to qualitatively understand whether implementing RTEM has any non-energy benefits to building owners and occupants.]

Finally, we wanted to discuss whether RTEM projects also provided benefits to your business and tenants besides energy savings.

1. Have you noticed any change in hot or cold calls from tenants since adopting your energy management system?

How many fewer calls compared to before RTEM changes were made?

2. Have you implemented occupancy-based energy management at your buildings?
3. Have you noticed any changes in equipment requiring maintenance or changes to maintenance related expenses since implementing RTEM? If yes, please describe?
4. Has having the RTEM system had any impact on staff time needed for building operations?
5. Have tenants noticed any differences in their living situation since you implemented RTEM? Has their level of satisfaction changed?
6. Have you noticed a difference in the occupancy rates (vacancies, tenant turnover) since you implemented RTEM? Please describe what changes you have experienced?
7. Has there been any change to emergency medical calls since you implemented RTEM? Please describe what changes you have experienced?

Section E: Closing

Those are all the questions that we have for you today.

1. Is there anything else you think is important for us to know that we did not discuss already?

Thank you again for taking the time to speak with us about your organization and experiences with NYSERDA. As a thank you for your time, we would like to offer you a $250 Tango gift card. This is a virtual gift card that you can redeem with participating retailers such as Amazon, Target, and Walmart.

Thank you again for sharing your experiences with the NYSERDA RTEM program. Have a great rest of your day.

[END CALL]

Appendix E: Nonparticipating Vendor Interview Guide

Section A: Firmographics/Introduction

[Interviewers note: Section A is the introduction to the rest of the interview. It allows us to confirm our intention to focus on the multifamily sector with the vendor and to gather key information].

2. To start, could you please introduce yourself and describe your role at your company?
    a. How long have you worked in this industry?
    b. What types of products or services do you provide to your customers?
    c. Does your company work only in New York, or does it also do business in other regions or countries? Can you estimate the percentage of your sales that take place in NY vs in other regions?
3. To your best estimate, how many employees work at your company?
4. What building types do you provide energy management services to?
   [PROBE]: Multifamily, commercial, industrial, healthcare, education, etc.

For the purposes of this interview, we want to focus on your experience working with multifamily customers. If there are experiences with other building types that you think are relevant, please feel free to discuss them.

Section B: RTEM Awareness

Next, I have a few questions about your familiarity and experience with real time energy management technologies, or RTEM, which can also be referred to as cloud-based control technologies.

1. Firstly, how familiar are you with cloud-based control technologies and practices?
   [PROBE IF FAMILIAR]: What do you see as the primary benefits of cloud-based controls technology? Challenges?
   [IF NOT FAMILIAR SKIP TO C1]:
   RTEM technologies help provide building energy use data of building systems and equipment. They are uniquely able to provide energy saving recommendations and detect inefficiencies in real-time.
    a. Do you include cloud-based controls or building management systems as part of your offerings to customers?
       [IF NO: SKIP TO B4]
       [IF YES: CONTINUE with B2a]
    b. In your estimate, what percentage of the projects you complete with multifamily customers include cloud-based controls technology or practices?
    c. How many projects including cloud-based controls do you complete every year, on average?
2. Have the volume and types of cloud-based controls offerings changed over time in your estimation? How?
3. In your experience, how familiar are multifamily customers with RTEM technology and practices?
    a. **[ASK IF A1c = MORE THAN JUST NY]:** Are customers in New York more or less familiar with cloud-based controls technology than customers in other states, or about the same?
    b. Do you see any other differences in the controls market in New York vs. other areas you worked in?
       [IF B3b = YES]
    c. What do you attribute these differences to?
    d. Do these differences affect customers' interest or demand in RTEM?

e. Have you seen any changes in the RTEM market over time? How do those changes in New York compared to other areas you worked in?

Section C: NYSERDA RTEM Program Awareness/Influence

Now, I want to ask specifically about the NYSERDA RTEM program. **[IF NEEDED]:** For context, NYSERDA is a public benefit corporation that promotes energy efficiency, renewable energy, and low-carbon future in New York State. In 2018, they started a real time energy management technology program that incentivized commercial and multifamily buildings to install RTEM systems.

1. How familiar are you with NYSERDA's program?
   [PROBE]:
   - Are you familiar with the RTEM Network resources, with information on RTEM best practices?
   - … the RTEM Database, with information collected from RTEM systems to better understand building performance?

   [SKIP TO D1 IF NOT FAMILIAR AT ALL]
2. When did you first become aware of the program?
3. We have in our records that you applied for the program, but ultimately did not participate. Is that right?
   a. If you qualified for the program, what were the main reasons that caused you ultimately to not participate? **[PROBE for SPECIFICS]**
4. Even though you did not participate in the program, has anything about the program influenced your offerings? How?
   [IF YES]:
5. How many multifamily energy management projects, since you became aware of the NYSERDA RTEM program, has your company completed?
   b. Can you describe the scope of these projects?
6. Could you estimate the average amount of energy savings saved at these multifamily projects on an annual basis?
7. Thinking of the multifamily projects (from C6) you completed since you became aware of the program, we are interested in if the NYSERDA RTEM program had any influence on your company completing those projects. Do you think NYSERDA's program had any influence on you winning those projects? (Yes/No) **[IF YES]:**

Could you rate the following statements on a scale from 0 to 10 where 0 means "no influence" and 10 means "very influential"?

a. NYSERDA's RTEM program helped increase customers' demand for RTEM technology leading to us winning additional multifamily projects

b. NYSERDA's RTEM program helped inform our business offerings and services in a way that helped us win these multifamily projects

c. NYSERDA's RTEM program helped inform our business offerings and services in a way that helped increase scope to existing customers.

d. NYSERDA listing us on their website helped us create market presence and/or reputation that helped us win additional projects

Section D: Closing

Those are all the questions that we have for you today.

1. Is there anything else you think is important for us to know that we did not discuss already?

Thank you again for taking the time to speak with us about your organization and experiences with NYSERDA. As a thank you for your time, we would like to offer you a $250 Tango gift card. This is a virtual gift card that you can redeem with participating retailers such as Amazon, Target, and Walmart.

Thank you again for sharing your experiences with the NYSERDA RTEM program. Have a great rest of your day.

[**END CALL]**