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Impact Evaluation

Multifamily Custom Programs

Rhode Island Energy

Developed For

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Executive Summary

RI Energy's custom multifamily program consists of five distinct pathways: Electric EnergyWise Multifamily (EWMF), Gas EWMF, Electric Income-Eligible Multifamily (IEMF), Gas IEMF, and C&I Multifamily. Collectively, the program offers comprehensive energy services for multifamily customers operating buildings that have five or more dwelling units. Although each pathway is designed to reach specific market segments, RI Energy coordinates across the pathways for a consistent and holistic offering for eligible customers. In 2022 and 2023, the program completed 76 projects at 40 different multifamily facilities across the state.

Why Evaluation?

RI Energy uses evaluation to retrospectively assess the performance of its programs and estimate savings for future program years. As part of its 2024 Annual Plan, RI Energy identified multifamily programs (and specifically custom projects) that would benefit from evaluation support. RI Energy requested that Cadeo conduct an impact evaluation to assess energy savings attributed to the program and to identify opportunities for program enhancement. Overall, RI Energy's goal was to evaluate the electric and gas energy savings attributed to multifamily custom measures. This evaluation study focuses solely on custom, non-lighting energy-efficiency measures.

Key Impact Findings

As part of the evaluation, Cadeo conducted a comprehensive analysis of program tracking data to summarize program activity, performed desk reviews for 65 projects, and completed virtual site visits for a subset of projects to verify energy savings calculation inputs and methods.

Gross Realization Rates

Overall, energy savings estimates accurately reflect realized energy savings, with the evaluation calculating realization rates of 100.1% for electric projects and 100.4% for natural gas projects. However, RI Energy appears to have under-reported energy savings for three projects due to data transcription errors.

Income-Eligible Projects

Income-eligible projects contribute most of the reported energy savings—86% of electric and 76% of natural gas savings—with Public Housing projects demonstrating particularly high average savings.

Dual-Fuel Projects

Most sites completed both electric and natural gas projects. Over two-thirds (68%) of electric savings and nearly all (96%) natural gas savings came from projects that included both measure types.

Conclusions

The evaluation validates the program's energy savings while highlighting areas for improved data management and evaluation methods. Implementing the recommendations presented in the report can enhance future program tracking, support more accurate savings verification, and inform strategies for optimizing multifamily energy efficiency initiatives.

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Executive Summary

This report details the findings of Cadeo's impact evaluation of custom projects in Rhode Island (RI) Energy's multifamily energy-efficiency programs. This evaluation focused on custom non-lighting projects completed in 2022 and 2023 for which RI Energy reported electric or natural gas[1] energy savings.[2] RI Energy's multifamily program includes five distinct pathways:

- Electric EnergyWise Multifamily (EWMF)
- Electric Income Eligible Multifamily (IEMF)
- Gas EWMF
- Gas IEMF
- Gas Commercial and Industrial Multifamily (CIMF)

Summary of Impact Results

Table 1 and Table 2 present overall impact savings for the multifamily programs in 2022 and 2023, based on adjusted *ex ante* energy savings.[3] To verify gross energy savings, our team completed 65 desk reviews and a nested sample of 22 virtual verifications with participating customers. None of the virtual verifications revealed any differences in energy savings calculated in the project files. Our desk reviews revealed three projects with energy savings calculated in the project files that differed from energy savings reported in the tracking database. This resulted in energy savings realization rates of 100.1% for electric projects and 100.4% for natural gas projects.

[1] This evaluation included natural gas energy and did not include other delivered fuels.

[2] Non-custom elements of the multifamily program were studied in 2020, see https://eec.ri.gov/wp-content/uploads/2020/10/ng-ri-mf-impact-and-process-comprehensive-report_final_04sept2020.pdf

[3] During the impact evaluation activities, the team uncovered some differences between savings reported in the tracking data and savings estimates in the corresponding project files. Cadeo reviewed the differences with RI Energy staff and adjusted the *ex ante* energy savings as needed. For our virtual verifications and desk reviews, the adjusted savings offered the more accurate comparison than savings reported in the tracking data. Throughout the report, we use adjusted *ex ante* energy savings unless otherwise noted. Additional details are provided in the Evaluation Findings section.

Table 1: Verified Annual Gross Energy Savings by Program, Electric (kWh), Adjusted *Ex Ante*

Pathway	Population of Projects	Adjusted *Ex Ante* Energy Savings	Evaluated Energy Savings	Realization Rate	Relative Precision at 90% Confidence
Electric EWMF	14	220,948	220,948	100.0%	0.00%
Electric IEMF	24	1,406,348	1,407,164	100.1%	0.04%
Total	**38**	**1,627,296**	**1,628,112**	**100.1%**	**0.03%**

Table 2: Verified Annual Gross Energy Savings by Program, Natural Gas (Therms), Adjusted *Ex Ante*

Pathway	Population of Projects	Adjusted *Ex Ante* Energy Savings	Evaluated Energy Savings	Realization Rate	Relative Precision at 90% Confidence
Gas EWMF	3	7,092	7,092	100.0%	0.00%
Gas IEMF	21	166,029	166,804	100.5%	0.18%
Gas CIMF	14	44,437	44,437	100.0%	0.00%
Total	**38**	**217,557**	**218,332**	**100.4%**	**0.14%**

Table 3 and Table 4 present overall impact savings for the multifamily programs in 2022 and 2023 based on unadjusted *ex ante* energy savings. Although we do not recommend RI Energy apply these realization rates prospectively, we present the results for comparison purposes. The unadjusted *ex ante* impacted two programs: Electric EWMF and Gas IEMF. While the realization rates and relative precisions differ from those in Table 1 and Table 2, the magnitude of the errors in the unadjusted *ex ante* energy savings represented only 1.8% of total electric energy savings and 0.6% of total natural gas energy savings.

Table 3: Verified Annual Gross Energy Savings by Program, Electric (kWh), Unadjusted *Ex Ante*

Pathway	Population of Projects	As Reported *Ex Ante* Energy Savings[4]	Evaluated Energy Savings	Realization Rate	Relative Precision at 90% Confidence
Electric EWMF	14	191,707	220,948	115.3%	14.40%
Electric IEMF	24	1,406,348	1,407,164	100.1%	0.04%
Total	**38**	**1,598,055**	**1,628,112**	**101.9%**	**1.76%**

Table 4: Verified Annual Gross Energy Savings by Program, Natural Gas (Therms), Unadjusted *Ex Ante*

Pathway	Population of Projects	As Reported *Ex Ante* Energy Savings	Evaluated Energy Savings	Realization Rate	Relative Precision at 90% Confidence
Gas EWMF	3	7,092	7,092	100.0%	0.00%
Gas IEMF	21	164,737	166,804	101.3%	0.36%
Gas CIMF	14	44,437	44,437	100.0%	0.00%
Total	**38**	**216,266**	**218,332**	**101.0%**	**0.27%**

[4] During the impact evaluation activities, the team uncovered some differences between savings reported in the tracking data and savings estimates in the corresponding project files. Cadeo reviewed the differences with RI Energy staff and adjusted the *ex ante* energy savings as needed. For our virtual verifications and desk reviews, adjusted savings made a more accurate comparison than the savings reported in the tracking data. Throughout the report, we use adjusted *ex ante* energy savings unless otherwise noted. Additional details are provided in the Evaluation Findings section.

Key Findings

Savings estimations accurately reflect realized energy savings for the programs, but savings estimations for ten projects did not match savings reported in the tracking data. Our team evaluated 65 of the 76[5] (86%) total multifamily projects completed in 2022 and 2023. The 65 projects represented 84% of reported electric energy savings and 96% of reported natural gas savings. (Our virtual verifications and desk reviews found no projects that required updated energy savings calculations.) However, our tracking data review identified ten projects with different energy savings reported in the tracking data than calculated in the project files. The differences seem to have occurred in the process of entering detailed project file data into RI Energy's tracking database.

RI Energy appears to have under-reported energy savings for three projects due to data transcription errors. Our team found 30,057 kWh and 2,066 therms calculated in project files that were not reported in the tracking data. In one case, the energy savings in the tracking data were 3 kWh while the energy savings calculated in the project files were 29,244 kWh. Our team suspects the measure quantity was entered in the tracking database rather than the savings.

Our team identified several types of data quality issues in the tracking database. These issues included incomplete participant contact information, inconsistencies in reported energy savings, and lack of measure-level energy savings.

Income-eligible projects serve as the primary source of energy savings for the multifamily programs. Savings generated through the income-eligible pathways represented 86% of electric savings and 76% of natural gas savings. On average, electric income-eligible projects realized 58,632 kWh per project compared to 15,782 kWh for non-income-eligible projects. Similarly, natural gas income-eligible projects realized 7,943 therms per project compared to 2,364 therms for non-income-eligible projects.

Projects at Public Housing site types were the largest projects by average energy savings. Savings from Public Housing projects represented 50% of total electric savings and 20% of natural gas savings.

Most sites completed both electric and natural gas projects. Thirty sites implemented both electric and natural gas measures, while five only implemented electric measures and another five only implemented natural gas measures. Of 76 total projects (i.e., unique applications) reported in the program tracking data, projects were completed at 40 unique sites. Over two-thirds (68%) of electric savings and nearly all (96%) natural gas savings came from projects that included both measure types.

[5] The original impact data collection methodology for this evaluation in the work plan included 102 projects. Upon review of the full tracking data, we determined that some of those projects could be rolled up to the facility level (e.g., a facility could have installed more than one measure for which RI Energy reported multiple projects).

Recommendations

In response to the key findings and other findings detailed in this report, Cadeo developed the recommendations presented in Table 5 for RI Energy's consideration as part of future multifamily program's delivery.

Table 5. Summary of Recommendations

#	Recommendation	Details
1	**Apply prospective realization rates based on adjusted *ex ante* energy savings.**	During the evaluation, we found several projects with erroneously reported savings. These errors did not result from miscalculations but rather from transcriptions from project documentation to RI Energy's program tracking database. If RI Energy demonstrates they have addressed the issues identified in this report, we recommend applying realization rates based on adjusted *ex ante* energy savings. Should RI Energy insufficiently demonstrate rectification of the issues, we recommend applying realization rates based on unadjusted *ex ante* energy savings.
2	**Include an analysis of cost-effectiveness in future research.**	Although not within this study's scope, we recommend including a cost-effectiveness analysis in a future evaluation or as a separate follow-up study. The custom calculators included cost-effectiveness as an output, though to appropriately update cost-effectiveness the review should include measure-level energy savings, effective useful life, project costs, incentives, avoided costs, and non-energy impacts.
3	**Conduct primary research with the objective of determining net-to-gross ratios for custom multifamily projects.**	One study objective was to assess net-to-gross (NTG) ratios for custom multifamily projects. However, due to low response rates and probable recall bias, we could not establish NTG ratios with statistical confidence in this study. RI Energy currently applies a 0.862 NTG ratio to Electric EWMF projects (all other projects use a 1.0 NTG ratio).[6] RI Energy's ratio is consistent with ratios used by other organizations. We recommend RI Energy continue to use existing NTG ratios and to conduct a study specific to non-income-eligible multifamily custom NTG using more recently completed projects.

[6] RI Energy currently uses results from the Massachusetts Residential Programs Net-to-Gross Research of RCD and Select Products Measures report published in 2021 available here: https://ma-eeac.org/wp-content/uploads/MA20R28-B-NTGRCDP_Final-Report_08Oct2021.pdf

#	Recommendation	Details
4	**Develop and implement a quality control process for entering data from project files to the program tracking database.**	We recommend that the multifamily programs implement quality control elements as part of the data entry process, such as (a) automated range checks for reasonable energy savings data; and (b) required spot checks between project files and the tracking database. Automated checks with associated alerts (e.g., minimum allowable energy savings, net savings equaling gross savings) will alert staff to outlying entries and allow them to make any necessary corrections immediately. The ability to override alerts is an important feature in the process, though the alerts would at least require those entering the data to explicitly acknowledge potential flags, thus likely avoiding issues when evaluating the program. We understand RI Energy has started to investigate this recommendation. We recommend prospectively using the realization rates based on adjusted *ex ante* energy savings. However, should RI Energy insufficiently address the issue, we recommend prospectively using realization rates based on unadjusted *ex ante* energy savings.
5	**Report energy savings at the measure level.**	We recommend tracking multifamily energy savings at the measure level. Currently, savings are tracked at the measure category level. For example, a project that included a boiler pump VFD and domestic hot water recirculation, with two separate energy savings calculations in the project files, had one aggregated line item in the tracking database. More detailed context in the tracking data would support more robust evaluations and data quality checks.
6	**Improve project contact information and include it directly in the program tracking database.**	We recommend recording project and site contact information in the tracking database. Combining datasets can be time-consuming, and contact information stored in customer information systems does not always reflect the most appropriate contact for a specific project. Additionally, multifamily projects often have multiple contacts representing different project phases (e.g., contacts representing the decision-making process, contacts representing the sites management and equipment). The program should collect contact information for each of these individuals as each contact might have a different role in the evaluation process. Additionally, tracking multiple contacts would improve outreach efforts when participants experience staff turnover.

Organization of Report

This report is organized as follows:

- The Introduction section summarizes the program and study objectives.
- The Methodology section describes the evaluation methods and approach, including data sources, data collection, and project-specific analysis.
- The Program Participation section summarizes the review of program tracking data.
- The Evaluation Findings section presents the study results, including key findings and recommendations.
- The appendices include additional information about the study:
    - Appendix A includes the evaluation scope of work.
    - Appendix B includes the NTG methodology.
    - Appendix C includes the NTG survey guide.
    - Appendix D includes a sample Site-Specific Measurement & Verification Plan

Introduction

This report details the findings from Cadeo's impact evaluation of custom projects undertaken through RI Energy's Electric EWMF, Electric IEMF, Gas EWMF, Gas IEMF, and Gas CI MF programs.

Background

As part of its 2024 Annual Plan, RI Energy identified multifamily programs (and specifically custom projects) that would benefit from evaluation support. RI Energy requested that Cadeo conduct an impact evaluation to assess energy savings attributed to the program and to identify opportunities for program enhancement.

About the Multifamily Programs

RI Energy's custom multifamily program consists of five distinct pathways: Electric EWMF; Electric IEMF; Gas EWMF; Gas IEMF; and Gas CIMF. Collectively, the program offers comprehensive energy services for multifamily customers operating buildings that have five or more dwelling units. Although each pathway is designed to reach specific market segments, RI Energy coordinates across the pathways for a consistent and holistic offering for eligible customers.

The program is implemented by a third party, which estimates energy savings using measure-specific spreadsheet-based calculators.[7] These calculators include measure-specific parameters that implementers input based on project-level data. Measure-level savings are aggregated and become the project-level energy savings estimate.

Study Objectives

Overall, RI Energy's goal is to evaluate the electric and gas energy savings attributed to multifamily custom measures. This evaluation study focuses solely on custom, non-lighting energy-efficiency measures. As part of this overarching goal, the evaluation seeks to achieve the following specific research objectives:

1 | Summarize program activity by program, measure category, and fuel.
2 | Review and update savings calculations and inputs for a sample of projects.
3 | Develop independent realization rates for each program pathway.
4 | Assess the usage and appropriateness of program implementation tools employed in estimating energy savings.

[7] Calculators reviewed during the evaluation activities include boiler pump VFDs, domestic hot water measures (recirculation, heat pump water heaters, indirect water heaters, exhaust fans, boilers, heat pumps, combined heat and power, pipe insulation, and wall insulation. This may not be the full list of calculators used by the program.

5 | Recommend improvements to program implementation processes as they relate to tracking system data, savings calculations, and areas for additional research.

Methodology

This section describes activities Cadeo that used in investigating the research objectives and the referenced data sources.

Research Activities

In evaluating the program, the team completed three research activities, as summarized in Table 6. Appendix A includes the full work plan.

Table 6. Evaluation Activities

Task	Summary
Analyze Program Data	Analyzed two years of tracking data provided by RI Energy. The analysis focused on overall savings, savings by measure category, savings by site size, and savings by ownership type.
Verify Gross Energy Savings	Completed engineering desk reviews for 65 of 76 projects and completed virtual verifications[8] of a nested sample of nine projects completed during PY2022-2023. For each verification, the team developed a site-specific measurement and verification plan (SSMVP) to facilitate data collection and verification.
Assess NTG[9]	Assessed net impacts for non-income eligible programs by surveying program participants. We supplemented findings through a review of existing literature related to multifamily NTG. Appendix B and Appendix C provide the NTG methodology and survey instrument, respectively.

[8] Virtual verifications included developing site-specific data collection plans, outreach to project contacts, and verbal and visual verification of installed measures by telephone.

[9] Due to insufficient survey responses, this study ultimately could not report NTG results.

Data Sources

RI Energy provided the following datasets, which our team used as the basis for evaluation activities:

- Electric Custom Detail Report for projects completed in PY2022-2023 (non-lighting measures only)
- Natural Gas Custom Detail Report for projects completed in PY2022-2023
- Contact information for multifamily accounts

Other sources of data included the following:

- RI Energy's program website[10]
- RI Energy Annual Energy Efficiency Program Plans (2022 and 2023) and the 2021-2023 Energy Efficiency Program Plan[11]

Program Data Review and Sampling

The team reviewed program tracking data for all projects completed in 2022 and 2023 to develop the impact evaluation sampling frame as shown in Table 7. The initial sample design's goal was to select a sample of projects within each program that would result in statistically significant impact evaluation findings.

For the sample design, we defined the sampling unit as unique application IDs within each program, as reported in the tracking data. Projects could include one or more installed measures, and individual sites could participate in more than one complementary program (e.g., electric measures through the Electric EWMF program and natural gas measures through the Gas EWMF program).

As shown in Table 7, we used a ratio estimation framework to achieve 90% confidence and 10% precision (90/10)[12] for each five programs using an assumed coefficient of variation (CV) of 0.25.[13]

[10] Available here: https://www.rienergy.com/site/ways-to-save/save-money-with-rebates-and-incentives
[11] Available here: https://eec.ri.gov/data-and-publications/
[12] The original sample design in the evaluation plan aimed to achieve 80/20 for each program and included additional samples to achieve 90/10 for each program. During the evaluation activities, we conducted sufficient project reviews to achieve 90/10 for each program.
[13] We expected the CV to be less than 0.5 due to the consistent nature of the program savings calculation methodologies.

Table 7. Summary Statistics and Sample Design

Pathway	Population of Projects	Reported Energy Savings	Sample to Achieve 90/10
Electric EWMF	14	191,707 kWh	8
Electric IEMF	24	1,406,348 kWh	10
Gas EWMF	3	7,092 therms	3
Gas IEMF	21	164,737 therms	10
Gas CIMF	14	44,437 therms	8
Total	**76**	**n/a**	**36**

Data Collection and Project-Specific Analysis

Cadeo initially requested project files for randomly sampled projects based on the sample design. However, to facilitate outreach and data collection activities, we ultimately requested project files for all projects. This increased the number of completed desk reviews and the number of available projects to include in virtual verification activities while not impacting the sample's randomness. The team reviewed each project and its measures individually to validate the energy savings. Savings calculation reviews ensured savings estimates were accurately modeled, used consistent inputs, and included reasonable assumptions, as required. Through the project desk reviews, the team also developed SSMVPs to facilitate telephone verification.

Where project file information proved inconsistent with program tracking data, the team attempted to reconcile the differences with RI Energy and vendor implementation staff. When we could resolve these differences, we adjusted the estimated savings to reflect savings that should have been reported by the program.[14] We chose to use adjusted savings to most accurately represent prospective realization rates and to use unadjusted savings to inform adaptation of program processes.[15] We also, however, calculated realization rates and relative precisions based on unadjusted *ex ante* energy savings.

Desk Reviews

Our team reviewed energy savings documentation for most projects. For each project receiving a desk review, the reviews included the following:

[14] In these adjustments, we only included non-calculation inconsistencies. Discrepancies in our evaluation findings related to specific project and measure energy savings calculations were not included in adjusted *ex ante* energy savings.

[15] In some cases, comparing verified savings to unadjusted savings resulted in impractical outcomes (e.g., a 975,000% realization rate for one project).

- Reviews of energy savings calculations and comparisons to reported energy savings.
- Reviews of baseline equipment and assumptions used in the energy savings calculations.
- Reviews of high-efficiency equipment and assumptions used in the energy savings calculations.
- Reviews of the appropriate use of sources and appropriate values for all calculation parameters used to estimate energy savings.
- Development of site-specific measurement and verification plans to facilitate outreach and virtual verification activities.
- Documentation of project contact information.

Virtual Verification

For a subset of projects receiving desk reviews, our team recruited sites for data collection using a combination of email and telephone outreach to project contacts listed in the tracking database and project files. In addition to contact information provided by RI Energy, we leveraged assistance from the third-party implementer for contact information and to introduce the evaluation to project contacts.

During the virtual M&V, we completed the following activities:

- Verified measure installation and operation.
- Collected information about pre-existing conditions.
- Confirmed energy savings parameter inputs, including equipment efficiencies, operating hours, and quantities.
- Discussed any operational changes since project completion.

As shown in Table 8, our team reached out to contacts representing 65 projects at 37 different sites. The completed virtual verifications represented 31% of reported electric energy savings and 37% of reported natural gas energy savings.

In some cases, outreach led to alternate contacts not listed in the tracking database or project files. Each contact received at least three telephone calls and at least three emails for those with available email addresses (13 of 30).

Despite these efforts and the $200 incentive we offered, most contacts were proved unresponsive to our requests. Most outreach attempts resulted in our team leaving voicemails, which generally were not returned. Two contacts declined to participate, while project contacts were no longer available at three sites, and site representatives were unresponsive or unfamiliar with the project.

Table 8. Virtual Verification Outreach Disposition

No. of Projects Represented	No. of Unique Sites	No. of Project Contacts	Unique Contacts Completing Verification [16]	Not Interested	Unresponsive
65	37	31	8	2	21

Analysis Process for Savings Verification

Using data collected through virtual verifications and desk review results, our team updated savings calculations for the sampled projects when necessary to reflect verified energy savings. Upon completing all measure-level savings reviews, the team calculated program-level evaluation results. Further, we calculated realization rates for all sampled projects as the ratio of project-level verified savings to adjusted savings from the tracking database. The team then extrapolated the project-level findings from the sample to calculate realization rates for each program.

The Evaluation Findings section presents savings verification process results.

Net-to-Gross Assessment

Cadeo developed a web-based survey for each project to estimate freeridership (i.e., action likely to occur without program support) and to collect data on spillover (i.e., subsequent reductions in energy consumption due to program influences that accrue outside of direct participation).[17] The survey, which included measure-level batteries, was made available for non-income-eligible participants.[18]

We leveraged the virtual verification activities to collect contact information for the most appropriate persons to respond to questions. Additionally, due to the complexity of the measure-level survey batteries, our team determined that web-based surveys with automated skip patterns and logic would be more effective and reliable than telephone surveys.

[16] These facility contacts represent 22 unique project applications. Some facilities submitted multiple project applications across more than one program.

[17] We recognize nonparticipant spillover exists, but we did not include it as part of this NTG research. Nonparticipant spillover captures savings incurred at nonparticipating market-levels in response to program efforts. A rigorous and defensible nonparticipant spillover study can be expensive, time consuming, and, depending on the methodology, face defensibility concerns.

[18] We did not plan to collect NTG data for Electric IEMF and Gas IEMF, which are deemed as 100% NTG (standard practice for income-eligible programs).

Our team did not collect sufficient data from participants to make statistically significant conclusions regarding NTG ratios for the programs.[19]

We collected responses from two facilities representing two Electric EWMF and two Gas CI MF projects. These projects comprised 4.5% of Electric EWMF energy savings and 5.6% of Gas CI MF energy savings. Additional details are provided in the Evaluation Findings section.

Our team conducted a literature review of existing NTG studies for multifamily programs. The review results, presented in the Net Energy Savings section, are intended to be used for informative purposes rather than as recommendations to change current RI Energy practices.

[19] We targeted responses from all sites for which we conducted virtual verifications, but received only two NTG survey question responses representing two electric and two natural gas projects. Those projects represented 4.5% and 5.6% of the Electric EWMF program and Gas CI MF program *ex ante* energy savings, respectively.

Program Participation Assessment

Cadeo analyzed program participation data from 2022 and 2023 to characterize recent project trends. The following sections are divided into electric programs and natural gas programs. The team characterized program activities by program, measure category, site size, and ownership type. Additionally, the team reviewed projects that included electric and gas measures as well as sites that completed separate projects in different years.

Comparison to Portfolio

Table 9 compares energy savings reported for RI Energy's custom multifamily programs to total portfolio savings in 2022 and 2023. Collectively, electric custom multifamily programs represented 1.0% and 0.6% of total electric savings in 2022 and 2023, respectively. Similarly, natural gas custom multifamily programs represented 3.0% and 3.4% of total natural gas savings.

Table 9. Comparison of Multifamily Custom Programs to Annual 2022 and 2023 Portfolio Energy Savings20

Year	Fuel	Total Portfolio	Multifamily Custom Programs Reported	% of Total Portfolio
2022	Electric (MWh)	105,036	1,062	1.0%
	Natural Gas (MMBtu)	383,562	11,609	3.0%
2023	Electric (MWh)	93,400	536	0.6%
	Natural Gas (MMBtu)	297,271	10,018	3.4%

[20] Reported savings were not adjusted based on this evaluation's findings.

Electric Projects

Program Pathway Participation and Energy Savings

Table 10 shows overall participation, energy savings, project costs, and incentives for projects that included electric measures. Nearly two-thirds of energy savings (65%) generated by the program came from projects completed in 2022 rather than 2023.

Defining a project

For this study, we defined a project as a unique combination of Site ID, program, and reporting year in RI Energy's tracking data. Projects could include multiple measures and measure categories. Though some projects included savings reported in other years, we only included measures with savings reported in 2022 and 2023.

Table 10. Aggregate Electric Program-Level Participation and Energy Savings (kWh)

Year	No. of Projects	No. of Sites	Reported Energy Savings	Adjusted *Ex Ante* Energy Savings	Project Costs ($000)	Incentives Paid as % of Project Cost
2022	23	21	1,062,263	1,062,263	$2,484	86%
2023	15	15	535,792	565,033	$2,061	73%
Total	**38**	**36**	**1,598,055**	**1,627,296**	**$4,545**	**80%**

Table 11 shows overall participation and energy savings for each electric program by year. Income-eligible projects served as the primary source of energy savings, representing 86% of the total electric savings.

Table 11. Electric Program-Level Participation and Energy Savings (kWh)

Pathway	2022		2023		Total	
	No. of Projects	Adjusted *Ex Ante* Energy Savings	No. of Projects	Adjusted *Ex Ante* Energy Savings	No. of Projects	Adjusted *Ex Ante* Energy Savings
Electric EWMF	9	66,859	5	154,089	14	220,948
Electric IEMF	14	995,404	10	410,944	24	1,406,348
Total	**23**	**1,062,263**	**15**	**565,033**	**38**	**1,627,296**

Measure Category Participation and Energy Savings

Table 12 breaks down electric projects by measure category over the two-year evaluation period.[21] Combined Heat & Power (CHP) projects represented the most energy savings in total (47%) and on average per project. Heat Pump projects were also important for the program, representing over one-quarter of overall savings (28%). By volume, Circulator Pumps (14) and Variable Frequency Drives (VFDs, 12) were the most common program measures.

Table 12. Electric Measure Category Participation and Energy Savings (kWh)

Measure Category	No. of Projects	Adjusted *Ex Ante* Energy Savings	Project Costs ($000)	Incentives Paid as % of Project Cost
Combined Heat & Power[22]	5	765,945	$1,459	100%
Heat Pumps	5	457,642	$1,946	77%
Variable Frequency Drives	12	169,828	$495	67%
Hot Water	3	110,043	$221	58%
Circulator Pumps	14	99,918	$321	55%
Heating	1	18,824	$83	28%
Other	1	5,096	$20	100%
Total	**41**	**1,627,296**	**$4,545**	**80%**

[21] Measure categories represent categorization reported in the program tracking data.

[22] For projects completed in 2021 and 2022, RI Energy calculated electric energy savings, thermal fuel offsets, and thermal fuel consumption using the Mass Save Micro-CHP model. Net additional thermal fuel consumption was not reported.

Site Type Participation and Energy Savings

Table 13, Table 14, and Table 15 break down electric projects by site size and ownership type over the two-year evaluation period. Nearly all of the energy savings (96%) came from large sites with at least 20 dwelling units, most of which (23 of 30) were non-public housing apartment buildings. However, Public Housing projects through the Electric IEMF program were generally the largest projects by average energy savings, representing 50% of the total electric energy savings.

Table 13. Electric Site Size Participation and Energy Savings (kWh)

Site Size	No. of Sites	Adjusted *Ex Ante* Energy Savings	Project Costs ($000)	Incentives Paid as % of Project Cost
5-20 Dwelling Units	5	64,179	$268	57%
>20 Dwelling Units	30	1,563,117	$4,277	82%
Total	**35**	**1,627,296**	**$4,545**	**80%**

Table 14. Electric Site Ownership Participation and Energy Savings (kWh)

Site Type	No. of Sites	Adjusted *Ex Ante* Energy Savings	Project Costs ($000)	Incentives Paid as % of Project Cost
Apartment Building	27	778,282	$2,740	69%
Public Housing	6	818,197	$1,722	100%
Condominium	2	30,817	$84	45%
Total	**35**	**1,627,296**	**$4,545**	**80%**

Table 15. Electric Projects by Site Size and Ownership (kWh)

Site Type/Size	5-20 Dwelling Units		>20 Dwelling Units		All Units	
	No. of Projects	Adjusted *Ex Ante* Energy Savings	No. of Projects	Adjusted *Ex Ante* Energy Savings	Total Projects	Adjusted *Ex Ante* Energy Savings
Apartment Building	4	62,606	23	715,676	27	778,282
Public Housing	0	0	6	818,197	6	818,197
Condominium	1	1,573	1	29,244	2	30,817
Total	**5**	**64,179**	**30**	**1,563,117**	**35**	**1,627,296**

Natural Gas Projects

Program-Level Participation and Energy Savings

Table 16 shows overall participation, energy savings,[23] project costs, and incentives for projects including natural gas measures. Natural gas projects remained consistent across the two years, with 54% and 46% of the energy savings in 2022 and 2023, respectively.

Table 16. Aggregate Gas Program-Level Participation and Energy Savings (Therms)

Year	No. of Projects	No. of Sites	Reported Energy Savings	Adjusted *Ex Ante* Energy Savings	Project Costs ($000)	Incentives Paid as % of Project Cost
2022	23	22	116,090	116,090	$3,930	73%
2023	15	15	100,176	101,467	$3,366	85%
Total	**38**	**37**	**216,266**	**217,557**	**$7,296**	**79%**

Table 17 shows overall participation and energy savings for each natural gas program by year. Income-eligible projects served as the primary energy savings source, representing 76% of total natural gas savings. Only three projects were completed through the Gas EWMF program, representing 3% of total energy savings.

Table 17. Program-Level Gas Participation and Energy Savings (Therms)

Pathway	2022		2023		Total	
	No. of Projects	Adjusted *Ex Ante* Energy Savings	No. of Projects	Adjusted *Ex Ante* Energy Savings	No. of Projects	Adjusted *Ex Ante* Energy Savings
Gas EWMF	3	7,092	0	0	3	7,092
Gas IEMF	11	99,998	10	75,030	21	166,029
Gas CIMF	9	18,000	5	26,437	14	44,437
Total	**23**	**116,090**	**15**	**101,467**	**28**	**217,557**

[23] During the impact evaluation activities, the team noticed some differences between savings reported in the tracking data and savings estimates in the corresponding project files. Cadeo reconciled the differences with program staff and determined adjusted *ex ante* energy savings to most accurately represent program impacts. Throughout the report, we use the adjusted *ex ante* energy savings, unless otherwise noted.

Measure Category Participation and Energy Savings

Table 18 breaks down natural gas projects by measure category over the two-year evaluation period.[24] Heating projects accounted for the most energy savings (85%) and on average per project.

Table 18. Gas Measure Category Participation and Energy Savings (Therms)

Measure Category	No. of Projects	Adjusted *Ex Ante* Energy Savings	Project Costs ($000)	Incentives Paid as % of Project Cost
Heating	27	185,721	$6,310	82%
Hot Water	4	18,936	$621	63%
Other	2	7,789	$309	43%
Circulator Pumps	4	3,677	$30	79%
Heat Pumps	1	1,434	$25	100%
Total	**38**	**217,557**	**$7,296**	**79%**

Site Type Participation and Energy Savings

Table 19, Table 20, and Table 21 break down natural gas projects by site size and ownership type over the two-year evaluation period. Nearly all energy savings (98%) came from large sites with at least 20 dwelling units, most of which (25 of 31) were non-public housing apartment buildings. In contrast to the high relative energy savings of the Electric IEMF program, Public Housing projects through the Gas IEMF program represented only 20% of total natural gas savings. Most energy savings came from non-public housing apartment buildings (73%).

Table 19. Gas Site Size Participation and Energy Savings (Therms)

Site Size	No. of Sites	Adjusted *Ex Ante* Energy Savings	Project Costs ($000)	Incentives Paid as % of Project Cost
5-20 Dwelling Units	4	5,250	$124	54%
>20 Dwelling Units	31	212,307	$7,712	79%
Total	**35**	**217,557**	**$7,296**	**79%**

[24] Measure categories represent the categorization as reported in the program tracking data.

Table 20. Gas Site Ownership Participation and Energy Savings (Therms)

Site Type	No. of Sites	Adjusted *Ex Ante* Energy Savings	Project Costs ($000)	Incentives Paid as % of Project Cost
Apartment Building	28	159,430	$4,913	71%
Public Housing	5	44,649	$2,011	100%
Condominium	2	13,478	$372	69%
Total	**35**	**217,557**	**$7,296**	**79%**

Table 21. Gas Projects by Site Size and Ownership (Therms)

Site Type/Size	5-20 Dwelling Units		>20 Dwelling Units		All Units	
	No. of Projects	Adjusted *Ex Ante* Energy Savings	No. of Projects	Adjusted *Ex Ante* Energy Savings	Total Projects	Adjusted *Ex Ante* Energy Savings
Apartment Building	3	3,659	25	155,771	28	159,430
Public Housing	0	0	5	44,649	5	44,649
Condominium	1	1,591	1	11,887	2	13,478
Total	**4**	**5,250**	**31**	**212,307**	**35**	**217,557**

Combination Projects and Repeat Participants

Table 22 breaks down energy savings by fuel types included in the projects. Over two-thirds of the electric energy savings (68%) and nearly all natural gas energy savings (96%) came from projects that included measures across both fuel types.

Table 22. Projects Including Electric and Natural Gas Measures

Project Type	No. of Sites	No. of Projects	Adjusted *Ex Ante* Energy Savings (kWh)	Adjusted *Ex Ante* Energy Savings (Therms)
Dual Fuel	30	65	1,099,016	209,037
Electric Only	5	6	528,280	0
Natural Gas Only	5	5	0	8,520
Total	**40**	**76**	**1,627,296**	**217,557**

Evaluation Findings

The team performed an impact evaluation to assess energy savings attributable to the program and to quantify savings generated by implementing custom multifamily projects in the Electric EWMF, Electric IEMF, Gas EWMF, Gas IEMF, and Gas CI MF programs between 2022-2023.

Gross Energy Savings

We conducted two subtasks contributing to the gross impact analysis:

1 | Engineering desk reviews of 65 out of 76 total projects.
2 | Virtual verifications of a subset of 22 projects receiving desk reviews.

Table 23 shows the impact evaluation's final disposition. After the program participation assessment, the team determined that the impact evaluation framework included 76 individual projects across the two-year evaluation period. The team completed engineering desk reviews for 86% of all projects and virtual verifications for 24%.

Table 23: Final Impact Evaluation Disposition

Pathway	Population of Projects	Desk Reviews Completed	% of Program Savings Desk Reviewed	Virtual Verifications Completed	% of Program Savings Verified
Electric EWMF	14	10	49%	2	2%
Electric IEMF	24	21	89%	9	34%
Total Electric Programs	**38**	**31**	**84%**	**11**	**31%**
Gas EWMF	3	2	87%	1	65%
Gas IEMF	21	20	98%	8	39%
Gas CI MF	14	12	91%	2	2%
Total Natural Gas Programs	**38**	**34**	**78%**	**11**	**35%**

Table 24 and Table 25 present overall impact savings for the 2022 and 2023 multifamily programs. The engineering desk reviews yielded three projects across all programs, with unreconciled differences identified between reported savings and evaluated savings—one in Electric IEMF and two in Gas IEMF. Virtual verifications of project-specific data yielded no differences between energy savings calculated in the project files and energy savings verified by our team.

Table 24: Verified Annual Gross Energy Savings by Program, Electric (kWh), Adjusted *Ex Ante*

Pathway	Population. of Projects	Adjusted *Ex Ante* Energy Savings	Evaluated Energy Savings	Realization Rate	Relative Precision at 90% Confidence
Electric EWMF	14	220,948	220,948		0.00%
Electric IEMF	24	1,406,348	1,407,164	100.1%	0.04%
Total	**38**	**1,627,296**	**1,628,112**	**100.1%**	**0.03%**

Table 25: Verified Annual Gross Energy Savings by Program, Natural Gas (Therms), Adjusted *Ex Ante*

Pathway	Population of Projects	Adjusted *Ex Ante* Energy Savings	Evaluated Energy Savings	Realization Rate	Relative Precision at 90% Confidence
Gas EWMF	3	7.092	7,092	100.0%	0.00%
Gas IEMF	21	166,029	166,804	100.5%	0.18%
Gas CIMF	14	44,437	44,437	100.0%	0.00%
Total	**38**	**217,557**	**218,332**	**100.4%**	**0.14%**

Table 26 and Table 27 present overall impact savings for the 2022 and 2023 multifamily programs based on unadjusted *ex ante* energy savings. Although we do not recommend RI Energy apply these realization rates prospectively, we present the results for comparison purposes. The unadjusted *ex ante* impacted two programs: Electric EWMF and Gas IEMF. While the realization rates and relative precisions differ from those in Table 24 and Table 25, the magnitude of errors in the unadjusted *ex ante* energy savings represented only 1.8% of total electric energy savings and 0.6% of total natural gas energy savings.

Table 26: Verified Annual Gross Energy Savings by Program, Electric (kWh), Unadjusted *Ex Ante*

Pathway	Population. of Projects	Unadjusted *Ex Ante* Energy Savings	Evaluated Energy Savings	Realization Rate	Relative Precision at 90% Confidence
Electric EWMF	14	191,707	220,948	115.3%	15.71%
Electric IEMF	24	1,406,348	1,407,164	100.1%	0.04%
Total	**38**	**1,598,055**	**1,628,112**	**101.9%**	**1.92%**

Table 27: Verified Annual Gross Energy Savings by Program, Natural Gas (Therms), Unadjusted *Ex Ante*

Pathway	Population of Projects	Unadjusted *Ex Ante* Energy Savings	Evaluated Energy Savings	Realization Rate	Relative Precision at 90% Confidence
Gas EWMF	3	7,092	7,092	100.0%	0.00%
Gas IEMF	21	164,737	166,804	101.3%	0.36%
Gas CIMF	14	44,437	44,437	100.0%	0.00%
Total	**38**	**216,266**	**218,332**	**101.0%**	**0.27%**

In addition to gross energy savings, our team investigated interactive effects for installed measure combinations. Of projects analyzed, only four had measures that could interact with other measures. These measures included wall insulation, pipe insulation, and scheduling setbacks.[25] Upon review of energy savings calculations for each of these measures, we determined that the calculations accounted for interactive effects (e.g., by including efficiencies of water heating and HVAC equipment).

[25] Lighting measures were not in the scope of this evaluation.

Recommendation 1: Apply prospective realization rates based on adjusted *ex ante* energy savings.

During the evaluation, we found several projects with erroneously reported savings. These errors did not result from miscalculations but rather from project documentation transcriptions to RI Energy's program tracking database. If RI Energy demonstrates that they have addressed the issues identified in the report, we recommend applying realization rates based on adjusted *ex ante* energy savings. Should RI Energy insufficiently demonstrate rectification of the issues, we recommend applying realization rates based on unadjusted *ex ante* energy savings.

Recommendation 2: Include a of cost-effectiveness analysis in future research.

Although not within the scope of this study, we recommend including a cost-effectiveness analysis in a future evaluation or as a separate follow-up study. The custom calculators include cost-effectiveness as an output, though, to appropriately update cost-effectiveness, the review should include measure-level energy savings, baseline methodologies, effective useful life, project costs, incentives, avoided costs, and non-energy impacts.

Net Energy Savings

Originally, our team sought to determine net energy savings through primary data collection. As discussed, we could not collect sufficient data to calculate NTG ratios for non-income-eligible programs. We collected responses from two facilities representing two Electric EWMF and two Gas CI MF projects, which comprised of 4.5% of Electric EWMF energy savings and 5.6% of Gas CI MF energy savings. The survey included questions related to freeridership as well as spillover, though respondents did not indicate any spillover actions.

Respondents reported the program's financial support as the most influential component in the decision-making process. One facility indicated two measures with deferred freeridership, though the respondent reported they most likely would not have installed the same efficiency level for that equipment.

For each measure, freeridership rates fell between 0.15-0.45. Weighted by energy savings, we calculated the Electric EWMF NTG ratio at 0.705, with a relative precision at 90% confidence of 1,089%, and the Gas CI MF NTG ratio as 0.85 with a relative precision at 90% confidence of 584%.

Due to the low response rate and low representation in the population, we do not recommend applying NTG ratio results from the survey.

Alternatively, we conducted a literature review of existing studies to benchmark current RI Energy practices. In 2022 and 2023, RI Energy applied a NTG ratio to gross energy savings for the Electric EWMF program, as shown in Table 28. For all gas projects and income-eligible projects, RI Energy used a ratio of 1.0.

Table 28. Current RI Energy Net-to-Gross Ratios

Program	NTG Ratio
Electric EWMF	0.862
Electric IEMF	1.000
Gas EWMF	1.000
Gas IEMF	1.000
Gas CI MF	1.000

Our team reviewed several recent, publicly available evaluation reports to inform RI Energy's current NTG practices for custom multifamily programs. The research leveraged a study

completed in 2023 for New Jersey residential and nonresidential program planning.[26] The study included a comprehensive literature review of freeridership values, spillover values, and NTG ratios in evaluation reports and other program guidance documentation in the Northeast and other regions.

The New Jersey study emphasized barriers researchers faced in trying to reach multifamily property owners and tenants. Although the study prioritized the primary research effort results, few NTG ratios were found for the multifamily sector. Furthermore, most primary research reviewed through the study only included prescriptive measures.[27]

Table 29 shows the New Jersey study results specific to custom measures for non-income-eligible projects. When possible, the measure categories reflected data specific to multifamily buildings. For measures not assigned a specific multifamily NTG ratio, the study recommends assigning residential ratios to in-unit measures and commercial ratios to common areas and building-wide measures.

Notably, a key study finding was for New Jersey to prioritize primary research for multifamily initiatives due to the unavailability of studies documenting program influences for multifamily programs.

Table 29: Non-Income Eligible NTG Ratio Ranges by Measure Groups

Sector	Typical Measure Groups in Range	NTG Range
Residential	Multifamily building-wide HVAC	0.90 to 0.99
Commercial	Custom electric	0.70 to 0.79
Commercial	Custom natural gas	0.80 to 0.89
Commercial	Custom water heating	0.70 to 0.79

As shown in Table 30, the team reviewed other studies with documented NTG ratios for multifamily programs. We excluded data specific to prescriptive programs, though studies did not always isolate custom measures. Consistent with findings from the New Jersey study, the non-income-eligible, program-level NTG ratios fell between 0.75 and 0.90.

[26] Available here: https://njcleanenergy.com/files/file/BPU/2023/Energy%20Efficiency%20Triennium%202%20Net%20to%20Gross%20Report%20(2023).pdf

[27] The study did not include Cadeo's impact and process Evaluation of National Grid Rhode Island's multifamily programs completed in 2020, citing a lack of primary research. Though Cadeo's study included primary research activities, it did not include custom measures.

Table 30: NTG Ratios for Multifamily Programs

Program Sponsor	NTG Ratio
Focus on Energy (Wisconsin, 2023)[28]	0.83
SoCalREN (California, 2022)[29]	0.96
BayREN (California, 2022)[30]	0.75
Xcel Energy (Colorado, 2023)[31]	0.90

Findings and Recommendations

RI Energy's 0.862 NTG ratio for the Electric EWMF program remains consistent with ratios used by other organizations. Due to limitations in our data collection efforts, we do not recommend RI Energy change current practices. We do, however, recommend scoping a study focused on NTG for multifamily using more recent projects.

Lessons Learned for Future Studies

Through this study, our team learned that the people most knowledgeable about equipment at multifamily sites are not necessarily the same people most knowledgeable about decisions to invest in energy-efficiency measures. Additionally, during our evaluation period, many site contacts oversaw projects across multiple sites, and we encountered concerns regarding recall bias when asking about specific measures installed at specific sites.

In a focused study, we recommend leveraging implementation staff to facilitate outreach and increase response rates. We also recommend developing specific survey guides for various stakeholders of multifamily projects (e.g., property owner/manager, facility manager) and engaging implementation vendors to provide context for NTG results.

[28] Source: https://assets.focusonenergy.com/production/inline-files/Evaluation_CY_2023_Vol-II_final.pdf
[29] Source: https://www.calmac.org/%5C/publications/CPUC_Group_A_REN_Evaluation_Report_DNV_FINAL2.pdf
[30] Ibid.
[31] Source: https://www.xcelenergy.com/staticfiles/xe-responsive/Company/Rates%20&%20Regulations/Regulatory%20Filings/05%20-%20TRC%202023%20Evaluation%20Summary.pdf

Recommendation 3: Conduct primary research to determine NTG ratios for non-income-eligible, custom multifamily projects.

A study objective included assessing NTG recall bias, though we could not establish NTG ratios with statistical confidence through the study. We recommend conducting a study specific to non-income-eligible, multifamily, custom NTG using more recently completed projects.

Data Quality

As noted, RI Energy provided 2022-2023 tracking data for the programs, with one dataset for electric projects and one dataset for natural gas projects. Our team identified several types of data quality issues that collectively impacted our ability to develop reliable verified savings for certain projects and measures. In this section, we summarize these data quality issues as follows:

- **Identified Issues.** Outlines specific data issues encountered by the team.
- **Study Implications.** Details how we addressed data issues and how they affected the team's impact evaluation efforts.
- **Recommendations.** Provided recommendations for RI Energy to improve data quality for future multifamily evaluations.

Identified Issues

Our team identified the following data issues during this evaluation:

1 | Missing Participant Contact Information.
2 | Inconsistent Energy Savings.
3 | Energy Savings for Measure Categories.

Missing Participant Contact Information

Part of our evaluation scope included contacting participants to inquire about installed equipment and to estimate impact factors, such as NTG. The datasets supplied by RI Energy lacked contact information outside of site names for all projects.

RI Energy supplied a second dataset that included account contact information that Cadeo combined with contact information collected from the engineering desk reviews. In some instances, contact information was inconsistent between the sources. For example, the tracking data might have a contact who acted as the project sponsor for the participating ownership group, while the project files might have a contact more closely associated with the equipment installed (e.g., a plant manager). For outreach purposes, Cadeo leveraged all available contacts for each project.

After combining the datasets, half of projects (38 of 76) still did not have email addresses available, which required our team to rely on telephone numbers provided by the tracking data, project files, or web scraping. The lack of email addresses limited our team's ability to effectively reach program participants and deliver the evaluation's web-based surveys.

Inconsistent Energy Savings

For 10 projects,[32] our team could not reconcile energy savings calculated in the project files to energy savings listed in the tracking data. The team identified the following three types of inconsistencies:

- One project with an anomalous error in the tracking data: a project had energy savings reported as 3 kWh while project files had energy savings calculated as 29,244 kWh.
- One project with a straightforward difference: a project in the tracking data had energy savings had an unambiguous mathematical factor of energy savings in the project files (143.4 kWh in the tracking data while the project files had 1,434.4 kWh).
- Projects with unclear differences: several projects in the tracking data had energy savings slightly less than energy savings in the project files. We understand that data entered in the tracking data represented net energy savings rather than gross energy savings. This resulted from a limitation in the program tracking database that required the net value to be entered into the gross column. However, this reasoning does not adequately explain two income-eligible projects that should have equal gross and net energy savings.

Energy Savings for Measure Categories

For each project, the tracking data include energy savings at the measure category level. However, energy savings in the project files were calculated at the measure level. Additionally, measure category quantities in the tracking data were generally "1" unit, with units not defined. The lack of measure-level energy savings in the tracking data limited our team's ability to readily reconcile project-level savings between the tracking data and he project files.

Study Implications

These data issues collectively affected our team's ability to effectively and efficiently complete many of our impact evaluation tasks.

Impact on Outreach

Though the impact evaluation methodology relied on our ability to interact with appropriate contacts from participating sites via telephone, the lack of reliable email addresses made it difficult to contact participating sites. Our team, in conjunction with RI Energy, leveraged emails from RI Energy's customer information system as well as support from the third-party implementer in the form of study introductions to participants. Although the latter boosted our successful outreach attempts, the benefit was limited to seven participants.

The impact on outreach affected our team's ability to complete telephone verification of energy savings and successfully reach respondents for the NTG survey. As such, our team emphasized engineering desk reviews for more projects and used the virtual verifications as a nested sample

[32] These inconsistencies are not related to our evaluation of energy savings calculations but rather to the comparison of energy savings in the calculators to energy savings reported in the tracking database.

that we could use to assess the frequency and magnitude of any miscalculations or updates affecting each measure.

Impact on Gross Savings Verification

The differences between program tracking data and project files as well as the lack of measure-level savings hindered the team's ability to compare reported savings efficiently and confidently with verified savings. For example, for some projects, the summation of measure-level savings in the project files did not match the summation at the measure category level in the tracking data. Our team attempted to reconcile such projects by trying various combinations of measures and quantities to arrive at the savings in the tracking data. In some cases, the method succeeded, though in others we were unable to reconcile the savings.

The team identified projects with differences and provided feedback to RI Energy, which in turn attempted to explain the differences. In most cases, where explanations proved sufficient, our team adjusted reported savings to accurately reflect energy savings that RI Energy should have reported. By doing so, we made impact observations and inferences directly related to savings estimations and calculators, such that our findings and recommendations would not be biased by data entry errors.[33]

Impact on Net-to-Gross Estimation

Similarly to the impact evaluation, the NTG estimation relied on our ability to identify and send web-based surveys to participating site contacts who were most familiar with the decision-making process related to measures implemented through the program. The lack of an e-mail addresses in the tracking data adversely affected our team's plan for estimating NTG:

> Our team found that participants experienced difficulties answering NTG questions about specific measures at specific sites, initiated as far back as 2019 and completed as far back as Q1 2021. Through initial participant screening during virtual verifications, we determined a substantial risk of recall bias could undermine data collected through the surveys.

Combined, the issues contributed to our team's inability to gather sufficient data to make quantitative conclusions about the programs' NTG. Notably, our outreach and virtual verifications were significantly more successful with income-eligible projects, possibly implying those projects had more complete participant contact information available. Although we did not expect differences in impact results between income-eligible and non-income-eligible projects, we expected differences in NTG estimations between the two. Our team did not attempt to collect NTG data from income-eligible projects because gross and net savings were equal for income-eligible projects.

[33] Though we did not want to include anomalistic impact evaluation results that might be used for prospective energy savings reporting, we wanted to ensure RI Energy understands the issue and can mitigate it through future program implementation.

Recommendations

Considering these issues and challenges, we offer RI Energy the following recommendations to improve data quality so RI Energy can obtain more robust results from future multifamily program evaluations.

Recommendation 4: Develop and implement a quality control process for entering data from project files to the program tracking database.

We recommend that the multifamily programs implement quality control elements as part of the data entry process, such as automated checks for reasonable energy savings data and required spot checks between project files and the tracking database. Automated checks with associated alerts (e.g., minimum allowable energy savings, net savings equaling gross savings) will alert staff to outlying entries and allow them to make any necessary corrections right away.

We understand that RI Energy has started to investigate this recommendation.

Recommendation 5: Report energy savings at the measure level.

We recommend tracking multifamily energy savings at the measure level. Currently, savings are tracked at the measure category level. For example, a project that included a boiler pump VFD and domestic hot water recirculation had two separate energy savings calculations in the project files and one aggregated line item in the tracking database under Custom Circulator. Greater detailed context in the tracking data would support more robust evaluations and data quality checks.

Recommendation 6: Improve project contact documentation and include contact information directly in the program tracking database.

We recommend recording project and site contact information in the tracking database. Combining datasets can be time-consuming, and contact information stored in customer information systems does not always reflect the most appropriate contacts for a specific project. Additionally, multifamily projects often have multiple contacts, representing different project phases (e.g., contacts representing the decision-making process and those representing the site's management and equipment). The program should collect contact information for each of these individuals as each contact might have a different role in the evaluation process. Additionally, tracking multiple contacts would improve outreach efforts when participants experience staff turnover

Appendix A. Evaluation Scope of Work

RI Energy -MF
Custom Measure Im

Appendix B. Net-to-Gross Methodology

RIE MF NTG
Methodology memo

Appendix C. Net-to-Gross Survey Guide

RI Energy Multifamily Impact: Participant NTG Survey

Table 31: Overview of Data Collection Activity

Descriptor	This Instrument
Instrument Type	Web Survey
Estimated Time to Complete	20 minutes
Population Description	Multifamily Custom Program participants 2022-2023 (exclude income-eligible) sampled for impact evaluation (Electric EWMF, Gas EWMF, Gas CI MF)
Sampling Strata Definitions	n/a
Completion Goal(s)	22 completed surveys
Type of Sampling	Other: Sample from impact evaluation sample
Contact Sought	Name in application materials/tracking data
Fielding Firm	Cadeo
Incentive Plan	Available up to $200 e-gift card delivered via email[34]

Programmer Information

Data Source: Impact evaluation sample

Table 32: Database Inputs

Variable Name	Variable Description and Values
CONTACT/BUSINESS NAME	Name of project contact
MEASURE_##	Measures installed through the program
ADDRESS	Physical address of facility where measure(s) were installed
YEAR	Year of program participation/project completion

[34] The total incentive available is $200 for each participating customer: $100 for the verification interview; and $100 for completion of the web survey.

Email Introduction

Subject Line: Here is Your Follow-Up Survey From Rhode Island Energy

Text: Dear [CONTACT/BUSINESS NAME]

We are a research firm under contract with Rhode Island Energy to conduct a survey of businesses that participated in Rhode Island Energy's Multifamily Energy Efficiency Program. We are providing a $100 e-gift card to each eligible person that completes the survey.

This is the follow-up survey we discussed during the telephone interview we completed with you. The survey should take less than 15 minutes to complete. If you are interrupted after you start taking the survey and you want to finish, you can simply click on the same link which takes you back to where you left off.

You can take the survey here: [LINK TO SURVEY]

If you would like to verify the legitimacy of this research, please contact Brett Feldman at Rhode Island Energy (BSFeldman@RIEnergy.com) or Ann Clarke at Rhode Island Energy (aclarke@rienergy.com).

Cadeo, an independent research firm, is conducting this research on behalf of Rhode Island Energy and using Qualtrics to gather feedback from program participants. This message was sent by Cadeo, 3506 N Vancouver Ave, Portland, OR 97227.

Introduction

Cadeo is conducting a survey on behalf of Rhode Island Energy to assess how well the energy efficiency programs are meeting the needs of multifamily customers. This research will help Rhode Island Energy to improve customers' future experiences with energy efficiency projects such as yours.

You are receiving this survey invitation because of your participation in a recent telephone survey during which we asked about equipment installed at your multifamily property.

This survey will ask questions regarding an energy efficiency project that your organization completed between 2021 and 2023. The reported results will only contain aggregated responses to maintain anonymity and confidentiality.

We request that the individual who responds to this survey be the person at your organization who is most familiar with your company's experience with and decision to complete this project. If you are not the appropriate person to answer these questions, please forward this survey weblink to the appropriate person.

This survey takes approximately 15 minutes to complete. At the end of the survey, we will ask to confirm your contact information; this will only be used to deliver the $100 e-gift card to thank you for your time. We will immediately send your e-gift card to the email address you enter.

Screening

S1. How would you best describe yourself? Are you a…

1. Property owner
2. Property manager
3. Facilities/maintenance manager
4. Condo Association Representative
97. Other (Fillable Field)

S2. During the previous telephone survey, we asked about equipment installed at your multifamily property located at [**ADDRESS**] through the Rhode Island Energy (formerly National Grid Rhode Island) Multifamily program in [**YEAR**]. Were you responsible for deciding which item(s) were installed at that property?

1. Yes
2. No
98. Don't know

S2a. **[IF S2=2 OR 98]**
We would appreciate it if you could forward the survey email to someone in your organization who is more familiar with this project. We ask that you also provide the person's name and contact information so that we can send the invitation directly, as well. Thank you for your time.

1. Name **[FILLABLE FIELD]**
2. Email address **[FILLABLE FIELD]**
3. Phone number **[FILLABLE FIELD]**
98. I'm not sure **[THANK AND TERMINATE]**

Program Influence

[FR SET PROGRAMMED TO ITERATE FOR ALL MEASURES INSTALLED AT EACH PROPERTY]

Now we'd like to ask you about equipment installed through the program at your property. If multiple measures were installed at your property, some questions may be repeated.

Specifically, we will ask about the following equipment/measures installed in **[YEAR]**:

Equipment/Measure
[MEASURE_01]
[MEASURE_02
[MEASURE_N]

[BEGIN LOOP]

F1. Please focus your answers to these questions on the [**MEASURE_01**] installed at your property through the Multifamily program in [**YEAR**]. Can you please confirm the number of units that you installed that received financial support from the program?

FILLABLE FIELD (must be whole number >0)

F2. Please rate the importance of each factor that may have influenced your decision to install the [**MEASURE_01**]. Please use a scale of 0 to 10, where 0 is "not at all influential" and 10 is "extremely influential."

1. The rebate or discount I received for **[MEASURE_01]**
2. Recommendation from the RISE
3. Information provided during the energy audit/assessment
4. Program materials or website
5. Project management and installation support
6. Recommendation from someone else
7. Experience with the same or similar equipment at other properties that participated in the program in past few years?

[IF F2=6]

F3. Did the person who gave you a recommendation participate in the Multifamily program in the past few years?

1. Yes
2. No
98. Don't know

F4. Without the Multifamily program, what is the likelihood you would have purchased **[MEASURE_01]** of the same level of efficiency? Please use a scale of 0 to 10, where 0 is "not at all likely" and 10 is "extremely likely."

[SHOW 0-10 SCALE, WITH END-POINT LABELS]

F5. Without the Multifamily program, what is the likelihood you would have purchased [**MEASURE_01**] of any efficiency within 12 months? Please use a scale of 0 to 10, where 0 is "not at all likely" and 10 is "extremely likely."

[SHOW 0-10 SCALE, WITH END-POINT LABELS]

[IF F1>1]

F6. Without the Multifamily program, what is the likelihood you would have purchased fewer units of energy efficiency [**MEASURE_01**]? Please use a scale of 0 to 10, where 0 is "not at all likely" and 10 is "extremely likely."

[SHOW 0-10 SCALE, WITH END-POINT LABELS]

[LOOP TO F1 FOR MULTIPLE MEASURES]

Consistency Check

C1. In your own words, can you tell us how influential the Multifamily program was in your decision to install the equipment at the time you did? Please consider all measures we have asked about in the survey in your response.

FILLABLE FIELD

C2. Prior to your participation in the Multifamily program, had you already purchased on your own any of the equipment below for which you received financial support from the program?

Equipment/Measure	1. Yes	2. No	98. Don't know
[MEASURE_01]			
[MEASURE_02]			
[MEASURE_n]			

[FOR C2=1 AND MIN(F4, F5, F6)<7]

C2a. For the measures you had already purchased prior to participation in the program, what factors contributed to your decision to complete the project(s) with support from the program?

FILLABLE FIELD

[FOR C2=2 AND MIN(F4, F5, F6)>6]

C2b. For the measures you had not already purchased prior to participation in the program, what factors contributed to your decision to complete the project(s). with support from the program?

FILLABLE FIELD

Spillover

SP1. Since your participation in the Multifamily program in **[YEAR]**, have you installed any ADDITIONAL energy efficiency equipment of any type at this property or other properties you own or manage in **Rhode Island**?

Note: This does not include actions that your tenants may have taken through the program.

1. Yes
2. No
98. Don't know

[IF SP1 = 1]

SP2. What additional energy efficient equipment did you install?

1. LED Lighting
2. Clothes Washer
3. Electric Clothes Dryer
4. Gas Clothes Dryer
5. Low Flow Faucet Aerator
6. Low Flow Showerhead
7. Programmable Thermostat
8. Smart Thermostat
9. Smart Strip Plug Outlet
10. Refrigerator
11. Freezer
12. Dishwasher
13. Dehumidifier
14. Central A/C
15. Furnace
16. Boiler
17. Air Source Heat Pump
18. Ductless Heat Pump
19. Electric Water Heater
20. Gas Water Heater
21. Solar Water Heater
22. Heat Pump Water Heater
23. Insulation
24. Low-e Storm Windows
25. Doors
26. Energy Management or Control Systems

27. Chiller
28. Package Terminal Air Conditioner (PTAC)/Package Terminal Heat Pump (PTHP)
97. [Other][Specify]
98. [Not Sure]

[IF SP2<98]

SP3. You indicated that you installed the following energy efficient equipment after your participation in the Multifamily program. Please indicate if you received financial support (e.g., rebate) from Rhode Island Energy to help offset the cost.

[LIST EACH ITEM SELECTED IN SP2]

Item	1. Yes	2. No	98. Not sure

[PROGRAMMING NOTE: FOR ANY MEASURES WHERE SP3=1, REMOVE FROM LIST OF MEASURES SELECTED IN SP2 AND DO NOT DISPLAY IN SUBSEQUENT QUESTIONS]

[IF ANY SP3=2]
[ONLY DISPLAY MEASURES WHERE SP3=1]

SP4. Why didn't you receive financial support for the equipment you installed?

1. Did not know rebate was available
2. Applied for rebate but item did not qualify
3. Did not think rebate amount was worth the effort
4. Did not apply because item did not qualify for a rebate
5. Did not want or need it
97. [Other][Specify]
98. [Not Sure]

[IF SP2<98]

SP5. For each measure you installed after your participation in the Multifamily program, how influential was your prior experience with the Multifamily program in your decision to install this equipment? Please use a scale of 0 to 10, where 0 is "not at all influential" and 10 is "extremely influential."

Item	SHOW 0-10 SCALE, WITH END-POINT LABELS

[IF S2<98]

SP6. How likely is it that you still would have installed the efficient product(s) on our own if you had never participated in or heard of the Multifamily program? Please use a scale of 0 to 10, where 0 is "not at all likely" and 10 is "extremely likely."

Item	SHOW 0-10 SCALE, WITH END-POINT LABELS

[IF S2<98]

SP7. For each item you installed, please specify how you knew that the product(s) you installed were energy efficient. Select all that apply. **[RANDOMIZE]**

1. Efficiency rating or label of equipment, such as an "ENERGY STAR®" logo
2. Equipment dealer/retailer said it was energy efficient
3. Prior corporate experience with product(s)
4. Met utility rebate requirements
5. Third party report, such as Consumer Reports
6. Recommendations from the contractor/installer
7. Did not rely on any specific type of information
8. Internet/website

97. [Other][Specify]
98. [Not Sure]

Closing

C1. We appreciate your feedback about your experience with the Multifamily program. May we contact you via email or phone with any additional follow-up questions we may have?

1. Yes
2. No

C2. Thank you for your time and thoughts! Select the email address where you would like your Amazon gift card to be sent OR if you prefer a card to be mailed to you, please include your mailing address:

1. The email address used for this survey
2. A different email address: [**FILLABLE FIELD**]
3. I prefer a card to mailed by post to this address: [**FILLABLE FIELD**]
4. I am unable to accept a gift card

PROGRAMMER NOTE: mailed cards are Tango gift cards

Appendix D. Site-Specific M&V Plan Example

EXAMPLE_SSMVP.pdf