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2013-2015 Regional Energy Networks Multifamily Programs Impact Evaluation Final Report

Prepared for the Energy Division of the
California Public Utilities Commission

CALMAC Study ID: CPU0150

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1 Executive Summary

This report presents the results of the impact evaluation of the Multifamily Whole Building (MF-WB) programs implemented by Bay Area Regional Energy Network (BayREN)[1] and Southern California Regional Energy Network (SoCalREN)[2]. The evaluation team designed this evaluation to answer the following research questions for the 2013-2015 BayREN and SoCalREN Multifamily Whole Building programs:

(1) What are the gross energy and demand savings (therms, kWh, kW) achieved by the BayREN and SoCalREN programs?
(2) What are the net energy and demand savings achieved by the programs?
(3) How can the RENs improve their reported savings claims so that they align with evaluated values?

The Multifamily Whole Building programs conduct targeted outreach to multifamily property owners to promote participation. As part of this program, property owners are offered technical and financial assistance designed to lower barriers to multiple measure upgrades by providing a combination of both technical and financial assistance. To participate, retrofits must result in expected savings of at least 10% from pre-program electric or gas energy consumption on a whole building level; however, the program allows for flexibility in the measures used to achieve this savings goal. Program savings are calculated through EnergyPro building simulation modeling software. Building owners are eligible for a per unit rebate upon completing the energy efficiency improvements identified in the scope of work.

Cumulatively, the two Regional Area Networks (RENs) implemented 246 projects during 2013-2015, representing over 18,000 dwelling units. Cumulatively, the RENs reported to save 8,073,279 kwh, 1,221 kw, and 515,104 therms, reaching 36% of the energy (kWh) goals, 19% of demand (kW) goals, and 48% of natural gas savings goals (therm). The majority of these savings (approximately 80% of BTUs) were achieved by BayREN.

The evaluation team performed two primary data collection activities for the Multifamily Whole Building programs, telephone surveys and site visits, which contributed to the following four evaluation activities:

[1] The BayREN program implementation plan can be retrieved using the following url: http://eestats.cpuc.ca.gov/EEGA2010Files/BayREN/PIP/2013/Clean/A.12-07-001%20Supp%2002_Appendix_A_BayREN_PIP_Revised%20091813%20clean.pdf

[2] The SoCalREN program implementation plan can be retrieved using the following url: http://eestats.cpuc.ca.gov/EEGA2010Files/SoCalREN/PIP/Clean/2014%2002%2014_Amended%20SoCalREN%20PIP_Clean%20Final.pdf

(1) Baseline assessment: estimate the percentages of early replacement and replace on burnout participant measures through analysis of the decision maker survey. Baseline assignments contribute to energy savings values by determining whether the existing conditions or current energy efficiency code should be used as a basis for first year energy savings.
(2) Free ridership estimation: estimate the percentage of savings that would have occurred without program intervention through analysis of the decision maker survey. The savings from measures that would have been installed without program intervention are excluded from evaluated savings values, potentially reducing energy savings achieved by a program.
(3) Consumption analysis: link meter numbers collected on-site to property level consumption, assess completeness, and determine pre-program consumption levels at each visited site. This analysis allows energy savings to reflect the energy consumed at the property prior to the program. In this manner, evaluators can ground savings in actual energy use.
(4) Simulation modeling: determine gross savings values for visited participant sites, updating building and measure characteristics to those found on-site and baseline assignments to those provided during the telephone survey. Energy Simulation Models estimate total consumption of the participant property and approximate energy savings that would result by changing particular features of the home. For example, the simulation model calculates energy savings resulting from installing a new roof, based on the HVAC system, existing insulation, windows, and building orientation of the participant project site. The evaluation team adjusted IOU simulation models to conditions observed during data collection activities.

The evaluation team surveyed 73 of 247participants in the REN multifamily programs to inform the baseline review and free ridership estimation portions of the impact evaluation. The survey targeted property managers, owners, or other primary decision makers involved in executing the program at the property level. Survey topics included the following:

- Confirmation/verification of installed measures
- Anticipated actions in the absence of program intervention
- Importance of program education and incentives on the decision to install high efficiency equipment
- Working status and estimated age of replaced units
- Timing for building maintenance/upgrades
- Recruitment for site visits.

Following the telephone surveys, the evaluation team conducted site visits for 20 completed Multifamily Whole Building projects, representing 596 dwelling units. The three objectives of these visits were to (1) to collect meter numbers to access utility consumption data for all buildings/units on the property that were part of the incentive; (2) to verify measure installation and collect data on measure quantity and efficiency; and (3) to collect high-level building and dwelling unit characteristics used to verify and update as necessary inputs in the EnergyPro models initially developed by the program contractors to calculate reported savings.

Key Conclusions and Recommendations

Conclusion 1: Although the RENs have assumed early replacement savings for all multifamily measures, this research indicated that a portion of projects may not qualify for early replacement because of planned improvements, installation of new equipment, or replacement of equipment that was in poor condition. For example, only 55% of water heater installations qualified as early replacement measures.

Recommendation 1: The RENs should set up a survey for multifamily participants at intake to better determine the appropriate baseline for each project and measure.[3] The intake survey can follow a similar logic as that used in this report or that from the California Public Utilities Commission (CPUC) early retirement guidance document.[4] The baseline assumptions for a sample of projects should then be verified by an independent third-party evaluator.

Conclusion 2: This research estimated free ridership at 48.9%, meaning that almost half of the project savings would have been achieved in absence of the program. This value is significantly higher than the REN reported value of 85%.

Recommendation 2: RENs should consider using the researched free ridership estimate from this study and update this information as future evaluation results become available. Because the program is still relatively new, the composition of participants may change over time, so the free ridership may change as the program matures. In addition, the free ridership should be updated if there are changes in the implementation strategies that might reduce or alter the free ridership (e.g., increasing incentive levels or changing the measure mix).

[3] Programs in place in 2017 and beyond need also comply with CPUC rulings and guidance surrounding AB 802 and Rulemaking 13-11-005, which prescribe appropriate baselines for varying sectors and measure types.

[4] Early Retirement Using Preponderance of Evidence, Version 1.0; http://www.cpuc.ca.gov/NR/rdonlyres/8AB0DEB5-41B0-4881-BC63-F7EBBEC81318/0/ProjectBasis_EULRUL_Evidencev1July172014.pdf

Conclusion 3: The consumption analysis did not result in comprehensive energy consumption for many of the sampled properties. This is due to challenges linking the meter numbers to IOU billing data and considerable time periods with zero energy use during the pre-program period. As such, the evaluation team could not calibrate the simulation models to the estimated consumption as planned, and relied upon the consumption estimates calculated in the simulation models.

Recommendation 3: Program administrators need to access and calculate whole building consumption for projects prior to approving project application and have this information readily available for evaluators to justify savings claims. Program administrators should access at least 12 months of gas and electric use prior to potential program upgrades, and 12 months of use after the upgrades occur. These data need to encompass all common area and dwelling units within the participant property and should be a prerequisite of participation. These data will allow savings assumptions and models to be calibrated and/or verified through actual customer bills and will be imperative to support future claims for projects utilizing an existing conditions baseline.

Conclusion 4: The meter numbers collected by the evaluation team were significantly more comprehensive than those collected by BayREN. Specifically, BayREN reported 54 meter numbers for the five evaluated sites, while the evaluation team collected 168 meter numbers at those same sites. Using the meter numbers collected by the program administrator would have resulted in significantly underestimated property level consumption information.

Recommendation 4: The REN meter number collection efforts need to be more thorough and comprehensive should future Multifamily Whole Building programs utilize meter numbers to link to property consumption.

Conclusion 5: The EnergyPro Lite simplified geometry methodology frequently overestimated savings when compared to the savings and consumption modeled with actual on-site conditions. Of the 20 projects evaluated, the evaluation team found 14 had reduced savings when modeled with actual window and wall characteristics; two sites saw increased savings and four projects were not affected by the change.

Recommendation 5: The evaluation team recommends modeling the exterior surfaces (wall and window area) based on actual conditions when implementing weather dependent measures.

Conclusion 6: A review of the results for projects with weather dependent measures showed there were zero supply fan energy savings, even though fan savings would be expected with reduced heating and cooling loads from implementing efficient HVAC equipment or envelope improvements. Additionally, all reported models assumed zero ventilation, impacting the modeled heating and cooling loads.

Recommendation 6: Program administrators should update ventilation, air infiltration, and HVAC fan controls assumptions in their reported models to improve model accuracy and show savings and envelope improvements.

Conclusion 7: There is a discrepancy between the Database for Energy Efficiency Resources annual hours of use (541) and the occupancy hours of use default schedules assumed in EnergyPro for high rise residential buildings (3,251). To account for this, the custom lighting calculator multiplies the actual lighting wattage by the ratio of Database for Energy Efficiency Resources annual hours of use by the occupancy based defaults used by EnergyPro (541/3,251). This results in lower estimated consumption for lighting during peak hours.

Recommendation 7: The evaluation team recommends modeling the actual lighting hours of use and creating a new lighting schedule in EnergyPro to match the Database for Energy Efficiency Resources occupancy schedule. A similar approach should be applied to the other building occupancies.

2 Introduction

This report presents the results of the impact evaluation of the Multifamily Whole Building programs implemented by Bay Area Regional Energy Network (BayREN)[5] and Southern California Regional Energy Network (SoCalREN)[6]. The following sections describe the evaluated programs and the approaches.

2.1 Multifamily Program Overview

The Multifamily Whole Building programs conduct targeted outreach to multifamily property owners to promote participation. It is marketed under Energy Upgrade California®. As part of this program, property owners are offered technical and financial assistance designed to lower barriers to multiple measure upgrades by providing a combination of both technical and financial assistance. To participate, retrofits must result in expected savings of at least 10% from pre-program electric or gas energy consumption on a whole building level; however, the program allows for flexibility in the measures used to achieve this savings goal. Program savings are calculated through EnergyPro building simulation modeling software. Property owners receive customized scopes of work designed to reduce building energy use. SoCalREN relies on participant raters to work with property owners to achieve their project goals; the costs of the rater services are then offset by the assessment incentive. BayREN, in contrast, relies on contracted raters for their technical assistance, which is offered at no cost to the building owners. Building owners are eligible for a per unit rebate upon completing the energy efficiency improvements identified in the scope of work. Table 1 outlines some of the features of multifamily program implementation between the two program administrators.

[5] The BayREN program implementation plan can be retrieved using the following url: http://eestats.cpuc.ca.gov/EEGA2010Files/BayREN/PIP/2013/Clean/A.12-07-001%20Supp%2002_Appendix_A_BayREN_PIP_Revised%20091813%20clean.pdf

[6] The SoCalREN program implementation plan can be retrieved using the following url: http://eestats.cpuc.ca.gov/EEGA2010Files/SoCalREN/PIP/Clean/2014%2002%2014_Amended%20SoCalREN%20PIP_Clean%20Final.pdf

Table 1. Multifamily Program Elements, by Program Administrator[7]

Program Element	SoCalREN		BayREN	
Service Territory	Joint SCE/SCG territory, minus municipal service territories (e.g. LADWP)		9-County Bay Area	
Eligibility Requirements	3+ units; SCE & SCG service; 3+ measures; work with Participating Rater		5+ units; 9-county Bay Area; PG&E gas and/or electric; 2+ measures	
Rater Delivery Model	Open Rater		Tech Assist. direct delivery by AEA	
Audit Requirement	ASHRAE Level 2		Clipboard audit	
CAS Testing	MF HERCC Protocols		MF HERCC protocols	
Energy Modeling Software	EnergyPro		EnergyPro Lite	
Assessment Incentive	**# Units**	**Incentive**	Free site visit and technical assistance up to $5000 value	
	1-49	$5,000		
	50-100	$10,000		
	100+	$20/Unit Increment		
Improvement Incentive	**Improvement**	**$/Unit**	**Improvement**	**$/Unit**
	10%	$550	10%	$750
	15%	$625		
	20%	$800		
	25%	$1,000		
	_> 30%	$1,200		
Verification	Participating Rater		Tech. Assist. (AEA)	

Combined, the two RENs implemented 246 projects representing 18,066 dwelling units, and claimed savings of 8,069,103 kWh, 1,221 kW, and 512,481 Therms for the Multifamily Whole Building programs during the 2013-2015 program years (Table 2).

[7] Table and program details provided by SoCalREN via basecamp on 7/14/16

Table 2. 2013-2015 Multifamily Program Reported Savings, by Program Administrator[8]

REN	Reported Savings		
	kWh	kW	Therms
BayREN	6,445,608	629	455,485
SoCalREN	1,627,671	592	59,619
Total	***8,073,279***	***1,221***	***515,104***

Cumulatively, California RENs allocated more than $36 million to implement and oversee the 2013-2015 Multifamily Whole Building programs.[9] Combined, the RENs spent 71% of this allocated budget and achieved 36% of their electric (kWh), 19% of their demand (kW), and 48% of gas (therm) savings goals. With the notable exception of BayREN kWh achievements, the California RENs did not meet their energy savings goals (based on reported savings) for the 2013-2015 Multifamily Whole Building program year (Table 3).

Table 3. Multifamily Whole Building 2013-2015 Program Reported Spending and Goals by Program Administrator

REN	Completed Projects	Dwelling Units	Budget	Spent	% Spent	% Savings Achieved (% of goal, reported savings)			
						kWh	kW	Therms	BTU
BayREN	234	15,896	$21,943,050	$20,622,092	94%	134%	82%	95%	125%
SoCalREN	12	2,170	$14,315,700	$5,274,845	37%	9%	10%	10%	9%
Totals	246	18,066	$36,258,750	$25,896,937	71%	36%	19%	48%	37%

Evaluation Overview

This section outlines the evaluation activities of the Multifamily Whole Building energy efficiency programs offered by BayREN and SoCalREN for the 2013-2015 program years. This research builds upon the findings from the 2013-2014 Regional Energy Network (REN) Impact Assessment[10], and results in gross and net savings impacts for the first three years of REN program implementation.

The 2013-2014 REN Impact Assessment provided a high-level assessment of the reported savings assumptions, including a comparison between REN and Investor Owned Utility (IOUs) impact assumptions. The objective of this previous research was to identify if there were any

[8] Reported MF savings taken from 2013-2015 program tracking data, accessed 6/20/16;
[9] Budgets provided in EEstats data requests
[10] Itron, Inc., Apex Analytics, LLC & DNV_GL. January, 2016. 2013-2014 Regional Energy Networks and Community Choice Aggregator Programs Impact Assessment Final Report.

obvious over- or understatements of claimed impacts and provide input to the RENs on what data should be collected and available to facilitate future impact evaluations. The 2013-2014 assessment provided the RENs insight on how to prepare for this full impact evaluation while their programs are scaling up.

The evaluation team designed this evaluation to answer the following research questions for the 2013-2015 BayREN and SoCalREN Multifamily Whole Building programs:

(1) What are the gross energy and demand savings (therms, kWh, kW) achieved by the BayREN and SoCalREN programs?
(2) What are the net energy and demand savings achieved by the programs?
(3) How can the RENs improve their reported savings claims so that they align with evaluated values?

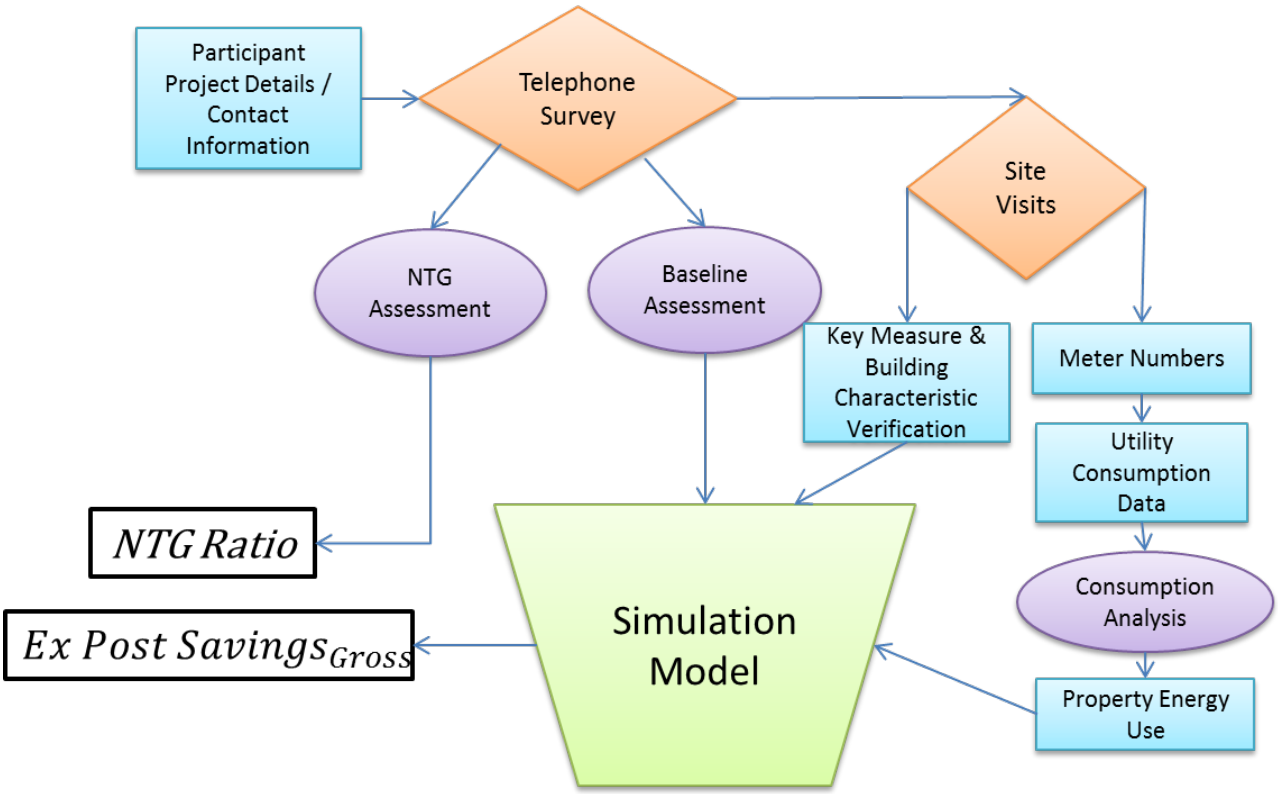
To answer these questions, the multifamily evaluation team performed two primary data collection activities, telephone surveys and site visits, which fed into the following four evaluation activities:

(1) Baseline assessment
(2) Free ridership estimation
(3) Consumption analysis
(4) Simulation modeling.

The evaluation team surveyed participants in the REN multifamily programs to inform the baseline review and free ridership estimation portions of the impact assessment. The survey targeted property managers, owners, or other primary decision makers involved in executing the program at the property level.

Projects were recruited for the on-site visits during the decision maker survey. The three objectives of these visits were to (1) to collect meter numbers to access utility consumption data for all buildings on the property that were part of the incentive; (2) to verify measure installation and collect data on measure quantity and efficiency; and (3) to collect high-level building and dwelling unit characteristics used to verify inputs in the EnergyPro models used to calculate savings. Figure 1 illustrates how these activities combine to result in evaluated savings. Details of these activities are discussed in the following sections.

Figure 1: Multifamily Whole Building Evaluation Activities and Outcomes



Baseline Assessment

Typically, two baseline options are used to calculate savings claims for retrofit (existing building) projects:

Early replacement, whereby the building owner/manager was not planning to replace or upgrade the equipment if the program were not available. This means that the savings would be based on a dual baseline or a step function, with the difference from existing equipment to new for the expected remaining useful life, and then the difference of code (replace on burnout) to new equipment for the difference between expected useful life and remaining useful life years (effective useful life-remaining useful life).

Replace on burnout, which can occur either when existing equipment fails or the building owner/manager was already planning to install new equipment if the program were not available (e.g., through a major remodel or the equipment was expected to fail in less than two years). In these cases, current codes/standards would serve as the baseline for the entire effective useful life of the equipment. The assumption is that the equipment would have been replaced anyway, but

the program motivated the decision maker to upgrade from standard efficiency to high efficiency equipment.

The evaluation team used a decision-maker survey to estimate the percentages of early replacement and replace on burnout participant measures (see Section 3.1 for details).

Free Ridership Estimation

This Multifamily Whole Building study also examined free ridership, which is the percentage of savings that would have occurred without program intervention. Note that this study focused exclusively on free ridership and did not account for potential spillover which, as noted above, is investigated under a separate study.[11] This is consistent with the reported freeridership values. Recognizing that the decision to participate and install energy efficiency measures in multifamily properties can differ by measure, the evaluation team examined potential differences in program attribution across different measures. In addition, the free ridership questions and the algorithm were carefully selected to capture the complex decision-making processes in the multifamily sector, which in some ways are more similar to nonresidential than residential processes. For example, the evaluation team:

- Explored company policy, because it has an impact on decisions about equipment spending and selection
- Investigated and attempted to reach the true decision maker, because some companies have more than one

Consumption Analysis

One of the challenges associated with performing a consumption analysis on multifamily properties is identifying a complete list of gas and electric account numbers at the tenant and common area levels for the participating buildings. Because the Multifamily Whole Building programs are comprehensive, a consumption analysis is successful only if the evaluation team can access consumption information for the entire project, including all tenant and common areas in the building(s). To ensure that the billing data represented comprehensive participant-building-level energy consumption, the evaluation team conducted a thorough assessment of the property consumption information to ensure that it represented the totality of the gas and electricity consumption for a property.

[11] Spillover effects are studied and applied at a portfolio level in a separate effort. See CPUC Resolution E-4700, December 18, 2014.

Calibrated Simulation Models

The evaluation team calculated evaluated gross savings based on simulation models using the Non-Residential Performance modules of the EnergyPro interface software for all projects including both high-rise and low-rise buildings. The non-residential performance module allows for flexibility in adjusting operating schedules and other fixed inputs and assumptions.

Both BayREN and SoCalREN use the non-residential performance module to determine project eligibility (which requires achievement of at least 10% or greater improvement over existing energy use) and calculate savings estimates for packages of energy efficiency measures which they present to the building owner. However, BayREN uses a modified interface version of EnergyPro called EnergyPro Lite which requires fewer inputs than the full version of EnergyPro and provides streamlined building geometry development through defaults and assumptions which will be discussed later in the report.

The evaluated models are based on the reported models created by the RENs for each project, then updated by the evaluation team based on four evaluation activities: a baseline assessment, building and measure attributes found on site, review of the custom calculations used for measure savings estimates that cannot be modeled directly in the EnergPro software, and pre-program consumption information. The evaluation team calculated a site-specific evaluated gross savings value based on these updated EnergyPro non-residential performance simulation models.

The results of these four activities provide the necessary inputs for the Evaluation Team to develop gross realization rates, calculated as the modeled savings divided by the reported savings, or:

$$Realization\ Rate_{Gross} = {Savings_{Modeled}}/{Savings_{ex\ ante}}$$

These gross realization rates are then applied to the participant population to estimate evaluated gross energy and demand savings for the BayREN and SoCalREN multifamily programs.

3 Methodology

3.1 Data Sources

The evaluation team used a variety of primary and secondary sources to assess impacts of the REN Multifamily Whole Building programs, including the following:

1) Decision-maker survey
2) Participant site visits
3) Property energy consumption (billing) data
4) REN EnergyPro models
5) REN informational data requests.

In addition, the team used an approved analysis method, the California Public Utilities Commission (CPUC) Energy Division's *Methodological Framework for Using the Self-Report Approach to Estimating Net-to-Gross Ratios for Nonresidential Customers* (referred to hereafter as the "framework").[12] This ensures consistency across evaluations, allows comparisons between programs, and ensures that the survey batteries and algorithms have been properly vetted. Both the free ridership and early replacement batteries have been customized to the unique characteristics of the California multifamily programs.

The following sections outline the primary and secondary data sources the evaluation team used in the REN multifamily impact assessment.

3.1.1 Baseline and Free Ridership Assessment (Participant Survey)

The evaluation team surveyed participants in the REN multifamily programs to feed into the baseline review and free ridership estimation portions of the impact assessment. The survey targeted property managers, owners, or other primary decision makers involved in executing the program at the property level. Survey topics included the following:

- Confirmation/verification of installed measures
- Anticipated actions in the absence of program intervention
- Importance of program education and incentives on the decision to install high efficiency equipment
- Working status and estimated age of replaced units
- Timing for building maintenance/upgrades
- Recruitment for site visits.

[12] CPUC Energy Division. Methodological Framework for Using the Self-Report Approach to Estimating Net-to-Gross Ratios for Nonresidential Customers. Prepared by the Nonresidential Net-To-Gross Ratio Working Group. 2012.

The evaluation team successfully completed surveys with 73 project decision makers, representing 30% the 2013-2015 Multifamily Whole Building participant projects. The 247 completed projects were managed by 183 unique decision makers; several decision makers managed more than one project. This survey was used to supplement the 2013-2014 surveys of the same type for those participants that were not contacted during the previous effort. Of these 73 surveys, 43 were completed as part of the 2013-2014 REN Impact Assessment, 30 conducted in this round. Table 4 summarizes the completed surveys by REN.

In order to ensure a representative population for the surveys, the evaluation team divided participant properties into two groups based on building type - low-rise buildings and high-rise buildings, and created survey quotas to proportionally reflect the participant population: the distribution of building types in the 247 completed projects was 70% low-rise buildings and 30% high-rise buildings, so the evaluation team targeted the same distribution in completed surveys. Of the 73 completed survey, 55 were conducted with decision makers of low-rise buildings[13] (75%) and 18 were conducted with decision makers of high-rise buildings (25%). This stratification allows the evaluation team to account for any potential systematic differences between buildings and property owners to be accounted for in the final survey results. While SoCalREN projects were included in the survey sample, the evaluation team attempts were unsuccessful at reaching these participants. This is likely due to the small number of completed SoCalREN projects.

Table 4. Multifamily Whole Building Completed Participant Surveys by Program Administrator

Program Administrator	Completed Projects	Completed Surveys by Program Year		Percent of REN Multifamily Whole Building Program Reported Savings Represented in Surveys	
		2013-2014	2015	Energy (kWh)	Natural Gas (therms)
BayREN	235	43	30	35%	31%
SoCalREN	12	-	-	na	na
Totals	*247*	*73*		*28%*	*27%*

3.1.2 Participant Site Visits

Surveyors conducted site visits for 20 completed Multifamily Whole Building projects (Table 5). Projects were recruited for the on-site visits during the decision maker survey (described previously) and the site visit participants were given a $100 incentive to reduce nonresponse bias and encourage participation. The three objectives of these visits were to (1) to collect meter

[13] Low-rise buildings are defined here as less than 3 stories high.

numbers to access utility consumption data for all buildings on the property that were part of the incentive; (2) to verify measure installation and collect data on measure quantity and efficiency; and (3) to collect high-level building and dwelling unit characteristics used to verify inputs in the EnergyPro models used to calculate savings. The administrators of the survey attempted to access at least one of each dwelling unit type[14], and 14% of total dwelling units, to sample a representative number of dwelling unit HVAC, lighting, and appliances.

Given the limited budgets for data collection, prior to the site visit the evaluation team reviewed the REN tracking data and project documentation to gain an understanding of the project and plan the site-specific data collection focusing on meter numbers, measure verification, and building characteristics. Project aspects under consideration during this review were size of the project, total number of unique and identical buildings, type of HVAC systems, the magnitude of common area, the measures implemented and their contribution to overall energy savings.

Building characteristics data collection focused on verifying the following which were compared to the ex-ante energy models and project documentation during the energy modeling phase of the ex-post analysis:

- Building conditioned floor area
- Exterior wall, window, roof, and floor surface areas by orientation
- Exterior surface construction and performance values
- HVAC equipment type and efficiency
- DHW equipment type and efficiency
- Interior lighting
- Exterior equipment/lighting

Table 5: Multifamily Whole Building Completed Participant Site Visits by Program Administrator

Program Administrator	Completed Projects	Completed Site Visits
BayREN	235	20
SoCalREN	12	0
Totals	*247*	*20*

3.1.3 Consumption Data

During the 2013–2014 REN Impact Assessment, the evaluation team found that tenant account numbers (i.e., service accounts or SAIDs) were not a reliable link to full property consumption data. At the same time, the DNV GL team contracted to store and process participant

[14] A "dwelling unit type" is generally defined by the layout of the individual tenant units. Example dwelling types are: one bedroom units, two bedroom units, two bedroom + loft, etc.

consumption information, having determined that meter numbers may be a more reliable way to capture consumption information at a building or property level because the meter numbers do not change when utility accounts change hands. In July 2015, REN multifamily program administrators were directed to capture comprehensive property meter numbers for projects starting in 2015; however, this evaluation captures projects completed prior to that directive.

The 2015 evaluation team utilized meter numbers collected during participant site visits to link to property consumption data. The investor owned utility (IOU) that supplies energy to the end user provided the consumption information for the REN whole building projects. These data are stored through the DNV GL and Itron, Inc. data management teams for use in ongoing evaluation efforts. Once linked and accessed, pre-program (2013–2014) consumption data were then assessed for completeness and intended to calibrate simulation model savings estimates in actual pre-program property consumption.

3.1.4 EnergyPro Models

As mentioned previously BayREN calculates reported savings using the EnergyPro Lite software interface to the non-residential performance module of EnergyPro. EnergyPro Lite is a simplified version of EnergyPro, and uses DOE-2.1e as the simulation engine for calculations and is capable of modeling some efficiency measures parametrically using the alternatives feature. However, what sets EnergyPro Lite apart from EnergyPro is the number of inputs required to complete a model; EnergyPro Lite uses multiple default assumptions to streamline the model input process, reducing the time required by BayREN Technical Assistance Provider to develop energy efficiency measure recommendations, thus reducing costs for the owner paying for the service. The *"BayREN Multifamily Technical Memo Draft 12.1.14.pdf"* describes the modeling approach and assumptions in more detail, however, a summary of the more important assumptions include the following:

- Total square feet, hallway square feet (which is assumed unconditioned), number of dwelling units, and number of stories are input and the software assumes a square box with these inputs equally distributed across each floor.
- Wall area is based on ten feet ceiling heights and the window to wall percentage is 35% equally distributed across all orientations.
- HVAC systems must be defined and input by the user and the software assumes one system per dwelling unit.
- Ventilation air, and infiltration are not accounted for in the analysis of existing energy use.
- Existing lighting wattage is input separately into EnergyPro Lite for the dwelling units, hallways/common area, and exterior based on site verified conditions using a custom calculation tool developed by the BayREN Technical Assistance Provider. The wattage input in EnergyPro Lite is converted to a watts/sf (lighting power density) value assigned to each zone along with the Title 24 based default lighting schedules based on occupancy.

Energy Pro and the Database for Energy Efficiency Resources use different hours of use and schedule assignments for areas within the building (Table 6).

Table 6: Multifamily Lighting Schedules and Hours of Use for Energy Pro and Database for Energy Efficiency Resources

Building Area	Hours of Use		Lighting Schedule	
	DEER	Energy Pro	DEER	Energy Pro
Dwelling Unit	541	3,287	Default	High-rise Residential
Hallway	7,474	3,266	Default	Multifamily Common Area
Common Areas	*4,340*	3,266	Default	Multifamily Common Area

- To calculate the lighting power density for translation into EnergyPro input, the site verified lighting wattage is multiplied by the ratio of the Database for Energy Efficiency Resources hours to the default Title 24 hours assumed by EnergyPro resulting in different wattages than actual values. For example, an actual verified wattage of 1,000W in the dwelling units is multiplied by (541/3,287) resulting in 166 Watts. The 166 Watts is input into the EnergyPro Lite software, translated to a lighting power density, and assigned the 3,287 hours of use default schedule. The multiplier for lighting wattage verified on-site for dwelling units, hallways, and common area is 0.165 (541/3,287), 2.29 (7,474/3,266), 1.33 (4,340/3,266), respectively. Energy savings are than modeled as a custom alternative and subtracted from total usage. Interactive effects are accounted for in the custom calculator using assumptions on heating and cooling system efficiencies. It is not clear why the program implementers chose this approach instead of inputting the actual wattage and creating a new schedule matching the Database for Energy Efficiency Resources based hours by occupancy type, which are generally accepted as more reasonable than the default values. This approach will account for actual interactive effects accounting for site verified wattage and heating and cooling efficiencies.
- The program automatically generates deemed savings estimates by matching measure descriptors to the Database for Energy Efficiency Resources and reports the savings on the EPL-1 and EPL-2 output reports for comparison when Database for Energy Efficiency Resources and modeled calculation options exist. Where they exist, such as for appliances like refrigerators and dishwashers, the Database for Energy Efficiency Resources savings will show up on the EPL-1 report.
- The alternatives tab has a custom alternative option which allows the user to input kWh and therms savings directly which are subtracted from the modeled consumption. These energy savings are calculated using either deemed savings based on Database for Energy

Efficiency Resources measures, utility work papers, or PUC Energy Division disposition papers.

If there are components or more complex features of a building that cannot be modeled using EnergyPro Lite, such as two different HVAC system types or water loop heat pumps, EnergyPro Lite can export the full version EnergyPro.bld file for editing which can be linked to EnergyPro Lite so the results from the full version of EnergyPro are shown on the EPL-1 and EPL-2 output reports used for program reporting. This allows the REN Technical team to develop more detailed energy models and improve the accuracy of the analysis. Nine of the 20 sample projects used EnergyPro Lite for the analysis and 11 used the full version of EnergyPro.

When available, the evaluation team used full version EnergyPro model as the starting point for evaluated analysis. Otherwise, the evaluation team exported the EnergyPro Lite file, imported into the full EnergyPro version, and adjusted building characteristics and measures verified during the on-site process.

3.1.5 Custom Measure Workpapers and Calculation Tools

The energy savings for measures which cannot be directly modeled in either the full version of EnergyPro, or EnergyPro Lite, are based on ether Investor Owned Utilities (IOU) or CPUC Energy Division work papers or custom calculations developed by the BayREN Technical Assistance Provider. Custom measures are not modeled directly in EnergyPro for several reasons. For example, there are not direct inputs to model a specific measure such as low-flow fixtures and thermostatic radiator valves. Another reason is that the fixed assumptions defined in the Title 24 Alternative Calculation Methodology Manual ("Title 24 ACM") assume a level of efficiency better than existing conditions, which is the case with pipe insulation measure and domestic hot water pumping demand control measure.

BayREN provided the evaluation team with work papers and calculation tools for the measures listed below in Table 7.

Table 7: Custom Measures and Sources of Savings Calculations

Measure Category	Measure Description	Source of Savings Calculations	Analysis Tool
Domestic Hot Water	Update central hot water pump from no control to demand control	Work Paper Disposition for On-Demand Pump Control for Central Domestic Hot Water Systems. California Public Utilities Commission, Energy Division (March 2013)	Central DHW Pump to Demand Control - From no control to demand control.xlsx
Domestic Hot Water	Addition of pipe insulation to un-insulated hot water pipes	Custom engineering calculations developed by BayREN Technical Assistance Provider	Uninsulated Pipe Calculation (DHW)_v2.0(1).xlsx Uninsulated Pipe Calculation (Electric DHW)_v2.1.xlsx
Domestic Hot Water	Low-flow water showerheads and faucet aerators	Work Paper Disposition for Water Fixtures California Public Utilities Commission, Energy Division (March 2013)	Showerheads and Aerators.xlsx
Hot Water/Steam Heating	Thermal Expansion Valves (TRV)	Custom engineering calculations based on NYSERDA study.	TRV Calc.xlsx
Lighting	Lighting savings for interior and exterior lighting	Custom Calculation developed by BayREN to calculate existing wattage, proposed wattage, energy savings for kWh, kW, and therms accounting for interactive effects of heating and cooling system.	MF Custom Lighting Tool BayRENv5.4.2.xlsm
Appliances	Vending Machine Control	Work Paper WPSDGENRCS0001	Deemed savings
Appliances	Clothes Washers	Work Paper PGECOAPP120 Clothes Washers Multifamily Revision # 3	Clothes Washers Calculations.xlsx

3.1.6 Informational Data Requests

Throughout the course of this evaluation, the team reached out to REN representatives in both formal and informal conversations. These discussions provided insight into calculations, costs, and operations of the Multifamily Whole Building programs that were used to analyze various program aspects.

3.2 Analysis

This section outlines the various analysis methods used in the baseline assessment, free ridership estimation, consumption analysis, and calibrated simulation models.

3.2.1 Baseline Assessment

The early replacement battery in this effort was established in the 2013-2014 multifamily program evaluation,[15] and is based on research and lessons learned from a variety of evaluations, technical resource manuals, and the CPUC early replacement guidance document.[16] The ongoing challenge in early replacement evaluations is finding a balance between the data needed to assess a measure as early replacement, and those that can be reasonably collected during a telephone survey. To achieve that balance, the early replacement assessment was based on the following four metrics:

1) Working status of prior equipment
2) Age of prior equipment
3) Expected remaining life of prior equipment
4) Regularly scheduled/government-mandated upgrade schedule and policy.

Specifically, measures qualified for early replacement if they were *not* part of a regularly scheduled or government-mandated replacement and if they

- Replaced existing equipment
- Replaced equipment that was functional and in need of only minor repairs (if any)
- Replaced equipment with self-reported ≥2 years left on its expected life.[17]

Figure 2 and Figure 3 illustrate the two-tiered early replacement logic schemes. Note that windows, roofing, lighting, small hot water (e.g., faucet aerators and low-flow showerheads), demand controls, and insulation measures were assumed to be early replacement unless they

[15] As reported in 2013-2014 Multifamily Focused Impact Evaluation. CPUC. 2016.
[16] Programs in place in 2017 and beyond need also comply with CPUC rulings and guidance surrounding AB 802 and rulemaking 13-11-005, which prescribes appropriate baselines for varying sectors and measure types.
[17] Two years was chosen as the cutoff for remaining useful life because this cutoff is analogous to that often used for free ridership analysis. It is deemed a reasonable time frame to indicate short-term outlook relative to a less-certain mid- or long-term time frame.

were part of a regularly scheduled, planned, or government-mandated upgrade process (e.g., insulation).

The evaluation team assessed baselines at the measure level to account for the possibility that there could be measure level differences within each site (e.g., prior plans to replace one measure but not another), as well as across the population of participants. To derive a single, program-wide early replacement estimate for each measure, each project-level measure quantity was used to proportionally weight up to the overall sampled quantity for that measure (i.e., the early replacement proportions are savings weighted across the different sites).

Figure 2: Early Replacement Logic for Lighting, Small Hot Water, Roofing and Shell Measures

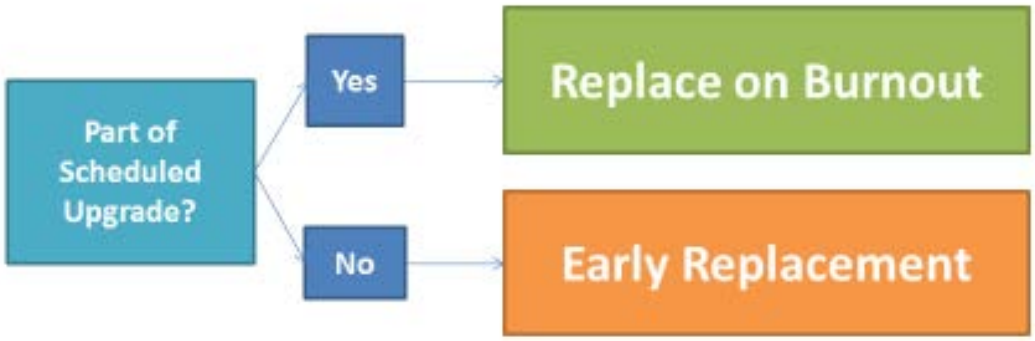
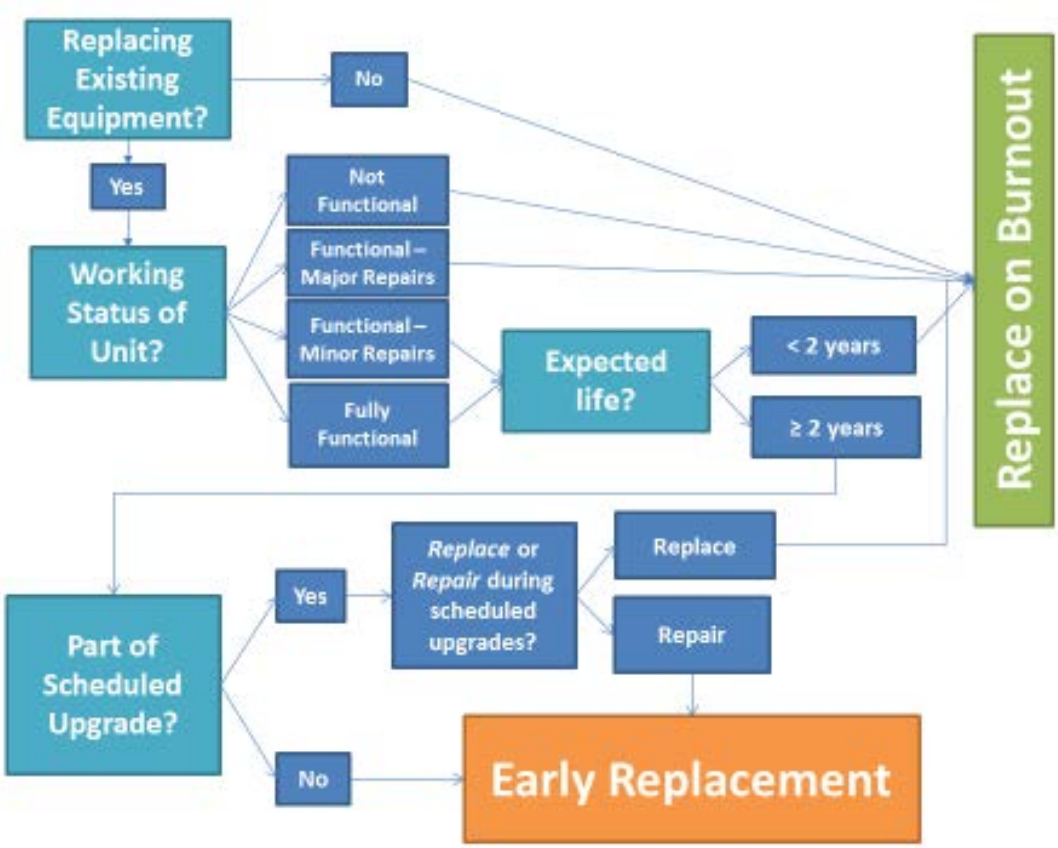


Figure 3: Early Replacement Logic for All Other Surveyed Measures



3.2.2 Free Ridership Estimation

The free ridership battery used in the participant survey was based on the CPUC Energy Division's framework.[18] It is important to note that this is a general framework meant to be adjusted for the individual program needs. The multifamily evaluation, therefore, modified the standards appropriately, particularly because multifamily projects represent a unique "crossroads" of residential and commercial decision making. The team believes that the modifications remain consistent with the intent of the framework.

The decision-maker survey questions were designed to measure the influence of the program on participant decisions to install program-eligible energy efficiency measure(s). Consistent with the framework, the surveys scored three different components of program attribution. The net of free ridership ratio was calculated as an average of these three attribution scores:

[18] Methodological Framework for Using the Self-Report Approach to Estimating Net-to-Gross Rations for Nonresidential Customers. Prepared for the Energy Division, CPUC by the Nonresidential Net-to-Gross Ratio Working Group. 2012.

1) The program attribution index 1 score (PAI-1) reflects the influence of the most important of the various program and program-related elements in the customer's decision to select the specific program measure at the time.
2) The program attribution index 2 score (PAI-2) captures the perceived importance of the program (whether rebate, recommendation, training, or other program intervention) relative to non-program factors in the decision to install the specific measure that was eventually adopted or installed. The program influence score was adjusted (i.e., divided by 2) if respondents said that they had already made their decision to install the specific program-qualifying measure before they learned about the program.
3) The program attribution index 3 score (PAI–3) captures the likelihood of various actions the customer might have taken at the time and in the future if the program had not been available (the counterfactual).

Survey respondents were divided into one of two groups: (1) those who believed that the decision-making process responses were applicable to all measures installed and (2) those who believed that the decision-making process was unique for each individual installed measure. For those respondents who believed that the decision-making process was unique for individual measures, the battery of questions was asked for each of three randomly selected measures for that project. For the respondents who indicated that their responses applied to all measures in the project, the free ridership value was applied to all measures within that project. Individual measure-level free ridership estimates were weighted to the single, program-level estimate using measure-level savings.

The free ridership battery also included consistency checks to ensure that answers to other survey questions were consistent with the program influence scoring. The consistency checks included the following:

1) If a respondent indicated that compliance with code or government mandated policy was/was not a reason they did the project but then scored this aspect low/high in the free ridership battery, respectively
2) If a respondent indicated that compliance with property owner or property management firm policy was/was not a reason they did the project but then scored this aspect low/high in the free ridership battery, respectively
3) If a respondent provided inconsistent responses between multiple questions (e.g., the respondent indicated that the rebate had a strong influence on why they did the project but then scored the likelihood that they would have installed the same equipment without the program (rebate) high: >7 on a likelihood scale from 0 [not at all likely] to 10 [extremely likely]).

Respondents were asked to give an open-ended response to the consistency check question, providing an opportunity to adjust the scoring from one or both of the questions that were inconsistent.

3.2.3 Consumption Analysis

The primary objective of the consumption analysis was to identify gas and electric consumption for each REN project to calibrate energy simulation models to actual, and not simulated, energy consumption. Ideally, the implementation project teams would have access to the actual billing data to calibrate reported building consumption and savings. The evaluation team in the 2013–2014 multifamily evaluation found that, with the notable exception of the SCE/SoCalGas programs, the RENs, IOUs, and their implementation contractors did not have a system in place that could capture the whole building consumption associated with all units and common areas of a multifamily building. To address this lack of whole building consumption data, the team collected meter numbers as part of the on-site verification activities. Once collected, the team performed a thorough quality control process to ensure the meters were correctly transcribed and assigned.

The evaluation team completed on-site data collection for 20 participant projects (see Section 3.1.2 for details), resulting in meter details captured for 19 REN sites. Because accounts may change over time, especially for multifamily housing, being able to identify meters allowed the team to connect all billing accounts associated with the static meters of a building. For all of the 19 multifamily sites, the team relied on the metering-to-billing data lookups as provided by DNV-GL (for residential meters) and Itron (for nonresidential meters).

The consumption analysis included electric and natural gas metering data from both residential and nonresidential billing systems. For any account associated with a meter that lacked residential consumption data, the team attempted to identify nonresidential consumption associated with this account through the Itron-maintained nonresidential consumption database. This was particularly important for high-rise properties, which are the most likely to be commercially (master) metered. Eight of the 19 properties included nonresidential billing data.

The team summarized monthly meter data for each site for both residential and nonresidential consumption information, allowing the team to assess the level of completeness for each month. For the residential consumption data, those buildings that had fewer monthly records than reported number of tenant units (based on non-zero consumption unit counts), the team took the average monthly consumption for those units with non-zero consumption and extrapolated this consumption to the expected total building units. Any common area or master metered “house” consumption was not adjusted, but added back in to the adjusted tenant unit total. This ensured that common meter consumption was applied correctly.

As a final step, the evaluation team compared the billing data annual consumption to the estimated annual consumption as defined within each project file. This step was completed for all 19 visited sites, as the team received all simulation or project files for these sites. Results from each of these steps are reviewed in the findings section.

3.2.4 Calibrated Simulation Models

As previously discussed, the evaluators utilized the energy models used for reported savings as a starting point for the calibrated modeling approach to calculating the evaluated gross savings. The evaluation team used the non-residential performance module to calculate evaluated savings for all projects.

The modeling process followed the following steps:

(1) First, the results from models used for reported savings were compared to the tracking data ex-ante savings and consumption data.
(2) Next, for the nine projects which used EnergyPro Lite for the analysis, the data were exported to the full version of EnergyPro. The evaluation team reviewed the model inputs for accuracy and results for accuracy or any potential anomalies for all twenty projects.
(3) After this, building characteristics and measure characteristics were updated in the model based on site conditions observed during on-site visits. The impact of these changes on program eligibility and energy savings was then examined.
(4) Then, for projects implementing custom measures, the evaluation team reviewed the spreadsheet calculations for accuracy and compared to the measure data collected on-site to the inputs and assumptions used in the analysis.
(5) Last, where identified as replace on burnout based on the early replacement/replace on burnout baseline assessment, the measure baseline efficiency was updated to Title 24 code baseline for the incented component (e.g., Title 24 climate zone based prescriptive window u-value and solar heat gain coefficient [SHGC values]) in the pre-retrofit non-residential performance. The impact of this on realization rates was then reviewed. This was the final run and at this point, the ex-post realization rates were reported.

In step one, the ex-ante models were re-run to verify whether the results match the tracking savings and REN documentation to assess the ex-ante reporting accuracy. In most cases, the modeled kW savings did not match the tracking data due to custom measure calculations. Specifically, custom measures are input on the alternatives tab of EnergyPro which does not have an input for kW savings. Therefore, if any custom measures were implemented in a project, the evaluation team reviewed the calculations for claimed energy and kW savings to determine if that was the cause of discrepancy between tracking kW savings and modeled kW savings.

In the second step of the process, for projects which BayREN used only EnergyPro Lite, the full version EnergyPro bld file was exported. The evaluation team than reviewed all twenty projects in detail using the full version of EnergyPro to gain insight into the results and summarize key model inputs including:

- Total conditioned floor area and number of dwelling units
- Roof areas, floor areas, exterior walls and windows by floor area and orientation
- Construction assemblies and window performance values
- HVAC system types, efficiencies, capacities, fan flow rates and fan power
- Domestic hot water system type and efficiency
- Lighting and miscellaneous loads
- Schedules and occupancy assumptions.

The evaluation team summed the modeled conditioned floor area by floor level, exterior walls and windows by orientation and floor level, roof area, and exterior floors/slab on grade perimeter taken directly from the EnergyPro files exported from EnergyPro Lite. The team next compared these modeled values to in situ measurements taken by the evaluation surveyors. Data collected on site were compared to the EnergyPro files for major discrepancies in inputs, such as HVAC system type (e.g., wall furnace or central furnace), missing HVAC fan flow capacities, construction assemblies (e.g., attic frame roof or cathedral roof), or conditioned floor differences more than ten percent. Appendix D includes full summaries of these reviews for each project along with the in-situ values collected by the evaluation surveyors. The most pertinent findings are discussed in Section 4.4

The third step was to update the models with any site changes for differences in building characteristics or measure discrepancies verified on site and summarized in step two. The evaluation team updated the ex-ante energy models with the site verified wall and window areas for all projects since a goal of the evaluation was to understand the impact of the simplified geometry approach implemented with EnergyPro Lite.

The evaluation team's sample design plan was to access approximately 14% of dwelling units to survey lighting, appliance, heating, cooling, and water heating equipment. However, in many projects, this goal was not achieved due to tenant and property manager survey fatigue from multiple touches during the REN audit and test-out verification.

The fourth step, for projects implementing custom measures, was to review these calculations for overall reasonableness, project specific accuracy and appropriate implementation.

The fifth and final step was to adjust the existing condition baseline to the Title 24 code requirement for measures identified as replace on burnout during the phone survey. For

example, the U-values and SHGC for windows in the pre-retrofit model were adjusted from the single-pane default to the Title 24 window alteration prescriptive requirements.[19]

[19] Single paned metal default values are 1.2 u-value and 0.80 SHGC. 2013 Title 24 Prescriptive requirements are 0.32 u-value and 0.25 SHGC for most climate zones.

4 Findings

This section includes findings from each of the primary evaluation objectives.

4.1 Baseline Assessment

The energy models provided by the RENs assumed existing conditions as the baseline for *all* whole building projects. Because the REN tracking database included the replacement status (the database field was titled "MeasAppType"), the evaluation team compared the tracking database-assigned baseline conditions to the baselines used in the models provided by the RENs. Table 8 shows each REN assigned whole building project baselines. Each REN assigned projects differently, with SoCalREN assigning 100% of projects as early replacement, while BayREN designated projects between replace on burnout (73%) and early replacement (27%).

Table 8: Reported Baseline, Whole Building Tracking Database

Program Administrator	Early Replacement	Replace on Burnout	Total
BayREN	63	171	234
SoCalREN	12	0	12
Total	*75*	*171*	*246*

Despite what the tracking database reports, existing conditions were the baseline used in the energy models used to calculate energy savings.

The evaluation team divided the baseline analysis into two distinct groups based on the end-use: shell and small hot water measures in the first group, and all other measures in the second. A detailed description of the factors underpinning this logic is included in the analysis discussion in Section 3.2.1.

Measures replacing equipment that was either fully functional or in need of only minor repairs could qualify for early replacement depending on the age and remaining useful life of the equipment and whether the installation was part of a scheduled or mandated upgrade. Table 9 reports measure baselines determined by the evaluation team based on feedback of 73 participants. Each participant was asked the early replacement battery for up to three measures. Two respondents only had one measure installed and 10 (of 73) had two measures installed, so there was a total of 205 measures reported on in the early replacement analysis.

Table 9: Evaluated Baseline, by Measure Category

Measure Category	Measures	% Early Replacement	n =
All Others	Pool pump, pool cover, HVAC repair, furnace	33%	6
Appliances	Clothes washer, dishwasher, refrigerator, vending machine	60%	20
Large hot water	Demand control, pipe insulation, storage tankless water heater, boiler controls, water heating boiler, thermostatic radiator valve	55%	79
Lighting	Indoor and outdoor CFLs and LEDs	72%	25
Shell	Attic/roof insulation, floor and wall insulation, windows	71%	35
Small Hot Water	Showerheads and aerators	78%	40

The results of this analysis demonstrate that program measures were a mix of both early replacement and replace on burnout. For example, 40% of appliances were replace on burnout instead of early replacement. Conversely, 78% of small hot water measures (showerheads and aerators) qualified as early replacement. The results in Table 9 show evidence that not all measures are early replacement (which was the baseline used in the energy models).

Table 10 breaks down responses by measure baseline assignments that determined ROB. While the majority of measures qualified for ER, there were 69 (of 205) measures that were evaluated as ROB. ROB baselines were determined by one of three aspects, according to the logic discussed above. Thirty-one measures were determined to be ROB based on the fact that the measure installed was part of a scheduled upgrade, 31 measures were determined to be ROB since the equipment replaced was either not functional or in need of major repairs, and seven measures had a Remaining Useful Life (RUL) less than 2 years, which determines ROB.

Table 10: Response Categories that Determined ROB

Baseline	Determining ROB Aspect	Measure Count
ROB	Measure was part of a scheduled upgrade	31
ROB	Replaced equipment was not functional or in need of major repairs	31
ROB	Replaced equipment RUL <2 years	7
ER	n/a	135

4.2 Free Ridership Estimation

To report on program free ridership, this section first provides a high-level summary of the overall program-level results and then covers the three primary components that comprise the

free ridership battery. This will help the reader understand the driving factors behind the free ridership results. A more detailed review of the findings, including utility-level and measure-level results, follows.

In all, 73 whole building respondents took part in the survey, with all 73 being able to complete all at least one subcomponent of the free ridership section (73 completed the first subcomponent, 65 completed the second and 73 completed the third). The majority of these (54 of 73) noted that their responses were indicative of all the installed measures, so that they did not have to provide measure-specific free ridership responses. For the 19 respondents that did provide measure-level free ridership responses, an overall free ridership value was based on weighted measure-level free ridership values. Overall net of free ridership for the REN Whole Building program was 1.1% based on a fuel-neutral Btu status. The three equally weighted components that comprise the free ridership estimate are shown in Table 11. The details behind these estimates follow the table.

Table 11: Three Subcomponents and Overall Free Ridership

PAI-1 (Influence)	PAI-2 (Relative Importance)	PAI-3 (Install Same Equipment)	Overall Net of Free Ridership	Free Ridership Precision (90%)
52.2%	43.1%	58.1%	51.1%	±2.7%

Note that the application of these results should be used with caution because they were specific to the 2013-2015 Multifamily Whole Building program. As the program measure mix, incentive levels, or outreach/intervention strategies change, the free ridership may also change. As a result, additional research is warranted to ensure that the proper attribution is applied to the program and its associated measures. In addition, the research reported here is free ridership (as noted in Section 3.2.2), and does not include spillover.

Influencing Factors (PAI-1)

Using a 0 to 10 rating scale, where 0 means “not at all important” and 10 means “very important,” program participants were asked to rate the importance of several program and non-program influences on the decision to install a measure. Respondents reported the availability of the REN rebate was more important than the payback or return on the project (Table 12). These responses fed into the PAI-1 score.

Table 12: Influences on Installation Decisions

Influence on Decision	Type of Influence	Average Importance Score
Availability of the [REN] Rebate	Program	8.1
Payback or Return on the Project	Program	7.8
Feasibility Study, Energy Audit, or Other Types of Technical Assistance Provided by the Program	Program	7.3
Information from Program or Utility Training Course	Program	7.1
Previous Experience with the [REN] Program	Program	6.7
Previous Experience with This Type of Project	Non-program	6.7
Increased Value of Property	Non-program	6.7
Utility Account Representative	Program	6.6
Recommendation from an Equipment Vendor	Non-program	6.1
Age or Condition of the Old Equipment	Non-program	6.0
Compliance with Company's Normal Maintenance Policies	Non-program	5.8
Compliance with City, State, or Federal Regulations	Non-program	5.8
Program Marketing Materials	Program	5.8

The PAI-1 score rates program influence as it relates to non-program influences. Specifically, this score is calculated as the maximum program influence score divided by the sum of the maximum program and non-program influence score, or

$$PAI1 = \frac{Program_{Max}}{Program_{Max} + Nonprogram_{Max}}.$$

Since respondents rated the non-program influences just as important than those of the program, the PAI-1 score was 0.522, or 52.2%.

The evaluation team also wanted to ensure that savings were not degraded both for early replacement and free ridership in instances where company policy (or perhaps scheduled maintenance) influenced decision making. To do this, the team performed a sensitivity analysis around the influence of a company's normal maintenance policies on the PAI-1 score and found

that removing that influence rating changed the calculated PAI-1 score by only a fraction of a percentage (the PAI-1 score increased to 52.3%).

Relative Importance (PAI-2)

For the PAI-2 score, respondents were asked about the relative importance of program and non-program influences on their decision to install a particular measure. More respondents (n = 26) ranked the importance of program influences as higher than that of the non-program influences (n = 20). Nineteen respondents rated the program influences and non-program influences as equally important. Looking more closely at the comparison of the ratings, six respondents gave the program score 100% compared to only four respondents who gave a non-program score of 100%. Furthermore, because the free ridership analysis was savings weighted, some of the higher-savings projects gave the program-based influences higher scores. The PAI-2 score is the respondent-provided importance of the program to their decision-making process (Table 13).

Table 13: Relative Importance of Program and Non-Program Influences on Installation Decision

Relative Importance of Factors	Count of Responses (n = 65)
Ranked Program Influences More Important than Non-Program Influences	26
Ranked Program and Non-Program Influences Equally Important	19
Ranked Non-Program Influences More Important than Program Influences	20

Respondents were also asked if they had learned about the program before or after deciding to install the equipment. A response of "after" decreases the measure's PAI-2 score by half because they were already planning to install the measure before any program intervention. Slightly less than one-sixth of all of respondents (16%) indicated that they had learned about the program after deciding to install the equipment. The average PAI-2 score after the adjustment was 0.431, or 43.1%.

Likelihood of Installing Same Equipment (PAI-3)

The final component of free ridership, PAI-3, is related to what equipment would have been installed if the program were not available. Using a likelihood scale from 0 to 10, where 0 is "not at all likely" and 10 is "extremely likely," respondents were asked the likelihood of installing the same efficiency equipment if the REN program were not available. The higher the likelihood of installing the exact equipment, the higher the free ridership and the lower the net of free ridership. Respondents, on average, provided a moderate likelihood of installing the same efficiency equipment in absence of the program, with an average savings-weighted likelihood

score of 4.19, resulting in a PAI-3 score of .581, or 58.1%. A review of the respondent likelihood of installing the same equipment is included in Table 14.

Table 14: Likelihood of Installation of Same Equipment

Likelihood of Installing (0 = not at all likely, 10 extremely likely)	Count of Responses (n = 44)
Likelihood Scores	
Likelihood above 5	27
Likelihood equal to 5	7
Likelihood below 5	38
Extreme Scores	
Extremely likely (10)	16
Not at all likely (0)	11

4.3 Consumption Analysis

As noted previously, the RENs were directed to begin capturing meter numbers for participant sites in 2015. As part of this analysis, the evaluation team compared meter numbers collected by the RENs to those collected by the evaluation team. Of the 82 sites where BayREN collected meter numbers, five overlapped with evaluated sites. The evaluation team, therefore, performed a high level comparison of the meters collected by the two teams for these five sites. The meter numbers collected by the evaluation team were significantly more comprehensive than those collected by BayREN. Specifically, BayREN reported 54 meter numbers for the five evaluated sites, while the evaluation team collected 168 meter numbers at those same sites. The REN meter number collection efforts need to be more comprehensive should future Multifamily Whole Building programs utilize meter numbers to link to consumption.

As noted in the analysis section, the evaluation team relied on the site-collected meter numbers and the associated DNV-GL and Itron customer billing database to access consumption information at participant projects. However, not all of the collected meter numbers linked to the customer billing databases, with the common areas showing a lower linkage rate relative to the tenant units. A summary of the number of electric and gas meters collected and the number of electric and gas meters linked to billing information at each site is summarized in Table 15.

Table 15: Multifamily Whole Building Meter Identification Summary

Meter-linkage Status	# Projects	# Units	Number of Meters Collected On-site	
			Total # Meters Collected On-site (Unit / Common)	Total # Meters Linked (Unit / Common)
Electric Meters				
100% Collected, 100% linked	9	142	142 / 11	142 / 11
100% Collected, incomplete linked	10	447	447 / 17	401 / 3
No meter data available	1	36	0 / 0	0 / 0
Gas Meters				
100% Collected, 100% linked	6	343*	32 / 7	32 / 7
100% Collected, incomplete linked	9	90	89 / 0	42 / 1
No meter data available	5	58	0 / 1**	0 / 0

**Note that only one of the six sites had unit gas meters, the remaining five only had common area (single) gas meters.*

***A single gas meter was collected for one of the five sites but no linkage to billing data was available.*

Unlike the research in the 2015 IOU Multifamily Whole Building evaluation[20], on-site meter identification was successful for nearly all of the electric meters during REN site visits; only one site did not result in collected electric meters. In the IOU research, there were inaccessible meter numbers and sites where meters did not have an identifying apartment number. The team attempted to look up all accounts and consumption data based associated with each collected meter; unfortunately, not all meters linked to billing information. Because of this, the team expanded the search for consumption information, and attempted to link meters, premise numbers, and addresses within the billing database in an attempt to append the incomplete project consumption. Even with the expanded search, there were gaps within over half of the sampled properties (10 out of 19). Using one REN site as an example, the on-site team collected six dwelling area and 1 common area electric meter numbers. The data team could only find consumption for four units and zero common areas at that property, even with the extensive search of the meter numbers, premise numbers, and addresses. Additionally, the billing data had large gaps during the pre-installation period (2012–2014), where the billing records were blank (no data recorded for that meter-month).

To further complicate the consumption analysis, there were instances across the buildings whereby the on-site data collection team had a meter assigned differently than the billing system. The on-site data, based on labels placed next to the meter number, would be listed as common or

[20] 2015 Multifamily Focused Impact Evaluation – Draft. California Public Utilities Commission. April 3, 2017.

"house" meter, and yet the utility billing system had this meter designated as tenant/unit meter (and vice versa). The team could not extrapolate missing common areas because some common area of house meters are tied to different end uses and there was too much uncertainty to be able to account for missing common area meters.

The evaluation team had planned to receive fully populated historical billing data across the billing period of interest (2012–2015) using the meter numbers as the direct link over time. However, the consumption gaps within the billing data proved too extensive; the evaluation team could not confidently calibrate simulation models to this incomplete consumption information. The evaluation team recommends that the RENs collaborate with the IOUs for each project to collect and maintain project level consumption information for participant projects prior to appropriating funds (See Section 5 for additional details on this recommendation).

Billing to Model Consumption Comparison

The evaluation team compared consumption calculated by the EnergyPro simulation model to the consumption calculated by linking meters, premise, and address information to REN project billing data. Due to the significant gaps discussed above, the team took several steps to adjust the billing data to attempt to fill in the missing data. These adjustments and results are discussed below.

For the residential consumption data, those buildings that had fewer monthly records than reported number of tenant units (based on non-zero consumption unit counts), the team took the average monthly consumption for those units with non-zero consumption and extrapolated this consumption to the expected total building units. As an example, if a site had 24 units but only 20 meters had complete consumption data, the whole building received the average per unit consumption across the 20 units and this average was applied to the 24 total units. Common areas metered consumption data was not adjusted, but added back in to the adjusted tenant unit total.

After completing these steps and generating the estimated consumption for each site, the evaluation team compared the billing-data estimated annual consumption to the EnergyPro model calculated consumption and generated a corresponding ratio (model calculated consumption as a percentage of actual evaluated billing-data based consumption). Table 16 reviews the electric savings comparisons. As the summary shows, a larger percentage of the 19 sites had meter-based annual consumption that was lower than the anticipated modeled consumption (average of 72% for those with 100% match and linkages and 83% for those with incomplete linkages). The remaining six sites showed higher meter-based consumption from the modeled, averaging 110% for those sites with full linkages and 126% for sites with incomplete linkages.

Table 16: Multifamily Whole Building Annual Electric Consumption Comparison

Criteria	Number of Sites in Category	Modeled Annual kWh Consumption	Evaluated Billing-Based kWh Consumption	Evaluated as % of Modeled kWh Consumption
100% linked sites with billing consumption < modeled	7	575,670	414,231	72%
100% linked sites with billing consumption > modeled	2	87,601	96,217	110%
Incomplete linked with billing consumption < modeled	6	2,290,371	1,896,462	83%
Incomplete linked with billing consumption > modeled	4	430,055	539,783	126%

Sources: Modeled annual kilowatt-hour consumption from audit project files; Evaluated billing-based kilowatt-hour consumption generated based on meter data collected on site and meter matches, and extracted from PA billing data stored and managed by Itron;

The evaluation team also compared the billing-data estimated annual natural gas consumption to the EnergyPro model calculated consumption and generated corresponding consumption ratios (evaluated billing consumption as a percentage of modeled consumption). Table 17 reviews the natural gas consumption comparisons. As the table shows, the gas billing data were considerably less consistent than the electric billing data, with widely varying billing-based consumption relative to the modeled values. Additionally, there were four sites that lacked billing data linkages to evaluate the projects.

Table 17: Multifamily Whole Building Building Annual Natural Gas Consumption Comparison

Criteria	Number of Sites in Category	Modeled Annual Therm Consumption	Evaluated Billing-Based Therm Consumption	Evaluated as % of Modeled Therm Consumption
100% linked sites with billing consumption < modeled	1	27,592	19,314	70%
100% linked sites with billing consumption > modeled	5	35,737	67,391	189%
Incomplete linked with billing consumption < modeled	7	38,351	10,672	28%
Incomplete linked with billing consumption > modeled	2	4,987	9,466	190%
No gas billing links	4	NA	NA	NA

Sources: Modeled annual therm consumption from audit project files; Evaluated billing-based therm consumption generated based on meter data collected on site and meter matches, and extracted from PA billing data stored and managed by Itron;

Across all 100% linked sites, on a fuel-neutral Btu consumption basis, the modeled annual consumption was 82.5% of the evaluated billing-based consumption, showing that the modeled consumption values were conservative estimates used for these sites. For this analysis, the electric meter-based consumption results closely aligned (within 10%) with the anticipated

modeled consumption for only one-fourth of the sites, while only one of the gas projects was within 25% of the simulated gas consumption. To help explain some of this disconnect, EnergyPro Lite simulation models assume all cooking load is electric, even if the site uses gas cooking appliances, to factor into internal heat gain interactive calculations. This modeling assumption may contribute to some, but not all, of the higher billing-to-modeled electric versus lower billing-to-electric gas consumption ratios reviewed above.

Given the challenges noted previously—the uncertainty around the meter label-assigned versus the billing system assigned location, the attrition of meters during the meter-to-billing system lookup, the lower count of house or common meters collected than anticipated, and the lack of fully populated pre-installation billing data—the evaluation team cannot definitively say whether the difference between the meter-generated consumption and the modeled consumption is due to inaccurate billing-data matching or incorrect model-generated savings estimates. Ultimately, the evaluation team selected to utilize the reported estimated consumption from the simulation models rather than the estimated consumption from the evaluated consumption analysis.

4.4 Calibrated Simulation Models

This section of the report presents findings on gross savings estimates by site for kWh, kW, and Therms along with a summary of the changes to the models based on site verification of measures and building characteristics impacting the results. A discussion on the evaluation team's assessment of EnergyPro Lite modeling approach and assumptions is also in this section.

Table 18, Table 19, and Table 20 report on the savings at each step in the evaluated evaluation process and the resulting gross realization rates. The first column is the site ID. The second column presents the annual savings from the CPUC tracking data. The third column reports annual savings based on changes made to the models based on measure verification and/or differences in observed building characteristics including. This third column includes all wall and window area changes, to test the impact of the EnergyPro Lite simplified geometry approach. The fourth column reports the annual savings for the final evaluated calculation, accounting for baseline adjustments (discussed in Section 4.1). The last column lists the realization rates, which were developed by comparing reported savings to the results from the final run, accounting for site and baseline adjustments as run in the non-residential performance module.

Table 18: Multifamily Whole Building Annual Kilowatt-Hour Savings at Steps in the Modeling Process

Site	Reported kWh Savings	Evaluated Annual kWh Savings – Actual Wall and Window Areas + Site Changes	Evaluated Annual kWh Savings – Actual Wall and Window Areas + Site Changes + Code Baseline	kWh Realization Rates
80015	8,657	7,102	7,102	82%
80114	34,402	23,472	23,472	68%
80290	1,953	2,053	2,053	105%
80365	20,302	21,912	10,691	53%
80382	9,475	2,657	2,657	28%
80399	4,675	3,226	3,226	69%
80424	6,840	6,906	6,906	101%
80447	4,930	10,325	7,907	160%
80540	13,882	15,420	15,420	111%
80668	(1,499)	(1,666)	(1,666)	111%
80892	4,331	4,640	4,640	107%
80921	1,480	1,644	1,644	111%
81403	11,372	10,315	10,315	91%
81768	1,559	1,732	1,732	111%
83048	590	630	630	107%
83234	50,900	55,206	55,260	109%
83311	203,678	226,309	226,309	111%
83482	10,166	5,926	5,926	58%
84949	5,393	5,152	5,152	96%
80479	747	747	830	111%
Total	*393,831*	*403,708*	*390,206*	*99%*

Table 19: Multifamily Whole Building Annual kW Savings at Steps in the Modeling Process

Site	Reported kW Savings	Evaluated Annual kW Savings – Actual Wall and Window Areas + Site Changes	Evaluated Annual kW Savings – Actual Wall and Window Areas + Site Changes + Code Baseline	kW Realization Rates
80015	0	5.3	5.3	NA
80114	4	2.8	2.8	69%
80290	0.2	0.1	0.1	30%
80365	4.4	5.1	1.2	28%
80382	2	0.7	0.7	33%
80399	1.7	0.8	0.8	48%
80424	0.6	0.5	0.5	87%
80447	0.3	0.3	0.3	93%
80540	1.2	0.1	0.1	6%
80668	0.1	0.1	0.1	60%
80892	0.4	0.5	0.5	130%
80921	0	0.2	0.2	NA
81403	5	4.6	4.6	92%
81768	0.4	0.4	0.4	88%
83048	0.1	0.1	0.1	80%
83234	5.8	6.8	6.8	117%
83311	19.5	21.7	21.7	111%
83482	0	0.7	0.7	NA
84949	0.1	2.9	2.9	2940%
84979	0.1	0.1	0.1	100%
Total	*45.8*	*53.6*	*49.7*	*109%*

Table 20: Multifamily Whole Building Annual Therm Savings at Steps in the Modeling Process

Site	Reported Therms Savings	Evaluated Annual Therm Savings – Actual Wall and Window Areas + Site Changes	Evaluated Annual Therm Savings – Actual Wall and Window Areas + Site Changes + Code Baseline	Therm Realization Rates
80015	1,783	1,043	1,043	58%
80114	936	1,040	1,040	111%
80290	866	419	419	48%
80365	156	173	173	111%
80382	260	258	258	99%
80399	76	52	52	68%
80424	1,364	501	501	37%
80447	1,309	1,145	857	65%
80540	231	279	279	121%
80668	2,164	2,349	2,349	109%
80892	533	592	592	111%
80921	620	551	551	89%
81403	480	409	409	85%
81768	503	417	417	83%
83048	665	495	495	74%
83234	1,025	1,139	1,139	111%
83311	561	622	622	111%
83482	2,738	3,042	3,042	111%
84949	520	577	577	111%
84979	708	708	791	112%
Total	*17,496*	*15,811*	*15,606*	*89%*

Appendix D summarizes the energy efficiency measures implemented for each project and the findings verified on-site for each project. Appendix F summarizes the site adjustments to the models based on site verification findings for both building characteristics and measures.

EnergyPro Lite Simplified Geometry Approach

An objective of this evaluation was to test the impact of implementing the simplified geometry approach EnergyPro Lite utilizes to distribute floor area, wall area, and window area across all floors and orientations on program eligibility and energy savings. Surveyors collected data on wall and window area by orientation and floor, and coupled with photos and on-line mapping tools using the three dimensional view, the evaluation team update the floor and exterior surface areas in the ex-ante models. This was the first step in updating the models with site verified building characteristics and measure characteristics. Details on the wall and window area differences between the EnergyPro Lite simplified geometry assumptions and actual building shape, wall area, and window area impact program eligibility and energy savings are provided in Appendix E.

Five of the projects, or 25% of the sample size, fall below the program eligibility requirements of exceeding projected existing energy consumption by at least 10% when the actual wall and window area is used instead of simplified geometry. However, energy savings in some projects did not change drastically and, in some cases, increased. Actual window to wall ratios in the buildings is significantly lower than the 35% window wall to ratio assumed.21 Building aspect ratios of buildings included in the sample are significantly different than the EnergyPro Lite square building assumptions, resulting in significant more exterior wall area and "slab on grade" perimeter. In most, if not all, the verified perimeter was greater than the reported model due to different aspect ratios or building geometries. Ten-foot wall height assumption is also likely inflating the total window area as the evaluation surveyors typically verified nine foot ceilings/walls.

Five of the twenty sites have HVAC systems with supply fans and the other fifteen sites used radiant systems or gravity wall furnaces without supply fans. For the five projects with HVAC fans, EnergyPro Lite modeled the HVAC fans as continuous, or operating continuously all hours of the day, as opposed to an intermittent control typical of residential HVAC systems which causes the system to cycle on and off as temperature in the space falls outside of the thermostat settings. A review of the results for these five projects, which also installed weather dependent measures, indicated there were no fan energy savings when they would be expected with reduced heating and cooling loads from implementing efficient HVAC equipment or envelope improvements. Additionally, all models had zero ventilation air included on the model, whether from natural infiltration of mechanical ventilation, which appears to impact the modeled heating and cooling loads. In this scenario, heating and cooling loads are attributed the envelope components only, potentially impacting energy savings estimates. For example, the roof insulation measure for site 80424 was predicting to save 17.1% of existing site energy consumption. Upon closer inspection, this measure was predicted to save 54% of existing heating energy consumption even though the roof conductive heating load is approximately 25%

[21] According the BayREN Technical Memo, this assumption is based on recommendations from implementers of the PG&E California New Homes Program

of total heating load (per the DOE2 output report). Adding in the high-rise residential default ventilation rate of 30 cfm/occ to the model, and setting the fan control to intermittent, the roof insulation measure saves 8% of heating energy which is a more reasonable savings estimate. Therefore, the evaluator changed ventilation rate to 30 cfm/occ and fan control to intermittent for all projects to account for account for some ventilation air and fan control typically used in residential HVAC systems. The interaction between ventilation air, infiltration, and HVAC fan control appears to an area where the multifamily programs can collect more detailed information during the auditing phase to improve model accuracy.

Measure Mix Assessment

Reported savings heavily relied on the custom calculations. Of the seventy-nine measures implemented in the twenty sample sites, fifty-two were custom measures and twenty-seven were measures directly modeled in EnergyPro. Two projects installed only custom measures only; EnergyPro Lite model was used only to estimate existing energy consumption and determine if the project met program eligibility requirements (Table 21).

Table 21: Modeling Approach and Measure Mix Summary

Site ID	Modeling Approach	Custom Measures
80015	EnergyPro for roof insulation and floor insulation	none
80114	EnergyPro Lite for custom measures only	1. Heating hot water pipe insulation 2. Parking garage lighting and hallway and stairs lighting 3. Domestic hot water recirculation controls
80290	EnergyPro for roof/attic insulation + custom measures	1. Aerators 2. Lighting 3. Clothes washers
80365	EnergyPro for windows + custom measures	1. Exterior lighting 2. Aerators
80382	EnergyPro Lite for windows + custom measures	1. custom lighting 2. Showerheads and aerators 3. Pipe insulation
80399	EnergyPro for windows, HVAC system + custom measures	1. Exterior and laundry room lighting 2. Domestic hot water pipe insulation
80424	EnergyPro for attic insulation, windows, + custom measures	1. Lighting - exterior, parking garage, common area
80447	EnergyPro Lite for windows + custom measures	1. Lighting 2. Piping insulation 3. Heating hot water supply temp outdoor air reset control
80540	EnergyPro for windows, wall insulation, floor insulation + custom measure	1. Interior and unconditioned common area lighting
80668	EnergyPro Lite for domestic hot water, appliances + custom measures	1. Exterior lighting 2. low-flow fixtures 3. Hot water pipe insulation 4. TRV's 5. Addition of domestic hot water recirculation pump (kWh penalty)
80892	EnergyPro for domestic hot water, appliances + custom	1. Low flow fixtures 2. Lighting

Site ID	Modeling Approach	Custom Measures
80921	EnergyPro Lite for domestic hot water + custom	1. Pipe insulation 2. TRV's 3. LED lighting
81403	EnergyPro for windows + custom	1. Low-flow fixtures 2. Dwelling unit lighting 3. Dishwasher (Database for Energy Efficiency Resources)
81768	EnergyPro for windows, appliances + custom measures	1. Exterior lighting 2. Aerators 3. Domestichot water recirculation control
83048	EnergyPro Lite for windows + custom measures	1. Exterior lighting 2. Aerators
83234	EnergyPro for appliances, pool pump + custom measures	1. Exterior and common area lighting 2. Showerheads and aerators 3. Pipe insulation 4. Dishwashers 5. Clothes washers
83311	EnergyPro Lite for domestic hot water boilers + custom	1, Garage lighting 2. Exterior lighting 3 Dwelling unit lighting 4. Spa cover
83482	EnergyPro Lite for custom measures only	1. Lighting 2. Piping insulation
84949	EnergyPro Lite for windows + custom measures	1. low-flow fixtures 2. Domestichot water demand control pumping 3. Domestic hot water pipe insulation
84979	EnergyPro for domestic hot water, refrigerator + custom measures	1. Low-flow fixtures 2. Boiler pump removal (2-model) 3. Domestic hot water pipe insulation

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4.5 Evaluated Savings and Realization Rates

As seen in the realization rates, evaluated energy, demand, and therm savings values were relatively similar to reported values. The EnergyPro Lite simplified geometry methodology commonly overestimated savings compared to the savings and consumption modeled with actual on-site conditions. Of the 20 projects evaluated, the evaluation team found 14 had reduced savings when modeled with actual window and wall characteristics; two sites saw increased savings and four projects were not impacted by the change.[22] However, changes to measure

[22] See Appendix E for details on this.

characteristics often mitigated these impacts.[23] The resulting evaluated gross realization rates were 99% for energy (kWh), 109% for demand (kW) and 89% for natural gas (therms) (Table 22).

Table 22: Multifamily Whole Building Reported and Evaluated Gross First Year Savings Values, Sampled Sites

Savings	Reported	Evaluated	Realization Rate
kWh	393,830	390,207	99%
kW	46	50	109%
Therms	17,495	15,606	89%

The team applied these gross realization rates, by fuel type, to the program savings claims to calculate evaluated savings values for each REN Multifamily Whole Building program (Table 23).

Table 23: Multifamily Whole Building Reported and Evaluated Gross First Year Savings Values, All Sites

REN	kWh			kW		
	Reported	Evaluated	Realization Rate	Reported	Evaluated	Realization Rate
BayREN	6,445,608	6,386,299	99%	629	683	109%
SoCalREN	1,627,671	1,612,694	99%	592	642	109%
Totals	*8,073,279*	*7,998,993*	*99%*	*1,221*	*1,325*	*109%*

REN	Therms		
	Reported	Evaluated	Realization Rate
BayREN	455,485	406,300	89%
SoCalREN	59,619	53,182	89%
Totals	*515,104*	*459,482*	89%

Additionally, the team applied the evaluated net of free ridership estimate (51.1%; Table 11) to the evaluated gross savings, resulting in the net realization rate in Table 24.

[23] Including changes to measure characteristics results in approximately half the sites over-estimating savings and half under-estimating savings.

Table 24: Multifamily Whole Building Reported and Evaluated Net First Year Savings Values, All Projects

REN	kWh (net)			kW (net)		
	Reported	Evaluated	Realization Rate	Reported	Evaluated	Realization Rate
BayREN	5,478,767	3,263,399	60%	535	349	65%
SoCalREN	1,383,520	824,087	60%	503	328	65%
Totals	*6,862,287*	*4,087,486*	*60%*	*1,038*	*677*	*65%*

REN	Therms (net)		
	Reported	Evaluated	Realization Rate
BayREN	387,162	207,619	54%
SoCalREN	50,676	27,176	54%
Totals	*437,838*	*234,795*	*54%*

Statewide, the 2013-2015 Multifamily Whole Building REN programs achieved 36% of their energy savings goals, 21% of their demand goals, and 43% of their therm goals (Table 25).

Table 25: Multifamily Whole Building Program Evaluated Gross Energy Savings and Goals by Program Administrator

REN	kWh			kW			Therms		
	Goal	Evaluated	% of Goal	Goal	Evaluated	% of Goal	Goal	Evaluated	% of Goal
BayREN	4,813,203	6,386,299	133%	770	683	89%	481,328	406,300	84%
SoCalREN	17,663,638	1,612,694	9%	5,670	642	11%	583,558	53,182	9%
Totals	*22,476,841*	*7,998,993*	*36%*	*6,440*	*1,325*	*21%*	*1,064,886*	*459,482*	*43%*

It cost the RENs between $798 and $874, on average, to save one MMBTU of energy during the 2013-2015 implementation years (Table 26). In comparison, the IOUs spent an average of $3,194 to save one MMBTU of energy in their multifamily whole building program during the 2015 program period.[24]

[24] 2015 Multifamily Focused Impact Evaluation – Draft. April 3, 2017. California Public Utilities Commission. Note the IOU $/MMBTU estimate is for one year only.

Table 26: 2013- 2015 Multifamily Whole Building Program Spending and Evaluated Btu Savings by Administrator

REN	Multifamily Whole Building	
	Spending	$/MMBTU
BayREN	$20,622,092	$798
SoCalREN	$5,274,845	$874
Total	$25,896,937	

Lifecycle Savings

Changes to the effective useful life values impact lifetime savings for a measure or project; lifetime savings reflects energy savings expected for the duration of a product's service. Specifically, this metric accounts for the longevity of a product, not only the savings from the first year of installation. BayREN assumed an 18 year effective useful life for all projects (reported). SoCalREN assumed a variety of effective useful lives.[25] The evaluation team has adjusted measure level EULs to reflect deemed effective useful life/remaining useful life values provided by Database for Energy Efficiency Resources, using the methodology described below.

The evaluation team calculated the lifecycle savings for each measure within the sampled Multifamily Whole Building projects using effective useful life and remaining useful life values from the Database for Energy Efficiency Resources, measure unit energy savings using existing conditions as the baseline (UES_1), and measure unit energy savings using code as the baseline (UES_2). For early replacement measures, the UES_1 is used for the 1st one third of the effective useful life and the UES_2 for two thirds of the effective useful life. The measure lifecycle savings were than summed to calculate the project lifecycle savings. This method is consistent with the recommended effective useful life calculation from the 2013-2014 Multifamily Focused Impact Evaluation.

$$Measure\ Lifecycle\ Savings\ ER = (EUL/3 * UES\_1) + \big((EUL * 2/3) * UES\_2\big)$$

$$Measure\ Lifecycle\ Savings\ ROB = (EUL/3 * UES\_2) + \big((EUL * 2/3) * UES\_2\big)$$

These calculations result in a 14.5 year average project level evaluated effective useful life. Applying this average evaluated effective useful life to the population of 2013-2015 Multifamily Whole Building claims results in the following evaluated lifecycle savings. When the effective useful life increased from the reported claim, the lifecycle realization rate is greater than the first year savings realization rate (Table 27). As noted previously, realization rates serve as

[25] SoCalREN reports they utilized effective useful lives for each measure to capture lifecycle of savings.

comparisons between what the RENs claimed to save (reported) and what the evaluation determined (evaluated). This metric is useful to assess the accuracy of the reported claims.

Table 27: Multifamily Whole Building Program Reported and Evaluated Lifecycle Savings Values, All Projects

REN	kWh (gross lifecycle)			kW (gross lifecycle)		
	Reported	**Evaluated**	**Realization Rate**	**Reported**	**Evaluated**	**Realization Rate**
BayREN	116,020,949	92,704,353	80%	11,327	9,914	88%
SoCalREN	38,046,136	23,410,074	62%	19,013	9,319	49%
Totals	*154,067,084*	*116,114,427*	75%	*30,340*	*19,234*	63%

REN	Therms (gross lifecycle)		
	Reported	**Evaluated**	**Realization Rate**
BayREN	8,198,722	5,897,907	72%
SoCalREN	539,979	771,990	143%
Totals	*8,738,701*	*6,669,897*	76%

5 Conclusions and Recommendations

Conclusion 1: Although the RENs have assumed early replacement savings for all multifamily measures, this research indicated that a portion of projects may not qualify for early replacement because of planned improvements, installation of new equipment, or replacement of equipment that was in poor condition. For example, only 55% of large hot water measures qualified as early replacement.

Recommendation 1: The RENs should set up a survey for multifamily participants at intake to better determine the appropriate baseline for each project and measure.[26] The intake survey can follow a similar logic as that used in this report or that from the CPUC early retirement guidance document.[27] The baseline assumptions for a sample of projects should then be verified by an independent third-party evaluator.

Conclusion 2: This research estimated free ridership at 48.9%, meaning that almost half of the project savings would have been achieved in absence of the program. This value is significantly higher than the REN reported value of 15% free ridership.

Recommendation 2: RENs should consider using the researched free ridership ratio from this study and update this information as future evaluation results become available. Because the program is still relatively new, the composition of participants may change over time, so the free ridership ratio may change as the program matures. In addition, the free ridership ratio should be updated if there are changes in the implementation strategies that might reduce or alter the free ridership (e.g., increasing incentive levels or changing the measure mix).

Conclusion 3: The consumption analysis did not result in comprehensive energy consumption for many of the sampled properties. This is due to challenges linking the meter numbers to IOU billing data and considerable time periods with zero energy use during the pre-program period. As such, the evaluation team could not calibrate the simulation models to the estimated consumption as planned, and relied upon the consumption estimates calculated in the simulation models.

[26] Programs in place in 2017 and beyond need also comply with CPUC rulings and guidance surrounding AB 802 and Rulemaking 13-11-005, which prescribe appropriate baselines for varying sectors and measure types.

[27] Early Retirement Using Preponderance of Evidence, Version 1.0; http://www.cpuc.ca.gov/NR/rdonlyres/8AB0DEB5-41B0-4881-BC63-F7EBBEC81318/0/ProjectBasis_EULRUL_Evidencev1July172014.pdf

Recommendation 3: Program administrators need to access and calculate whole building consumption for projects prior to approving project application and have this information readily available for evaluators to justify savings claims. Program administrators should access at least 12 months of gas and electric use prior to potential program upgrades, and 12 months of use after the upgrades occur. These data need to encompass all common area and dwelling units within the participant property and should be a prerequisite of participation. These data will allow savings assumptions and models to be calibrated and/or verified through actual customer bills and will be imperative to support future claims for projects utilizing an existing conditions baseline.

Conclusion 4: The meter numbers collected by the evaluation team were significantly more comprehensive than those collected by BayREN. Specifically, BayREN reported 54 meter numbers for the five evaluated sites, while the evaluation team collected 168 meter numbers at those same sites. Using the meter numbers collected by the program administrator would have resulted in significantly underestimated property level consumption information.

Recommendation 4: The REN meter number collection efforts need to be more thorough and comprehensive should future Multifamily Whole Building programs utilize meter numbers to link to property consumption.

Conclusion 5: The EnergyPro Lite simplified geometry methodology frequently overestimated savings when compared to the savings and consumption modeled with actual on-site conditions. Of the 20 projects evaluated, the evaluation team found 14 had reduced savings when modeled with actual window and wall characteristics; two sites saw increased savings and four projects were not affected by the change.

Recommendation 5: The evaluation team recommends modeling the exterior surfaces (wall and window area) based on actual conditions when implementing weather dependent measures.

Conclusion 6: A review of the results for projects with weather dependent measures showed there were zero supply fan energy savings, even though fan savings would be expected with reduced heating and cooling loads from implementing efficient HVAC equipment or envelope improvements. Additionally, all reported models assumed zero ventilation, affecting the modeled heating and cooling loads.

Recommendation 6: Program administrators should update ventilation, air infiltration, and HVAC fan controls assumptions in their reported models to improve model accuracy and show savings and envelope improvements.

Conclusion 7: There is a discrepancy between the Database for Energy Efficiency Resources annual hours of use (541) and the occupancy hours of use default schedule assumed in EnergyPro for high rise residential buildings (3,251). To account for this, the custom lighting

calculator multiplies the actual lighting wattage by the ratio of the Database for Energy Efficiency Resources annual hours of use by the occupancy based defaults used by EnergyPro (541/3,251). This results in lower estimated consumption for lighting during peak hours.

Recommendation 7: The evaluation team recommends modeling the actual lighting hours of use and creating a new lighting schedule in EnergyPro to match the Database for Energy Efficiency Resources occupancy schedule. A similar approach should be applied to the other building occupancies.

6 Appendix A: Measure Group Mapping for Free Ridership and Baseline Analysis

Measure	Measure Group
HVAC repair	All Others
Pool cover	All Others
Pool Pump	All Others
Space Heating Boiler	All Others
Space Heating Furnace	All Others
Clothes Washer	Appliances
Dishwasher	Appliances
Refrigerator	Appliances
Vending Machine	Appliances
DHW Demand Control	Large DHW
DHW Pipe Insulation	Large DHW
Hot Water Pipe Insulation	Large DHW
Storage Water Heater	Large DHW
Storage Water Heater	Large DHW
Tankless Water Heater	Large DHW
Thermostatic Radiator Valve	Large DHW
Water Heater Boiler Controls	Large DHW
Water Heating Boiler	Large DHW
Indoor LED Bulbs	Lighting
Indoor LED Exit Sign	Lighting
Induction Lighting	Lighting
Outdoor CFL Bulbs	Lighting
Outdoor Exit Sign	Lighting
Outdoor LED Bulbs	Lighting
Outdoor LED Fixture with Bulb(s)	Lighting
Outdoor LED Reflector	Lighting
Attic / Roof Insulation	Shell
Floor Insulation	Shell
Wall Insulation	Shell
Windows	Shell
Faucet Aerator	Small DHW
Low-flow Showerhead	Small DHW

7 Appendix B: Recommendations and Responses

EM&V Impact, Process, Market Assessment Study Recommendations

Study Title: 2013-2015 Regional Energy Networks Multifamily Programs Impact Evaluation Final Report

Program: MF-WB
Author: Apex Analytics and Itron

Item #	Page	Findings	Best Practice / Recommendations	Recommendation Recipient	Utility/ Agency Perspective	Program Actions
1	50	Although the RENs have assumed ER savings for all multifamily measures, this research indicated that a substantial portion of projects may not qualify for ER because of planned improvements,	The RENs should set up a survey for multifamily participants at intake to better determine the appropriate baseline for each project and measure	BayREN and SoCalREN		
2	50	This research found a NTG ratio of 51.1%. This value is slightly lower than the 2013–2014 REN MF-WB NTG value and significantly less than the IOU provided ex ante value of 85%	RENs should consider using the researched NTG ratio from this study and update this information as future evaluation results become available.	BayREN and SoCalREN		
3	50	The consumption analysis did not result in comprehensive energy use for many of the sampled properties.	Program administrators need to access and calculate whole building consumption for projects prior to approving project application and have this information readily available for evaluators to justify savings claims. Program administrators should access at least 12 months of gas and electric use prior to potential program upgrades, and 12 months of use after the upgrades occur. These data need to encompass all common area and dwelling units within the participant property and should be a prerequisite of participation. These data will allow savings assumptions and models to be calibrated and/or verified through actual customer bills and will be imperative to support future claims for projects utilizing an existing conditions baseline.	BayREN and SoCalREN		
4	51	The meter numbers collected by the evaluation team were significantly more comprehensive than those collected by BayREN.	The REN meter number collection efforts need to be more thorough and comprehensive should future Multifamily Whole Building programs utilize meter numbers to link to property consumption.	BayREN		
5	51	The EnergyPro Lite simplified geometry methodology frequently overestimated savings when compared to the savings and consumption modeled with actual on-site conditions.	The evaluation team recommends modeling the exterior surfaces (wall and window area) based on actual conditions when implementing weather dependent measures.	BayREN		
6	51	A review of the results for projects with weather dependent measures showed there were zero supply fan energy savings, even though fan savings would be expected with reduced heating and cooling loads from implementing efficient HVAC equipment or envelope improvements. Additionally, all reported models assumed zero ventilation, affecting the modeled heating and cooling loads.	Program administrators should update ventilation, air infiltration, and HVAC fan controls assumptions in their reported models to improve model accuracy and show savings and envelope improvements.	BayREN		

Item #	Page	Findings	Best Practice / Recommendations	Recommendation Recipient	Utility/ Agency Perspective	Program Actions
7	51	There is a discrepancy between the Database for Energy Efficiency Resources annual hours of use (541) and the occupancy hours of use default schedule assumed in EnergyPro for high rise residential buildings (3,251). To account for this, the custom lighting calculator multiplies the actual lighting wattage by the ratio of the Database for Energy Efficiency Resources annual hours of use by the occupancy based defaults used by EnergyPro (541/3,251)	The evaluation team recommends modeling the actual lighting hours of use and creating a new lighting schedule in EnergyPro to match the Database for Energy Efficiency Resources occupancy schedule.	BayREN		

8 Appendix C: Decision Maker Survey Instrument

REN MF-WB IMPACT EVALUATION

2013-2015 PARTICIPATING DECISION MAKER FINAL SURVEY INSTRUMENT

October 2016

Purpose of this Survey Guide (not to be read to Participants)

The purpose of this survey guide is to collect information from participating customers in the Regional Area Network (REN) EUC-MF programs. Questions in this survey guide are to ask participating multi-family property managers or other decision-makers about their motivations for participation and possible actions in absence of the program. The table below outlines the sections, topics and questions of the interview guide.

Survey Guide: Topics and Corresponding Questions

Section	Topics	Questions
Introductory Questions	Ensuring we are talking to the primary decision maker/ actor for participation. Discussing reasons for project.	INT1 - INT4
Verification Questions	Verification of measure installation and removals.	V1 - 0
On-site Recruitment	Recruit for on-site study	R1-R2
Early Replacement/baseline Questions	Determine working status, expected life, and scheduled upgrade of replaced unit to determine if measure qualifies for early replacement.	ER1 - ER15
Free ridership Questions	Determine importance of program in decision to upgrade measures	PAI1 - PAI7
Firmographics	Do residents own or rent? How many other properties do they manage?	F1 – F8

Survey Variables

REN: BayREN or The Energy Network
PREV_SRVY: 0/1 flag to indicate if contact has been previously surveyed
PROGRAM_LONG: Bay Area Multifamily Building Enhancements (BAMBE) program or Multifamily Upgrade Program
PROGRAM: BAMBE or Multifamily Upgrade Program
PROJECT: Property/project name
ADDRESS: Property address
COMPLETION_YEAR: Year project was completed (i.e., 2013, 2014, or 2015)
CONTACT: Contact name
PHONE: Contact phone number
STRATA: Low Rise / High Rise
QTY_MEAS_x: quantity of measure x, where x = 1 through 16
UNIT_MEAS_x: unit of measure x, where x = 1 through 16
MEAS_x: measure x, where x = 1 through 16
FLAG_MEAS_x: a flag which equals 1 for measure x (for x = 1 - 3) that asks ER1 – ER14 or 2 for measure that asks ER15
ADD_PROPERTIES, a 0/1 flag, equals 1 if contact is listed for more than one site
AP_ADDRESS: street address and city of additional multifamily property

INTRODUCTION AND SCREEN

[NOTE TO INTERVIEWER: Cross-reference names from program tracking database to ensure you indicate the property utilities. Multiple decision makers will be involved in many properties – please be sensitive to respondent's need to get input from associates. Please review the participant information prior to the interview and probe for inconsistent responses.]

Hello, this is **[INTERVIEWER'S NAME]** calling from Star Data Systems on behalf of [**REN]**. ***This is not a sales call.*** May I please speak with **[CONTACT]** or the person who is most knowledgeable about your firm's involvement in the **[PROGRAM_LONG]** for **[PROJECT]** located at **[ADDRESS]**. As part of this program, you received a rebate in **[COMPLETION YEAR]** for the installation of energy efficient products at this property.
[IF PREV_SRVY = 1] First, I'd like to thank you for completing our participant telephone survey last year. Your participation is helping to shape our program offerings and is greatly appreciated. As a follow up to that survey, we are conducting an on-site study, for which you will be paid for your time. [SKIP TO ON-SITE RECRUITMENT SECTION]

[START HERE IF PREV_SRVY = 0]

INTa. First, do you own or manage this building?

1. Yes, own /manage - Go to INT1
2. No, not familiar with listed address Thank and Terminate
3. No, live here, someone else owns the building – Ask for the contact information for the owner or property manager

INT1. Are you the person who is most knowledgeable about your company's participation in the **[PROGRAM]** Program in [COMPLETION YEAR]?

1. YES [GO TO INT4]
2. NO [GO TO INT2]
3. REQUESTS MORE INFORMATION [GO TO INT3]

-98. DON'T KNOW [GO TO INT3]

-99. REFUSED [GO TO INT3]

INT2. Is there someone who may be more knowledgeable about the upgrades that I could speak with?

1. YES AND AVAILABLE [GO BACK TO INT1]
2. YES AND BUSY [SCHEDULE CALLBACK]
3. NO [TERMINATE – REFUSAL]
4. DON'T KNOW/REFUSED [TERMINATE]

INT3. Your local gas and electric utilities sponsor the [PROGRAM]. The California Public Utilities Commission (CPUC) authorizes the rebates for the Regional Energy Network programs (otherwise known as REN) and requires them to submit such a report each year. The CPUC hired our firm to prepare an independent evaluation of their energy efficiency programs. The information that we gather will help the CPUC determine the savings achieved through these programs and assist in the design of future programs.

1. SATISFIED WITH INFORMATION – CONTINUE [GO TO **Error! Reference source not found.**]
2. WANTS TO VERIFY STUDY [SCHEDULE CALLBACK]
3. REFUSED [TERMINATE]

(**IF NEEDED:** It will take about 15 minutes.)

We are interviewing firms that participated in **[PROGRAM]** during 2013, 2014, and 2015 to discuss the factors that may have influenced their decision to participate in the program. In this survey, I will refer to the **[PROJECT]** property at **[ADDRESS]** that participated in the program as "the property."

IF NEEDED: Your answers will be consolidated with answers from other program participants and used to help evaluate the effectiveness of the program and to design future programs. *We would be grateful for your participation in our research.*

INT4. There are usually a number of reasons to do a project of this type. In your own words, can you tell me why you decided to carry out this upgrade at [PROJECT]? Were there any other reasons? [DO NOT READ; ACCEPT MULTIPLE]

a. To replace old or outdated equipment
b. As part of a planned remodeling, build-out, or expansion
c. To gain more control over energy use in the building(s)
d. The maintenance of old equipment was high/equipment kept breaking
e. To improve quality/value of property to renters
f. To comply with codes and/or regulatory requirements
g. To Improve tenant comfort/satisfaction
h. To reduce gas/electric bills
i. To get a rebate from the program
j. To reduce energy use / power outages
k. To update to the latest technology
l. To adhere to company policy
m. OTHER [RECORD]

-98. [DON'T KNOW]

-99. [REFUSED]

VERIFICATION QUESTIONS

IF MEAS_x NOT BLANK, FOR x = 1 through 16

V1. The program records show that the following products were installed at **[PROJECT]** as part of the **[REN] [PROGRAM]** Program. Please confirm that this is correct. Did you install approximately [**QTY_MEASx] [UNIT_MEASx] [MEASx]? (READ MEASURES FROM INSTALLATION LIST ON CUSTOMER RECORD; ONLY READ MEASURES WITH QTY > 0; DO NOT READ RESPONSES)**
[IF NEEDED: I understand if you cannot confirm the exact quantity, however, please let me know if these products or quantities seem correct.]

1. Yes, installed that measure and quantity
2. Yes, installed that measure, not sure of quantity
3. Yes, installed that measure, but that quantity is incorrect
4. No, I did not install that measure

-98. [DON'T KNOW]

-99. [REFUSED]

a. [FOR ANY MEASURES WHERE V1=3] What is the correct quantity installed?

MEASURE	**UNIT**	**V1 (1-4, 98, 99)**	**a. If V1 = 3: What is the correct quantity?**
Air conditioner			
Attic / Roof Insulation	Sq.Ft.		
Ceiling Fans			
Central System Space and Water Heater			
Clothes Washer			
Cool Roof			

Crawlspace Insulation	Sq.Ft.		
Delamp			
DHW Demand Control			
DHW Pipe Insulation	Sq.Ft.		
Dishwasher			
Faucet Aerator			
Faucet aerators			
Floor Insulation	Sq.Ft.		
Heat pump			
Heat pump fan			
HVAC			
HVAC repair			
Indoor CFL Bulbs			
Indoor CFL Fixtures with Bulb(s)			
Indoor LED Bulbs			
Indoor LED Exit Sign			
Indoor LED Fixture with Bulb(s)			
Indoor LED Strip Lights			
Indoor Lighting Controls or Occupancy Sensors			
Indoor Linear Fluorescent Fixture or Bulbs			
Indoor Linear Fluorescent LED Fixture or Bulbs			
Indoor T5			
Indoor T8			
Induction Lighting			
LED Pool light			
Low-flow showerhead			
Low-flow showerhead and faucet aerator			
Outdoor CFL Bulbs			
Outdoor CFL Reflectors			
Outdoor Exit Sign			
Outdoor LED Bulbs			
Outdoor LED Fixture with Bulb(s)			
Outdoor LED Reflector			
Outdoor Lighting Controls or Occupancy Sensors			
Pipe insulation	LinFt		
Pool cover			
Pool heater			
Pool Pump			
Recirculation Pump			
Refrigerator			
Remove heat lamps			
Space and Water Heating Boiler			
Space heating boiler			
Space Heating Boiler controls			
Space Heating furnace			
Storage Water Heater			
Tankless Water Heater			
Thermostatic Radiator Valve			

Thermostatic Shower Valve			
T-stat Setback			
Vending Machine			
Vending machine controls			
Ventilation Fan			
Wall Insulation	Sq.Ft.		
Water Heater Boiler Controls			
Water Heating Boiler			
Windows - Count			
Windows-Count			
Windows-SF	Sq.Ft.		

V3. Did you receive any of the following services as part of the **[PROGRAM]** Program? **[READ LIST]**

	Measure	[**1=YES, 2=NO, -98 = DON'T KNOW, -99 = REFUSED**]
A	Energy Audit	
B	Technical Assistance	
C	Feasibility Study	
D	Program Training	
E	Program Incentives	
F	Assistance with Filling out Rebate Applications and/or Incentive Options	

ON-SITE RECRUITMENT

We are looking for property owners that previously participated in the **[REN]** multifamily program that are willing to allow a trained technician to walk through and around their participant property. The technician will need access to the areas upgraded during the project. The study is very important to the future of these programs and you will be paid $100 for your time. The site visits are scheduled to take place in the late October to November timeframe. If you are interested, a technician will call you a few weeks prior to the visit to arrange a time that is convenient for you.

R1. Would you be interested in being a part of this study?

a. Yes

b. No [THANK AND TERMINATE]

R2. [IF YES] Great. I just need to get some contact information from you for scheduling purposes.

a. First and last name? [RECORD]
b. Preferred phone number? [RECORD]
c. Alternate phone number? [RECORD]
d. Email address? [RECORD]
e. Best times to call/make contact [RECORD]
f. [OPTIONAL – OTHER REQUESTS/ DETAILS TO SHARE WITH SCHEDULERS?] [RECORD]

[IF PREVIOUSLY PARTICIPATED IN PHONE SURVEY] Thank you so much for your time, a technician will be in touch with you in the next few weeks to schedule the on-site visit. END SURVEY.

[IF NOT PREVIOUSLY PARTICIPATED IN PHONE SURVEY, continue with survey]

[IF NEEDED – BELOW ARE SOME ANSWERS TO FREQUENTLY ASKED QUESTIONS ABOUT THE ON-SITE VISITS]

How long will it take?

Depending on the size of your property, between one and two hours.

What does the visit consist of?

The technician will take measurements in and around your property and visually inspect some of the incentivized equipment.

What is the purpose of this study?

The purpose of the study is to evaluate the equipment incented by the program. There will be no attempt to sell you anything or encourage future participation.

Who can I call to verify the study?

Our project manager at the CPUC is Jeremy Battis. He can be reached at (415) 703-3041 to validate our study.

What are the next steps?

Our scheduler will call you in the next few weeks to arrange a convenient time for the visit.

STATUS OF PRE-EXISTING EQUIPMENT AND RETROFIT SCHEDULE

I just have some more questions. Now I want to ask about the equipment you replaced.

[ASK ER1- ER14 IF FLAG_MEASx = 1 for up to 3 measures (i.e., FOR STORAGE WATER HEATERS, TANKLESS WATER HEATERS, DISHWASHERS, RECIRCULATION PUMPS, REFRIGERATORS, SPACE HEATING FURNACE, SPACE HEATING BOILER, WATER HEATER CONTROLS, CLOTHES WASHERS, POOL PUMPS, POOL HEATERS, VENTILATION FAN, AND WATER HEATER BOILERS, AIR CONDITIONER, CENTRAL SPACE AND WATER HEATER, VENDING MACHINE, CEILING FAN, WATER HEATER PUMP, HOT WATER DEMAND CONTROL, DUCTLESS HEAT PUMP, POOL COVER, SPACE HEATING BOILER CONTROL, THERMOSTATIC RADIATOR VALVE, THERMOSTATIC SHOWER VALVE, FREEZER, SPACE HEATER)

[RANDOMIZE ORDER OF MEASURES ASKED]

[ASK ER1- ER8 where QTY >1; IF QTY = 1 SKIP TO ER9]

ER1.You installed [MEAS_1] as part of the program. What percent of the [MEAS_1] were replacing existing equipment? [**IF NEEDED:** An example of this would be where there was/were [MEAS_1] in the apartment prior to the new [MEAS_1] being installed.]

1. [**RECORD PERCENT]**

-98. [DON'T KNOW]

-99. [REFUSED]

[IF ER1 = 0%, SKIP TO NEXT MEASURE]
[IF ER1] 0%, CALCULATE "REPLACED_QTY_MEAS_1". REPLACED_QTY_MEAS_1 = QTY1*ER1%]

ER2.Of the [REPLACED_QTY_MEAS_1] [MEAS_1] that replaced existing equipment, what percent were… [**RESPONSES NEED TO SUM TO 100%]**

1. Fully functional and not in need of repair?

   [**RECORD PERCENT]**
2. Functional, but needed minor repairs?

   [**RECORD PERCENT]**
3. Functional, but needed major repairs?

   [**RECORD PERCENT]**
4. Not functional?

   [**RECORD PERCENT]**

-98. [DON'T KNOW]

-99. [REFUSED]

[IF ER2c + ER2d = 100%, SKIP TO [NEXT MEASURE]]

ER3.On average, how old were the [MEAS_1], prior to replacement? Your best guess is fine.

[**RECORD AGE]**

-98. [DON'T KNOW]

-99. [REFUSED]

ER4.On average, how much longer do you think your old [MEAS_1] would have lasted if you had not replaced it?

[**RECORD YEARS]**

-98. [DON'T KNOW]

-99. [REFUSED]

ER5. Was the installation of [MEAS_1] part of a scheduled, planned, or government mandated upgrade/refurbishment? [IF NEEDED: a scheduled or planned upgrade is when a company has a regularly scheduled renovation; a government mandated upgrade are those required to keep up with city, state, or federal building codes or to qualify for city, state, or federal housing subsidies.]

1. Yes, these were part of our scheduled, planned, or government mandated refurbishment/upgrade of the property
2. No, these were not part of our scheduled, planned, or government mandated refurbishment/upgrade of the property
3. [Some were part of a scheduled/mandated refurbishment upgrade, and some were not]

-98. [DON'T KNOW]

-99. [REFUSED]

[IF ER5= b, SKIP TO [NEXT MEASURE]]

ER6. [IF ER5 = c] What percent of the replaced equipment was part of a scheduled, planned, or government mandated upgrade, and what percent was not? **[REPONSES NEED TO SUM TO 100%]**

	Responses	Record Percent
A	Percent of replaced [MEAS_1] part of regularly scheduled or government mandated refurbishment/upgrade	
B	Percent of replaced [MEAS_1] <u>not</u> part of regularly scheduled or government mandated refurbishment/upgrade	
-98	(DON'T KNOW)	
-99	(REFUSED)	

ER7. [IF ER5=a, OR IF ER5=c] As part of your regularly scheduled or government mandated upgrade process at **[PROPERTY]**, do you generally *replace* the [MEAS_1], or r*epair* the existing [MEAS_1]?

1. I generally replace the existing [MEAS_1]
2. I generally repair the existing [MEAS_1]
3. Depends on the [MEAS_1]; Sometimes replace the [MEAS_1] and sometimes repair them.

-98. [DON'T KNOW]

-99. [REFUSED]

ER8. [IF ER7= 3] What percent of replaced [REPLACED_QTY_MEAS_1] [MEAS_1] would you expect to replace during your scheduled upgrade, and what percent would you expect to repair? [REPONSES NEED TO SUM TO 100%]

		Record Percent

A	Percent of replaced [MEAS_1] expect to replace	
B	Percent of replaced [MEAS_1] expect to repair	
-98	(DON'T KNOW)	
-99	(REFUSED)	

[ASK ER9 - ER14 where QTY =1]

ER9. As we just discussed, you installed ONE [MEAS_1] as part of the **[PROGRAM]**. Was that [MEAS_1] replacing existing equipment? [**IF NEEDED:** An example of this would be where there was/were [MEAS_1] in the apartment prior to the new [MEAS_x] being installed.]

1. Yes
2. No

-98. [DON'T KNOW]

-99. [REFUSED]

[IF ER9= No, SKIP TO NEXT MEASURE]

ER10. Was the replaced [MEAS_1] ….

1. Fully functional and not in need of repair?
2. Functional, but needed minor repairs?
3. Functional, but needed major repairs?
4. Not functional?

-98. [DON'T KNOW]

-99. [REFUSED]

[IF ER10 = C or D, SKIP TO [NEXT MEASURE]]

ER11. How old in years was the [MEAS_1], prior to replacement? Your best guess is fine.

[**RECORD AGE]**

-98. [DON'T KNOW]

-99. [REFUSED]

ER12. How much longer do you think your old [MEAS_1] would have lasted if you had not replaced it?

[**RECORD YEARS]**

-98. [DON'T KNOW]

-99. [REFUSED]

ER13. Was this replaced [MEAS_1] part of a scheduled, planned, or government mandated upgrade/refurbishment of **[PROPERTY]**?

1. Yes, this was part of our scheduled, planned, or government mandated refurbishment/upgrade of the property

2. No, this was not part of our scheduled, planned, or government mandated refurbishment/upgrade of the property

-98. [DON'T KNOW]

-99. [REFUSED]

[IF ER13= B, SKIP TO [NEXT MEASURE]. ELSE CONTINUE.]

ER14. [IF ER13 = a] As part of your regularly scheduled or government mandated upgrade process at **[PROPERTY]**, do you generally *replace* the [MEAS_1], or r*epair* the existing [MEAS_1]?

1. I generally replace the existing [MEAS_1]
2. I generally repair the existing [MEAS_1]
3. Depends on the [MEAS_1]; Sometimes replace the [MEAS_1] and sometimes repair them.

-98. [DON'T KNOW]

-99. [REFUSED]

[ASK ER15 IF FLAG_MEASx = 2 for up to 3 measures (i.e., WINDOWS, COOL ROOF, ATTIC/ROOF INSULATION, WALL INSULATION, FLOOR INSULATION, FLOOR INSULATION, CROWLSPACE INSULATION, PIPE INSULATION, LIGHTING MEASURES, FAUCET AERATORS, AND LOW-FLOW SHOWERHEADS]

ER15. As we just discussed, you also installed [MEAS_1] as part of the **[PROGRAM]**. Was this replaced [MEAS_1] part of a scheduled, planned, or government mandated upgrade/refurbishment of **[PROPERTY]**?

1. Yes, this was part of our scheduled, planned, or government mandated refurbishment/upgrade of the property
2. No, this was not part of our scheduled, planned, or government mandated refurbishment/upgrade of the property

-98. [DON'T KNOW]

-99. [REFUSED]

[REPEAT ER1- ER15 FOR UP TO 3 MEASURES]

PROGRAM ATTRIBUTION INDEXES

I'm going to ask you to rate the importance of the program as well as other factors that might have influenced your decision to install [MEAS_1 V1 & V2], where 0 means not at all important and 10 means very important. An importance rating of 8 shows twice as much influence as a rating of 4.

PAI1. Now, using this 0 to 10 rating scale, where 0 means "Not at all important" and 10 means "Very important," please rate the importance of each of the following in your decision to install the [MEAS_1] at this time. [IF A PARTICULAR FACTOR IS NOT APPLICABLE, RECORD THE IMPORTANCE VALUE AS 0]

a. The age or condition of the old equipment

[**RECORD 0-10]**

-98. [DON'T KNOW]

-99. [REFUSED]

b. Availability of the program rebate

[**RECORD 0-10]**

-98. [DON'T KNOW]

-99. [REFUSED]

c. [ASK IF 0a=1, 0b=1, OR 0c = 1] Information provided through a feasibility study, energy audit or other types of technical assistance provided through the **[PROGRAM]**

[**RECORD 0-10]**

-98. [DON'T KNOW]

-99. [REFUSED]

d. Recommendation from an equipment vendor that sold you the equipment and/or installed it

[**RECORD 0-10]**

-98. [DON'T KNOW]

-99. [REFUSED]

e. Your previous experience with this type of project?

[**RECORD 0-10]**

-98. [DON'T KNOW]

-99. [REFUSED]

f. Your previous experience with the **[PROGRAM]** or a similar utility program?

[**RECORD 0-10]**

-98. [DON'T KNOW]

-99. [REFUSED]

g. [IF ASK IF V3D=1] Information from the program or utility training course?

[**RECORD 0-10]**

-98. [DON'T KNOW]

-99. [REFUSED]

h. Information from **[REN]** marketing materials

[**RECORD 0-10]**

-98. [DON'T KNOW]

-99. [REFUSED]

i. Suggestion from your utility account representative

[**RECORD 0-10]**

-98. [DON'T KNOW]

-99. [REFUSED]

j. Payback or return on the project

[**RECORD 0-10]**

-98. [DON'T KNOW]

-99. [REFUSED]

k. Increased value of the property

[**RECORD 0-10]**

-98. [DON'T KNOW]

-99. [REFUSED]

l. Compliance with city, state, or federal government regulations

[**RECORD 0-10]**

-98. [DON'T KNOW]

-99. [REFUSED]

m. Compliance with your company's normal maintenance or retro commissioning policies

[**RECORD 0-10]**

-98. [DON'T KNOW]

-99. [REFUSED]

n. How does your company policy influence your decision to install [MEAS_x]?

[**OPEN END]**

96. Not applicable not a company

-98. [DON'T KNOW]

-99. [REFUSED]

Consistency Checks

CC1. [IF INT4 = f AND PAI1-l < 4 ASK] You indicated earlier that compliance with codes or regulatory policies was one of the reasons you did the project. However, just now you scored the importance of compliance with city, state, or federal government regulations in your decision making fairly low, why is that?

[**OPEN END]**

-98. [DON'T KNOW]

-99. [REFUSED]

CC2. [IF INT4 ≠ f AND PAI1-l > 7 ASK] You indicated earlier that compliance with codes or regulatory policies was one of the reasons you did the project. However, just now you scored the importance of compliance with city, state, or federal government regulations in your decision making fairly HIGH, why is that?

[**OPEN END]**

-98. [DON'T KNOW]

-99. [REFUSED]

CC3. [IF INT4=l AND PAI1-m < 4 ASK] You indicated earlier that adhering to company policies was one of the reasons you did the project. However, just now you scored the importance of compliance with normal maintenance or retro commissioning practices in your decision making fairly low, why is that?

[**OPEN END]**

-98. [DON'T KNOW]

-99. [REFUSED]

CC4. [IF INT4=l AND PAI1-m > 7 ASK] You indicated earlier that adhering to company policies was one of the reasons you did the project. However, just now you scored the importance of compliance with normal maintenance or retro commissioning practices in your decision making fairly high, why is that?

[**OPEN END]**

-98. [DON'T KNOW]

-99. [REFUSED]

PAI2. Did you learn about the **[PROGRAM]** BEFORE or AFTER you decided to install the [MEAS_1] at your multifamily property?

1. I learned about the Program BEFORE I decided to install the [MEAS_x]
2. I learned about the Program AFTER I decided to install the [MEAS_x]

-98. [DON'T KNOW]

-99. [REFUSED]

Now I'd like to ask you a question about the importance of the program to your decision as opposed to other factors that you mentioned above. [READ THE FACTORS A-M WHERE THEY GAVE AN IMPORTANCE RATING OF ≥8 IN PAI1]

a. The age or condition of the old equipment
b. Recommendation from an equipment vendor that sold you the [MEAS_x] and/or installed it
c. Your previous experience with this type of project?
d. Payback or return on the project
e. Improved quality of the property
f. Compliance with city, state, or federal government regulations
g. Compliance with the company's normal maintenance or retro commissioning practices

PAI3. If you were given 10 points to award in total, how many points would give to the importance of the program and how many points would you give to these other factors?

a. How many of the ten points would you give to the importance of the program?

[**RECORD 0-10 SCORE]**

-98. [DON'T KNOW]

-99. [REFUSED]

b. … And how many of the ten points would you give to all these other factors?

-98. [DON'T KNOW]

-99. [REFUSED]

We want these two sets of numbers to equal 10. We have [RESPONSE FROM PAI3a] for program importance and [RESPONSE FROM PAI3b] for non-program factors. Does that sound about right? [IF NO, GO BACK TO PAI3]

PAI4. Now I would like you to think about the action you would have taken with regard to the installation of this [MEAS_x] if the **[PROGRAM]** had not been available. Using a likelihood scale from 0 to 10, where 0 is "Not at all likely" and 10 is "Extremely likely", if the program had not been available, what is the likelihood that you would have installed exactly the same efficiency equipment that you did in this project?

[**RECORD 0-10 SCORE]**

-98. [DON'T KNOW]

-99. [REFUSED]

Consistency Checks

CC5. [IF PAI1b > 7 AND PAI4 >7 ASK] When you answered [PAI1b] for the question about the influence of the rebate, I would interpret that to mean that the rebate was quite important to your decision to install. Then, when you answered [PAI4] for how likely you would be to install the same equipment without the rebate, it sounds like the rebate was not very important in your installation decision. I want to check to see if I am

misunderstanding your answers or if the questions may have been unclear. Will you explain in your own words, the role the rebate played in your decision to install this efficient equipment?

[**OPEN END]**

-98. [DON'T KNOW]

-99. [REFUSED]

CC6. [IF PAI1b >7 AND PAI4 > 7 ASK] Would you like for me to change your score on the importance of the rebate that you gave a rating of [PAI1b] and/or change your rating on the likelihood you would install the same equipment without the rebate which you gave a rating of [PAI4] and/or we can change both if you wish?

[**OPEN END]**

-98. [DON'T KNOW]

-99. [REFUSED]

PAI5. Now I would like you to think one last time about what action you would have taken if the program had not been available. Supposing that you had not installed the program qualifying [MEAS_x], which of the following alternatives would you have been MOST likely to do (READ LIST)?

1. Install fewer [MEAS_x]s
2. Install standard efficiency equipment or whatever required by code [SKIP TO PAI8]
3. Install equipment more efficient than code but less efficient than what you installed through the program [SKIP TO PAI7]
4. Repair the existing equipment [SKIP TO PAI8]
5. Do nothing (keep the existing equipment as is) [SKIP TO PAI8]
6. (OTHER, SPECIFY)

-98. [DON'T KNOW]

-99. [REFUSED]

PAI6. [IF PAI5 = 1] How many fewer units would you have installed?

[**RECORD]**

-98. [DON'T KNOW]

-99. [REFUSED]

PAI7. [IF PAI5 = 3] Can you tell me what model or efficiency level you were considering as an alternative?

[**RECORD OPEN END]**

-98. [DON'T KNOW]

-99. [REFUSED]

[IF MORE THAN ONE MEASURE INSTALLED AT PROPERTY]

PAI8. I understand you installed several other measures at your multifamily property through the program – list MEAS_x, for x = 2, 3. Did the program have the same influence on your decision to install the [LIST OTHER MEASURES] as we just discussed?

1 Yes

2 No [REPEAT PAI1 - PAI7 FOR UP TO 3 MEASURES]

-98. [DON'T KNOW] [REPEAT PAI1 - PAI7 FOR UP TO 3 MEASURES]

-99. [REFUSED] [REPEAT PAI1 - PAI7 FOR UP TO 3 MEASURES]

FIRMOGRAPHICS

I have just a few questions left for background purposes.

F1. Is the property that we discussed master-metered (e.g. one meter for the entire property) or individually metered (e.g. a meter for each unit or building and possibly another meter for the property's common areas)
1. MASTER-METERED
2. INDIVIDUALLY METERED
3. OTHER (SPECIFY)
-98. [DON'T KNOW]
-99. [REFUSED]

F2. Do residents at your property own or rent their homes?
1. OWN
2. RENT
3. OTHER (SPECIFY)
-98. [DON'T KNOW]
-99. [REFUSED]

F3. Are units at this property offered at market rental rates or government subsidized housing?
1. Market Rate
2. Government Subsidized
3. Both market rate and government subsidized
-98. [DON'T KNOW]
-99. [REFUSED]

F4. How many apartments are at this property]?
1. [RECORD #]
-98. [DON'T KNOW]
-99. [REFUSED]

F5. How many multifamily complexes, including this property, does your company own or manage?
1. [RECORD #]
-98. [DON'T KNOW]
-99. [REFUSED]

F6. [IF F5]1] And approximately how many individual apartments or dwellings does that represent?
1. [RECORD #]
-98. [DON'T KNOW]
-99. [REFUSED]

F7. [IF F5]1] Have some of your other properties participated in [REN] energy efficiency programs?
1. Yes
2. No
-98. [DON'T KNOW]
-99. [REFUSED]

F8. [IF F7=1] What other programs have these properties participated in? [OPEN END]
1. [RECORD RESPONSE]
-98. [DON'T KNOW]
-99. [REFUSED]

F9. [IF F7=2] Why have your other properties not participated in [REN] energy efficiency programs?
1. [RECORD RESPONSE]
-98. [DON'T KNOW]
-99. [REFUSED]

F10. And approximately how many years have you worked at [PROPERTY]?
1. [RECORD #]
-98. [DON'T KNOW]
-99. [REFUSED]

OUTRO. Those are all the questions I have. On behalf of the CPUC thank you very much for your time.

9 Appendix D: Measure Verification Summary

Site ID	Measure Summary	Evaluation Findings
80015	1. Attic Insulation: R-38; 7978 sq. ft. 2. Floor Insulation (floors over crawlspace only): R-19; 4,985 sq. ft.	1. Insulation Attic: R-38; 5,048 sq. ft. 2. Insulation Floors over crawlspace: R-19; 3,448 sq. ft.
80114	1. 436' of 0.75" piping, 528' of 1" piping. Documentation indicates the in-wall piping is being insulated, however, all photo documentation shows rooftop piping. 2. Halls/stairs: replace (100) 16w BR CFL with 7.5 LED Halls/stairs: replace (131) 14w BF CFL with 6.5 LED Garage: replace (100) 2F32T8 with 30W LED 3. Heating hot water outside air temperature control	1. Verified metal covered insulation on heating hot water piping located on the roof, at least one inch thick. Using building dimensions, the length appears close the REN documentation. Ex-ante calculations used the 81% boiler efficiency. Savings passed thru even though it is not entirely clear if the pipes that were insulated were in walls or on the rooftop. 2. Halls: spot checked and verified (96) 7.5W LED can lights and the ex-post analysis assume total counts match ex-ante counts. Garage: Verified (65) 2L 20W LED fixtures (40W/fixture) in the entire garage. 3. Verified new temperature control on rooftop hot water units. Savings small and are passed thru.
80290	1. Pipe Insulation: 27' linear feet 2. Low-flow fixtures: (13) Kitchen faucet 1.5 bathroom faucet 0.9 gpm 3. Attic insulation: Building 1 only 2,482 s.f., 4. Bathroom vanity lighting: 9W CFL's 5. Clothes washers: Specs not provided in RI documentation, however, the REN custom ca ED work papers states the unit be a CEE TIER MEF of 2.4 or greater and WF of 4.0 or less.	1. Verified newer 1" pipe insulation on hot water piping 2. Verified installed and calculated per the Energy Division guidance. 3. Access to attic space not allowed so this measure was not physically verified and is passed thru in the model. 4. Verified 13W screw-in CFL (13W/fixture) and not the CFQ9/1 (14W/fixture) in the REN lighting spreadsheet. 5. Measure not verified as installed since surveyor found Speed Queen/Alliance m/n SSG109WF1124 with an MEF of 2.16 and WF of 5.2 which does not qualify for CEE Tier III.
80365	1. Aerators: (30) 1.5 gpm kitchen aerators and (39) 1.5 gpm bath aerators 2. Exterior LED lighting a) Entry breezeway (11) 10W recessed cans b) Carports - Nine 18W LED flood lamps. Two on 8,760 and the other two on timeclock upgraded with photocell control. 3. Windows: 4,272 s.f. U-0.34 SHGC-0.31	1. Surveyor verified 1.5 gpm faucet aerators in bathrooms and kitchens in the two surveyed units. 2. Verified as installed. a) (11) ceiling mount 10W LED fixtures located in building entry area b) (10) 18W lamps on carports with photocells verified.

Site ID	Measure Summary	Evaluation Findings
		3. 2,493 s.f. new double pane vinyl frame windows.
80382	1. Low-flow fixtures: (24) 2.0 gpm shower aerators and (24) 1.5 gpm kitchen aerators 2. Windows: 2,028 s.f. of 0.34 u-value 0.23 SHGC windows 3. Vending machine control: Vending Miser 4. Exterior lighting: (9) 70W HPS to 19W LED 5. Pipe insulation: 2' of hot water pipe insulation	1. Verified 1.8 gpm showerhead 2. Verified new windows, 1,624 s.f. 3. This measure was not verified and the site contact indicated they did not want to install the device. 4. Verified (3) 23W Lithonia LED fixtures m/n TWS LED per building x3 buildings. 5. Verified installed.
80399	1. Lighting: Five 60W porch lights and one F41LL in laundry room replaced with 13W LED. Other exterior locations had additional lamp added and increased wattage. 2. Windows: 0.34 u-value 0.30 SHGC, 1,328 s.f. total area windows per EPL assumption 3. Pipe Insulation: 1" of insulation on 10' feet of hot water piping within 10' of the water heater. 75% efficient water heater used even though the modeled hot water is 80%. 4. HVAC: (6) new 11.3 EER systems	1. Verified six porch/walkway 13W LED fixtures and one 13W ceiling mounted LED fixture in laundry room. Verified five CF13W/2 in various exterior location. All except laundry are on time clock which matches control assumptions in custom calculator. Savings increased from 751 kWh to 943 kWh 2. Verified new double pane vinyl windows, 552 s.f. total area 3. 80% water heater verified on-site and calculations updated with this efficiency. Savings decreased 23.8 to 22.3. 4. Verified Frigidaire FFRE1233Q1 each per dwelling unit. 12,000 BTU, 11.3 EER
80424	1. Windows: 0.33 u-value 0.4 SHGC, 256 s.f. of single paned metal glazing on 1st and 2nd floors. Appears to be repair. 2. Attic Insulation: R-38, 4,509 s.f. attic 3. Lighting in exterior, parking garage, common area	1. Verified all dual pane glazing 2. verified 6"-8"' of blow in insulation 3. Lighting in exterior, parking garage, common area
80447	1. Windows: 0.29 u-value 0.30 SHGC, 4,017 s.f. (117 windows) 2. Lighting: apartment halls - (36) 20W LED A-lamp, Parking lot 38W LED flood lights 3. hot water pipe insulation: 9.5 linear feet 1.5" 4. Tekmar 256 outdoor air reset control	1. New windows verified, unable to verify performance. Square feet is approximately 3,240. 2. Verified these lights as installed. 3. Verified presence of pipe insulation, savings passed thru. 4. Tekmar 256 outdoor air reset control. PG&E Database for Energy Efficiency Resources measure D03-45 Hot Water Reset deemed savings values used.
80540	1. R-15 wall insulation 2. R-30 crawlspace insulation 3. Windows - 0.32 u-value 0.65 SHGC 4. Interior: replaced (27) I60/1 recessed cans and (9) CFQ22/1 with (36) 20W LED A	1. Contact indicated insulation was added to the walls, but unable to physically verify. 2. Verified 3. Verified new windows 4. All verified as installed

Site ID	Measure Summary	Evaluation Findings
	lamps. Exterior: replaced (18) HPS70/1 with (18) 38W LED flood lamps. Exterior is majority of lighting savings.	
80668	1. Refrigerators: 591 kWh/yr. 2. Low-flow fixtures: (36) 1.5 gpm showerheads and 1.5 gpm kitchen faucets 3. Water heating boiler: HTP PH199-119, 199 kBtuh input, 96% thermal efficiency, 0.0036 standby loss. 4. Hot water pipe insulation 5. 5. hot water and Heating hot water improvements: TRV's, New hot water tank, addition of hot water recirculation pump	1. The surveyor accessed one dwelling unit during the survey and there was not a refrigerator in the unit at the time because it was being replaced. Savings passed through since surveyor was only able to access one unit and there is no way to know if the units all have the new refrigerators or not. 2. 1.5 gpm showerheads and 1.5 gpm kitchen faucets found in the one unit accessed during survey. Energy Division deemed savings guidance[28] applied correctly. 3. Verified (1) large central hot water, however, unable to collect full nameplate data and it appears to match the REN documentation 4. Pipe insulation not seen during the survey. 5. Macon MTW-28 TRV's verified. The new hot water tank and hot water recirculation pump were not captured by the surveyor so these savings and penalties are being passed thru.
80892	1. Refrigerators: seven units rated at 379 kWh/yr. and seven units rated at 373 kWh/yr. 2. Low-flow fixtures: (20) 0.5 gpm bathroom faucet aerators 3. Lighting (see below) (20) Vanity - 18W CFL to 13W CFL, (40) Vanity - 65W Inc. to 13W CFL, (18) kitchen 60W Inc. to 14W CFL, (4) laundry 22W T9 to 16W LED, (6) exterior porch 60W Inc. to 9.5W LED, (14) exterior porch 13W CFL to 9.5W LED	1. Verified two new refrigerators (manufactured 2014), however, unable to obtain Energy Guide ratings for the products as they have been discontinued. Frigidaire m/n FFTR1514QW Frigidaire m/n FFHT1826LWC manufacturer specs indicate 383 kWh/yr. Savings passed thru. 2. Verified 0.5 gpm aerators in the bathroom faucets. Energy Division guidance applied correctly. Savings passed thru.

[28] Energy Division guidance refers to the custom calculations the Energy Division directed the RENS to use for the following measures: DHW Demand Control (Update Central DHW Pump to Demand Control - From no control to demand control.docx), Low-flow water fixtures (2013-2014_DHWFixtureMeasures_Disposition-1March2013.docx)

Site ID	Measure Summary	Evaluation Findings
	4. Domestic hot water: AO Smith BTH 199 200. 100 gallons, 199 kBtuh input, 97% recovery efficiency and 1.8% stand by loss.	3. Verified all lighting measure types and quantities except in the two dwelling units accessed; the bathroom vanity fixtures still had 18W CFL lamps and have been removed as the proposed fixture type from the custom lighting savings calculations. Lighting savings reduced from 1,685 kWh to 1,617 kWh. 4. Verified AO Smith Cyclone m/n BTH 199 200 as installed
80921	1. TRV's: (17) total 2. Hot water and Heating HW pipe insulation: 1.5" on 36 linear feet of steam heating pipe, 1" on 219 linear feet of hot water piping 3. hot water boiler" 95% 60-gallon MF central system 4. Indoor lighting: Common area: 9.5W A19 LED (16 total), 4W E26 chandelier type bulbs (6 total)	1. Verified per documentation 2. Verified per documentation. However, the hot water pipe calculations are using the existing equipment efficiency of 75%. Ex-post changed the efficiency to that of new hot water equipment, or 95%. 3. Verified per documentation 4. Verified per documentation
81403	1. Dishwashers 2. Low-flow fixtures: (20) 1.5 gpm showerheads, (20) 1.0 gpm kitchen faucet aerators, (20) 1.0 gpm bathroom faucet aerators 3. Windows: Ameriglass AG3 Low E 3, 0.28 u-value 0.22 SHGC, 2,592 s.f. total area	1. Frigidaire m/n TH43161584 cannot locate efficiency rating, even on the Frigidaire website. 2. Verified the low-flow fixtures as documented in REN custom calculator. Application of Energy Division guidance is accurate. 3. Verified new double paned vinyl windows, 2,160 s.f. total area
81768	1. Low-flow fixtures: (7) showerheads, (10) bathroom faucets, (5) kitchen faucets 2. Hot water recirculation pump: REN documentation does not include pictures of the hot water system and pump. 3. Windows: 0.31 U-value 0.22 SHGC, 813.6 s.f. total area to be replaced (67.8 s.f. per orientation) 4. Refrigerators: (10) total 5. Parking area LED's, Porch LED's, and Security light 14W LED	1. Surveyor indicated new aerators had been installed on shower heads and faucets in dwelling units accessed during the survey. 2. Surveyor was not able to access the area where the hot water equipment is located to verify the hot water system and recirculation pump and controller and evaluator cannot definitively prove this measure was installed or not, and therefore, is being passed thru. REN needs to provide photographic documentation of every measure included in the work scope. 3. Surveyor indicated all dual paned non-metal windows (921 s.f. total window area

Site ID	Measure Summary	Evaluation Findings
		compared to REN total of 2,592 s.f.). Because the REN indicated about one-half the windows were single pane and will be replaced, and there is no way to verify the existing conditions, the ex-post modeled one-half the site verified windows as single pane (461 s.f.) to be replaced and half as double pane non-metal (461 s.f.) to remain. 4. Accessed three dwelling units and verified one Electrolux FFTR18140W0 (not able to find kWh/yr. rating) and two Hotpoint HTS18GBSARWW (480 kWh/yr.). Per the REN documentation, it appears the replaced refrigerators were in dwelling units not accessed by evaluation surveyor and the savings are passed thru. 5. Spot check of exterior lighting indicated LED lamps in the garages, porch/exteriors, and security lighting.
83048	1. Dual paned windows: 2,054 s.f. 2. Laundry Room Lighting: (2) CFL replaced with 10W LED A-lamps and twist-time control installed 3. Replaced existing washing machine with CEE Tier 3 washing machine 4. 1.5 GPM kitchen aerators in (13) dwelling units	1. Windows measure verified as dual paned, vinyl frame, low-e, 1,067 s.f. total area to be updated in model 2. Laundry room lighting and control - (2) 13.5W LED A-lamps with (1) MSW control 3. Washing machine - verified SFNNCASP113TW01 2.9 MEF and 3.8 WF which meets TIER 3 MEF (2.4 or greater) and WEF requirements (4.0 or less). 4. Verified low-flow aerators installed on kitchen faucets in two dwelling units accessed during survey.
83234	1. Pool pump: 3.0 hp VSD 2 and 3 Appliances: (6) dishwashers CEE TIER 1 units, (15) refrigerators 358 kWh/yr., (3) clothes washers CEE TIER 3 in common area 4. Showerheads and aerators: (84) 1.0 gpm bath aerators, (68) 1.5 gpm kitchen aerators, (84) 1.7 gpm shower heads. 5. Exterior and interior common area lighting: LED fixtures throughout (see supporting calculations). 4,340 hours of use for exterior, 7,474 hours of use for interior hallways, and 1,556 hours of use for support. 6. Pipe insulation: 1.5" on 14 linear feet	1. Verified a 3.0 hp Pentair Intellaflow pool pump. 2 and 3: Appliances 4. Itron surveyor verified low flow fixtures in the bathrooms and Energy Division guidance applied correctly. 5. Itron surveyor surveyed the lighting throughout the common area and exterior and determined the measure is installed with the following exceptions: a) Fitness room - (6) ceiling mount fixtures with (3) 15W LED linear per fixture and a fixture wattage of 45W. REN calculated three fixtures at 15W per fixture.

Site ID	Measure Summary	Evaluation Findings
		b) Laundry room - (3) ceiling mount fixtures with (2) 15W LED linear per fixture for a fixture wattage of 30W. REN calculated three fixtures at 15W per fixture 6. Pipe insulation verified, savings passed thru without reviewing calculations since they are minor.
83311	1. Two new 85% boilers resulting in an 82% weighted average efficiency for the EPL model input. 2. Garage Lighting: bi-level LED lighting 3. Corridor Lighting	1: Verified new boilers with 85% efficiency 2 and 3: Spot check of fixture types, wattages, and counts matches the REN documentation fixture types, wattages, and counts
83482	1. Common Area Lighting 1a. Stairwells 1st through 6th floors - (6) 12W LED replacing 60W incandescent and 23W screw in CFL, 7474 annual hours of use in spreadsheet calculations. 1b. Hallways 2nd-6th floors - (15) 5W LED replacing (15) 40W candelabra lamps (five 3-lamp fixtures) 7474 annual hours of use in spreadsheet calculations. 1c. Common-Storage/Utility/Mechanical - (10) 12W LED replacing (10) 23W CFL 2. Pipe Insulation Steam heating - 1" insulation on 75.6 linear feet, 1.5" insulation on 315 linear feet, 2" insulation on 150.6 linear feet. hot water - 1" insulation on 170 linear feet, 1.5" insulation on 237.6 linear feet.	1a and 1b. Surveyor verified fixture counts and LED lamp wattages as 5W and 9.5W. It is not clear if the 12W LED's indicated in the close-out memo were replaced with 9W throughout, or just the one verified lamp was changed out. Either way, the savings are passed through as-is since LED lamps were installed. 1c. Common Storage/Utility/Mechanical - it appears there was an error in the calculation spreadsheet as the fixture wattage was input as 368 W per fixture when the lamps are 23W CFL's resulting in inflated kWh savings. 2. Surveyor verified installation of piping insulation, however did not measure the pipe lengths so this measure is passed thru as installed.
84949	1. 1. Low-flow fixtures: (16) 1.75 gpm showerheads, (5) 1.5 gpm kitchen sink aerators, (11) 0.5 gpm bathroom sink aerators. 2. Windows: 0.34 u-value and 0.27 SHGC, 2,872 s.f. total area 3. Demand control pumping 4. 20 linear feet of hot water pipes with 1" insulation	All measures appeared to be installed and functioning properly. 1. Verified 1.1. gpm bathroom faucet and kitchen faucet Niagara aerators and the picture of the showerhead taken during the on-site looks like the same one as REN close-out documentation. Calculations applied correctly. 2. Verified new dual pane vinyl windows, unable to collect NFRC labels, 1,716 s.f. total area. 3. Verified an Enovative AutoHot Model DCP-9913 demand controller. Calculations

Site ID	Measure Summary	Evaluation Findings
		appear correct. 4. Verified between 0.5 - 1.0" pipe insulation on central hot water piping, length appears correct from pictures. Calculations appear correct.
84979	1. (5) refrigerators rated at 363 kWh/yr. (modeled as average of 463 kWh/yr. accounting for all 23) 2. AO Smith BTH199 200. 100 gallons, 199 kBtuh, 97% recovery efficiency, 5% SBL 3. (23) 2.0 gpm showerheads, 1.0 gpm bath faucet aerators, 1.5 kitchen faucet aerators. 4. 30 linear feet, no insulation to 1"	1. Savings passed through because Itron verified three older refrigerators and only five were replaced per the REN documents and it cannot be definitively proved the five claimed as replaced were in dwelling units accessed during ex post survey. 2. Verified. AO Smith BTH199 200, 97% thermal efficiency 3. Verified installed - 6.6 liters/min (1.75 gpm), 1.1 gpm bath faucet aerators, did not check kitchen. 4. Verified installed - 21 linear feet, however, savings are 7.5 therms and these savings are passed thru.

10 Appendix E: Exterior Surface Area Adjustments, Impact on Program Eligibility and Energy Savings

Site ID	EnergyPro Lite Assumptions	Evaluation Assessment	Impact on Program Eligibility
80015	Total Wall: 9,280 s.f. Total window: 3,240 s.f.	Total Wall: 8,208 s.f. Total Window: 1,417 s.f.	Percent improvement reduced from 21.9% to 18.8%. kWh savings reduced from 9.624 to 7,102 Therm savings reduced from 1,982 to 1,043
80114	Total Wall: 12,542 s.f. Total Window: 4,392 s.f.	Total Wall: 20,358 s.f. Total Window: 4,247 s.f.	Percent improvement barely affected. Savings not affected because all modeled as custom measure.
80290	Total walls - 5,728 s.f. Total windows - 2,004 s.f.	Total walls - 6,660 s.f. Total windows - 990 s.f.	Percent improvement increased 19.3% to 20.7%. kWh savings not affected (no cooling). Therm savings increased from 962 to 1,164.
80365	Total Wall: 12,216 s.f. Total Window: 4,272 s.f. Slab - 10,366 s.f., perimeter - 415'	Total Wall: 14,688 s.f. Total Window: 2,493 s.f. Slab - 0 s.f., perimeter - 0 Raised floor over open - 10,366	Percent improvement decreased 8.8% to 8.3%. kWh savings decreased from 22,558 to 21,371. Therm savings not affected (electric heating).
80382	Total Wall: 5,800 s.f. Total Window: 2,028 s.f. Walls: 725 s.f. per floor per orientation Windows: 254 s.f. per floor per orientation	Total Wall: 16,500 s.f. Total Window: 1,624 s.f. Walls: between 1,836 s.f. and 2,430 s.f. Windows: between 72 s.f. and 348 s.f.	Percent improvement reduced from 10.7% to 7.6%. kWh savings reduced from 10,582 to 9,111. Therm savings increased from 289 to 327. Removed cooling from second floor and the % improvement drops to 5.6% and kWh savings to 4,416.

Site ID	EnergyPro Lite Assumptions	Evaluation Assessment	Impact on Program Eligibility
80399	Total Wall: 5,800 s.f. Total Window: 1,328 s.f. Slab - 2,260 s.f., perimeter - 90.4' linear feet Roof - 2,260 s.f.	Total Wall: 3,582 s.f. Total Window: 552 s.f. Slab - 3,375 s.f., perimeter - 256' linear feet Roof - 3,375 s.f.	Percent improvement reduced from 14.7% to 8.0%. kWh savings decreased from 5,194 to 2,837. Therm savings decreased from 85 to 39.
80424	Total Walls: 12,893 s.f. Total Windows: 4,512 s.f.	Total Walls: 17,712 s.f. Total Windows: 3,356 s.f.	Percent improvement reduced from 20.7% to 17.9%. kWh savings increased from 7,601 to 7,631. Therm savings increased from 1,516 to 1,562.
80447	Total Walls: 9,696 s.f. Total Windows: 3,392 s.f. Slab - 14,703 s.f., perimeter – 588'	Total Walls: 15,723 s.f. Total Windows: 3,420 s.f. Slab - 12,247 s.f., perimeter – 699'	Percent improvement reduced from 17.3% to 12.4%. kWh savings increased from 5,748 to 6,475. Therm savings decreased from 1,453 to 1,260.
80540	This project modeled them as-is and ex-post did not change	NA	NA
80668	Total Walls: 8,712 s.f. Total Windows: 3,048 s.f.	Total Walls: 10,440 s.f. Total Windows: 2,160 s.f.	Percent improvement reduced from 25.9% to 22.3% kWh savings not affected (all custom measures). Therm savings increased from 2,405 to 2,410.
80892	Total Walls: 5,638 s.f. Total Windows: 1,973 s.f. Slab: 4,966 s.f., 198.6 linear feet perimeter	Total Walls: 8,640 s.f. Total Windows: 1,041 s.f. Slab: 4,5,040 s.f., 272.0 linear feet perimeter	Percent improvement reduced from 22.8% to 22.2% Therm savings not affected (all custom measures). kWh savings decreased from 4,812 to 4,711.

Site ID	EnergyPro Lite Assumptions	Evaluation Assessment	Impact on Program Eligibility
80921	Total Walls: 5,244 s.f. Total Windows: 1,922 s.f. Windows - 166 s.f. all orientations all floors	Total Walls: 6,642 s.f. Total Windows: 1,440 s.f.	Percent improvement reduced from 20.1% to 19.8%. No impact on energy savings because TRV is only weather dependent measure and modeled on back end as custom measure.
81403	Total Walls: 7,408 s.f. Total Windows: 2,592 s.f. Slab on grade floor: 8,580 s.f. 343' linear feet	Total Walls: 15,660 s.f. Total Windows: 2,160 s.f. Slab on grade: 9,310 s.f., 880' linear feet	Percent improvement reduced from 10.9% to 7.9%. kWh savings 12,635 to 10,276. Therm savings 532 to 427.
81768	Total Walls: 7,404 s.f. Total Windows: 2,592 s.f.	Total Walls: 8,100 s.f. Total Windows: 921 s.f.	Percent improvement drops to 9.0%. kWh savings not affected. Therm savings reduced 559 to 417.
83048	Total Walls: 5,864 s.f. Total Windows: 2,053 s.f.	Total Walls: 9,018 s.f. Total Windows: 1,067 s.f.	Percent improvement reduced from 12.7% to 7.4%. kWh savings not affected (all custom measures). Therm savings reduced from 737 to 495
83234	Total Walls: 9,792 s.f. Total Windows: 3,429 s.f.	Total Walls: 13,185 s.f. Total Windows: 2,818 s.f.	Percent improvement reduced from 11.9% to 11.8%. Savings not affected, all non-weather dependent measures
83311	Did not compare since all custom non-weather dependent measures and billing data was good for this site and it matched well to the modeled usage.		Savings not affected, all non-weather dependent measures
83482	Total Walls: 2,333 s.f. Total Windows: 816 s.f.	Total Walls: 3,654 s.f. Total Windows: 713 s.f.	% improvement increases from 17.1% to 26.9%

Site ID	EnergyPro Lite Assumptions	Evaluation Assessment	Impact on Program Eligibility
84949	Total Walls: 8,208 s.f. Total Windows: 2,873 s.f.	Total Walls: 9,840 s.f. Total Windows: 1,716 s.f.	Percent improvement reduced from 13.4% to 12.4%. kWh savings 5,950 to 6,097. Therm savings not affected.

11 Appendix F: Summary of Model Adjustments from Site Verification

Site ID	Adjustments to Models Based on Site Verification Findings
80015	Building Characteristics 1. Total floor area, exterior surfaces, and window areas. Measures 1. Sq. ft. of both the attic and floor per actual building characteristics verified on-site.
80114	Building Characteristics 1. Walls and windows for eligibility considerations. 2. 30 cfm/occ ventilation and changed HVAC fan control from continuous to intermittent. Measures 1. Revised the garage lighting counts from (100) to (65) and proposed fixture wattage from 30W to 40W.
80290	Building Characteristics 1. Exterior wall and window areas 2. 30 cfm/occ ventilation Measures 1. Adjusted custom lighting savings 2. Removed clothes washer measure
80365	Building Characteristics 1. Window and wall areas, changed roof to flat roof, changed floor to raised floor over open 2. 30 cfm/occ ventilation and changed HVAC fan control from continuous to intermittent. Measures 1. Window area adjusted to actual configuration.
80382	Building Characteristics 1. Update floor areas by floor, windows and walls by orientation. 2. Removed cooling from 2nd floor HVAC systems since no cooling was verified during ex-post survey. 3. 30 cfm/occ ventilation Measures 1. Adjusted window area by orientation to actual values. 2. Changed LED Parking lot fixture wattage from 19W to 23W. 3. Remove vending miser savings from custom measures alternative.
80399	Building Characteristics 1. window wall areas, 1st and 2nd floor areas, slab area/perimeter and roof areas. 2. Changed the HVAC system fan control from continuous to intermittent for existing PTAC and proposed PTAC unit. 3. 30 cfm/occ ventilation 4. Added 0.594 w/sf plugs per Energy Division guidance calculation.

Site ID	Adjustments to Models Based on Site Verification Findings
	Measures 1. Adjusted pre and post exterior lighting to account for six porch lights instead of five. 2. Changed the HVAC system fan control from continuous to intermittent for existing PTAC and proposed PTAC unit.
80424	Building Characteristics 1. Walls and window areas by orientation to reflect actual conditions. 2. Changed walls from R-0 wood framed to concrete CMU walls. 3. 30 cfm/occ 4. Added exterior/garage lighting Watts to exterior tab. Measures 1. Revised post-retrofit garage lighting fixture from 25W LED to 24W LED. 2. Revised post-retrofit hallway lighting fixture from 9W LED to 13W CFL.
80447	Building Characteristics 1. windows and walls, floor areas
80540	Building Characteristics 1. Change heating system to gravity wall furnaces instead of central furnaces.
80668	Building Characteristics 1. Wall and window areas 2. Changed floor R-0 floor over crawl to R-0 floor no crawl since it is over the unconditioned garage. 3. 30 cfm/occ
80892	Building Characteristics 1. Update exterior wall area, window area, and slab on grade perimeter based on site verified dimensions and listed above in the Exterior Surface Areas section. 2. Update existing dwelling unit and hallway LPD's based on ex-post evaluation approach to lighting. 3. 30 cfm/occ Measures 1. Lighting LPD in dwelling units to account for 18W CFL's still in the bathroom vanity fixture.
80921	Building Characteristics 1. wall and window areas, total conditioned floor area
81403	Building Characteristics 1. 30 cfm/occ 2. Exterior surface areas 3. Set PTAC fans to intermittent 4. 30 cfm/occ Measures

Site ID	Adjustments to Models Based on Site Verification Findings
	1. bathroom vanity lighting
81768	Building Characteristics 1. Wall and window areas. 2. 30 cfm/occ Measures 1. Window area
83048	Characteristics and Other Adjustments: 1. Total floor area, exterior surfaces, and window areas. 2. 30 cfm/occ Measure Adjustments: 1. Laundry room lighting savings adjusted from 74.65 kWh to 49.13 kWh to account for 13.5 W LED verified on-site. 2. Window areas.
83234	Building Characteristics 1. Adjusted wall and window areas 2. 30 cfm/occ Measures 1. Lighting Measure - adjusted post-retrofit fixture wattage from 15W to 45W for six fitness room fixtures.
83311	No changes
83482	Building Characteristics 1. Wall and window areas Measures 1. Changed the existing fixture wattage in the common storage/utility/mechanical room from 0.368 kW to 0.0230 kW for each of the ten fixtures retrofit.
84949	Building Characteristics 1. Exterior surface areas 2. change roof to R-11 cathedral roof from default attic roof (R-11 attic) 3. 30 cfm/occ Measures 1. Window area updated to reflect conditions found on-site
84979	Building Characteristics 1. Walls and windows by orientation, slab perimeter 2. Changed R-11 attic roof to R-11 flat roof. 3. 30 cfm/occ Measures No changes

12 Appendix G: SSMVP Write-ups

Site ID: BayREN_80015			
Element	**Details**	**REN**	**Itron Review Summary**
Model Inputs and Building Characteristics	Building and Appliances	14,956 s.f. two-story low-rise / two bldg 12 dwelling units Refrigerator: 775 kWh/yr	8,496 s.f. two-story low-rise, two bldg 1st bldg: 5,616 s.f. 2nd bldg: 3,856 s.f. 12 dwelling units Refrigerator: (12) Hotpoint HTR16ABSALWN
	Exterior Surface Areas	Walls - 9,280 total Windows - 3,240 s.f. total Floor - 4,985 s.f. Roof - 7,978 s.f.	Walls - 8,208 s.f. total Windows - 1,417 s.f total Floor: 5,048 s.f. Roof - 3,448 s.f.
	Exterior Surface Construction and Performance Values	Walls: Wood frame (Default Wall Prior to 1978) Windows: Vinyl Low E Roof: Wood Framed Attic Floor: R-0 Floor Crawlspace	Surveyor verified: Walls -Wood Framed, insulation not accessible Windows- Dual paned vinyl Roof - 2x6 Wood Framed attic, R-38 insulation (measure) Floor - 2x8 Wood Framed over crawlspace, R-19 insulation (measure)
	HVAC Equipment Type and Efficiency	(12) Split DX / (1) for each dwelling unit Carrier 58EFB125-20* Gas Furnace 101,000 Btu, 0.8 AFUE Cooling 38,000 Btu, 10 SEER Ducts in crawl No supply fan (0 hp and 0 cfm)	Surveyor verified: Top Floor Systems (4) Gas Package Units, Carrier 584BNW024040AABE, Heating 40,000 Btuh, Cooling 24,000 Btuh, 10 SEER, Ducts in attic; (2) Gas Package Units, Carrier 48NLT024321BE, Heating 40,000 Btuh, Cooling 24,000 Btuh, 10 SEER, Ducts in attic; Ground Floor Systems (5) Split Electric HP Units, Carrier 3892C03143, Heating 30,000 Btuh, Cooling 24,000 Btuh, 10 SEER, Ducts in crawlspace; (1) Split A/C Units, Carrier 38TK8024300, Heating 30,000 Btuh, Cooling 24,000 Btuh, 10 SEER, Ducts in crawlspace
	DHW Equipment Type and Efficiency	(12) DHW Heaters / (1) for each dwelling unit Rheem GG28T06AXK00 0.62 EF	Surveyor verified (12) DHW units GE GG28T06AXK00 30,000 Btuh
	Lighting	Dwelling units: 7-unit bldg, 0.275 W/sf 5 unit bldg, 0.783 W/sf	(4) 60W incandescent ceiling mounted fixtures in the one unit accessed during survey (0.3432 w/sf)
	Exterior Equipment	none	none
	Operating schedules		
Measure Verification	1. Insulation Attic 2. Insulation Floors	1. Attic Insulation: R-38; 7978 sq. ft. 2. Floor Insulation (floors over crawlspace only): R-19; 4,985 sq. ft.	Surveyor Verified: 1. Insulation Attic: R-38; 5,048 sq. ft. 2. Insulation Floors over crawlspace: R-19; 3,448 sq. ft.
Dwelling Unit Sampling and Verification Summary	(12) 1- BDRM / 1-Bath		Itron Surveyed 1 dwelling unit
Modeling Approach	General Observations		
	Errors		The HVAC systems were modeled as split DX even though pictures show rooftop package units. Modeled at 100 kBtuh heating with 0 cfm and no supply fan.
	Eligibility Considerations		Misc plug loads per ED guidance not included in the models.
Change Log	Initial Comparison - modeled to metered ratio		182% kWh 374% therms
	Adjustments and Impact - building characteristics and measures		Characteristics and Other Adjustments: 1. Total floor area, exterior surfaces, and window areas. 2. Added in 1/3/ hp supply fan and 800 cfm to HVAC system, corrected heating capacities to 40 kBtuh. St fan control to intermittent. Measure Adjustments: 1. Sqft of both the attic and floor per actual building characteristics verified on-site.
	Adjustments and Impact - ER/ROB		1. Attic insulation, ER, R-38 U-0.025 2. Floor Insulation, ER, R-19 U-0.037
	Final Comparison - modeled to metered ratio		139% kWh 230% therms
Tracking Ex-Ante 1st Year Savings	Total Energy Savings (% Improvement)	21.90%	
	kW	-	
	kWh	8,657	
	Therms	1,783	
Ex-Post 1st Year Savings	kW		5.31
	kWh		7,102.00
	Therms		1,043.00
1st Year Realization Rates	kW		100%
	kWh		82%
	Therms		58%

Site ID: BayREN_80144			
Element	**Details**	**REN**	**Itron Review Summary**
Model Inputs and Building Characteristics	Building and Appliances	3-story block style building, Dwelling units: 32,800 s.f. Hall/common: 3,501 s.f. 33 dwelling units	4-story mixed use high-rise building with dwelling units on 2nd-4th floors and retail on ground level.
	Exterior Surface Areas	Walls: 1,045 s.f. per orientation per floor (12,542 s.f. total) Windows: 366 s.f. per orientation per floor (4,392 s.f. total) Floor: 10,933 s.f. 2nd floor Roof: 10,933 s.f. 4th floor	Walls: between 810 and 2,196 s.f. per orientation per floor (20,358 total) Windows: between 144 and 568 s.f. per orientation per floor (4,247 total) Floor: 11,480 s.f. Roof: 11,480 s.f.
	Exterior Surface Construction and Performance Values	Walls: R-13 wood walls Windows: Double non-metal clear Floor: uninsulated raised slab Roof: R-13 attic roof	Walls: not surveyed Windows: double vinyl Floor: raised slab Roof: not surveyed
	HVAC Equipment Type and Efficiency	Hot water fan coils, 0.33 hp/1,200 cfm supply fan continuous operation Boiler w/ 81% thermal efficiency VFD hot water pump	Surveyor not allowed into dwelling units to see the fan coil units.
	DHW Equipment Type and Efficiency		
	Lighting	Dwelling units: 0.022 W/sf Hallways/common: 7,858 Watts (2.48 W/sf) Exterior: 11.896 kW (measure)	Surveyor not allowed into dwelling units.
	Exterior Equipment		
	Operating schedules		
Measure Verification	1. Heating hot water pipe insulation 2. Lighting: Garage and Stairwells Halls to LED 3. DHW Recirc Control temperature	1. 436' of 0.75" piping, 528' of 1" piping. Documentation indicates the in wall piping is being insulated, however, all photo documentation shows rooftop piping. 2. Halls/stairs: replace (100) 16w BR CFL with 7.5 LED Halls/stairs: replace (131) 14w BF CFL with 6.5 LED Garage: replace (100) 2F32T8 with 30W LED 3.	1. Verified metal covered insulation on heating hot water piping located on the roof, at least one inch thick. Using building dimensions, the length appears close the REN documentation. Calcs used the 81% boiler efficiency. Savings passed thru even though it is not entirely clear if the pipes that were insulated were in walls or on the rooftop. 2. Halls: spot checked and verified (96) 7.5W LED can lights and the ex-post analysis assume total counts match ex-ante counts. Garage: Verified (65) 2L 20W LED fixtures (40W/fixture) in the entire garage. 3. Verified new temperature control on rooftop DHW units.
Dwelling Unit Sampling and Verification Summary	(33) 2-bed units		Surveyor not allowed into dwelling units.
Modeling Approach	General Observations		BEPU submitted EPL and BLD files show a 100% of throttling range
	Errors		
	Eligibility Considerations		
Change Log	Initial Comparison - modeled to metered ratio		
	Adjustments and Impact - building characteristics and measures		Building Characteristics 1. Walls and windows for eligibility considerations. 2. High-rise ventilation (30 cfm/occ) and changed fan control to intermittent. Measures 1. Revised the garage lighting counts from (100) to (65) and proposed fixture wattage from 30W to 40W.
	Calibration Adjustments - modeled to metered ratio		
	Adjustments and Impact - ER/ROB		None
Tracking Ex-Ante 1st Year Savings	Total Energy Savings (% Improvement)	12.20%	
	kW	4.0041	
	kWh	34401.6	
	Therms	936	
Ex-Post 1st Year Savings	kW		2.77
	kWh		23,472.27
	Therms		1040
Realization Rates	kW		69%
	kWh		68%
	Therms		111%

Site ID: BayREN_80290			
Element	**Details**	**REN**	**Itron Review Summary**
Model Inputs and Building Characteristics	Building and Appliances	(2) buildings 6,863 s.f. low-rise; 13 dwelling units	(2) buildings 6,326 s.f. low-rise; 13 dwelling units
	Exterior Surface Areas	Total walls - 5,728 s.f. Total windows - 2,004 s.f. Building 1 (2 floors) Walls - 498 s.f. all orientations all floors Windows - 174 s.f all orientations all floors Floor over crawl - 2,482 s.f. Roof - 2,482 s.f. Building 2 (2nd floor only) Walls - 436 s.f. all orientations all floors Windows - 153 s.f all orientations all floors Floor over open - 1,899 s.f. Roof - 1,899 s.f.	Total walls - 6,660 s.f. Total windows - 990 s.f. Building 1 (2 floors) Walls - 468 s.f. N and S orientations all floors, 756 s.f. E and W 1st floor, 855 s.f. E and W 2nd floor, Windows - between 12 s.f and 150 s.f per orientation Floor over crawl - 2,482 s.f. Roof - 2,482 s.f. Building 2 (2nd floor only) Walls - 585 s.f. N and S orientation, 198 s.f. E and W Windows - 96 s.f North orientations only Floor over open - 1,430 s.f. Roof - 1,430 s.f.
	Exterior Surface Construction and Performance Values	R-0 Wall (default prior to 1978) Roof R-11 Attic Bldg. 1 (measure), R-11 cathedral Bldg. 2 R-11 Floor Crawlspace Windows - Double Non-Metal Clear	Surveyor verified: Walls -Wood Framed, Insulation not Accessible Roof - Wood Framed Attic Floor - Crawlspace Windows - Dual Pane, Vinyl frame
	HVAC Equipment Type and Efficiency	67% gravity wall furnace. 17,870 Btu/hr No cooling	Gas Wall Furnace (14) 1 in each dwelling unit Ductless / No Fan Make: Williams / Model: Info Unavailable No Cooling
	DHW Equipment Type and Efficiency	(13) small storage units, 34.5 gallons, average 0.59 energy factor	(13) Sears 153 332463; 40 gal; 32000 Btu; Dwelling units (1) GE 6640T06AV601; 40 gal: 36000 Btu; Common/Laundry
	Lighting	Dwelling: existing modeled at 512 Watts (0.075 W/sf) actual is 3,110 Watts and 0.4352 W/sf (measure) Exterior: 198 Watts	Dwelling: 3,110 Watts (0.4532 W/sf) existing Exterior: 198 Watts
	Exterior Equipment		
	Operating schedules		
Measure Verification	1. Pipe Insulation (custom) 2. Low-flow fixtures (custom) 3. Attic insulation 4. Bathroom vanity and exterior lighting (custom) 5. Clothes washers (custom)	1. Pipe Insulation: 27' linear feet 2. Low-flow fixtures: (13) Kitchen faucet 1.5 gpm and (13) bathroom faucet 0.9 gpm 3. Attic insulation: Building 1 only 2,482 s.f., R-30 batts 4. Bathroom vanity lighting: 9W CFL's 5. Clothes washers: Specs not provided in REN documentation, however, the REN custom calculator using ED workpapers states the unit be a CEE TIER III and have a MEF of 2.4 or greater and WF of 4.0 or less.	1. Verified newer 1" pipe insulation on DHW piping 2. Verified installed and calculated per the ED guidance. 3. Access to attic space not allowed so this measure was not physically verified and is passed thru in the model. 4. Verified 13W screw-in CFL (13W/fixture) and not the CFQ9/1 (14W/fixture) in the REN lighting spreadsheet. 5. Measure not verified as installed since surveyor found Speed Queen/Alliance m/n SSG109WF1124 and the looked up an MEF of 2.16 and WF of 5.2 which does not qualify for CEE Tier III.
Dwelling Unit Sampling and Verification Summary	(4) Studio (8) 1- BDRM (1) 2- BDRM		Itron surveyed one dwelling unit
Modeling Approach	General Observations		
	Errors		
	Eligibility Considerations		
Change Log	Initial Comparison - modeled to metered ratio		Billing data incomplete
	Adjustments and Impact - building characteristics and measures		Building Characteristics 1. Exterior wall and window areas 2. 30 cfm/occ ventilation Measures 1. Changed custom lighting savings 2. Removed clothes washer measure
	Calibration Adjustments - modeled to metered ratio		Billing data incomplete
	Adjustments and Impact - ER/ROB		3. Attic insulation R-30
Tracking Ex-Ante 1st Year Savings	Total Energy Savings (% Improvement)	18.40%	
	kW	0.185	
	kWh	1953.0	
	Therms	865.8	
Ex-Post 1st Year Savings	kW		0.06
	kWh		2,053.00
	Therms		419
Realization Rates	kW		31%
	kWh		105%
	Therms		48%

Site ID: BayREN_80365			
Element	**Details**	**REN**	**Itron Review Summary**
Model Inputs and Building Characteristics	Building and Appliances	31,200 s.f. low-rise; Square shaped 3 levels 30 dwelling units Refrigerators - 594 kWh	30,096 s.f. low-rise Rectangle shaped 3 levels 30 dwelling units Refrigerators - 591 based on two dwelling units accessed during survey.
	Exterior Surface Areas	Walls - 1,018 s.f. all orientations all floors (4,272 s.f. total area) Windows - 356 s.f all orientations all floors Slab - 10,366 s.f., perimeter - 415' Roof - 10,366 s.f.	Walls - 396 s.f. N and S orientations all floors, 2,052 E and W orientations all floors Windows - 120 s.f east orientations all floors, 720 s.f. west orientation all floors (2,493 s.f. total) Slab - 0 s.f., perimeter - 0 Raised floor over open - 10,366 Roof - 10,366 s.f.
	Exterior Surface Construction and Performance Values	Default Wall Prior to 1978 Default Roof 1978 to Present R-0 wood framed attic Single Metal Clear Slab on Grade	Surveyor verified: Walls -wood framed, insulation not accessible Roof - 2x4 Wood frame rafter roof Raised floor for the dwelling units, there is a minor slab area for the 1st floor laundry and tiki room,
	HVAC Equipment Type and Efficiency	PTAC 10.22 EER and Electric Baseboard 3.412 HSPF, (30) units Ductless distribution	Surveyor verified electric radiant baseboards for the heating type with no make/model tags and (30) Ductless PTAC Units, Hampton Bay HBJ 180, 18,000 BTU unable to locate efficiency ratings and 10.22 EER used by REN appears to be slightly better than standard efficiency.
	DHW Equipment Type and Efficiency	Central DHW; Large American Standard boiler 82% recovery efficiency.	American Standard ND100-270AS 270,000 Btu/hr. input, 80% efficiency American Standard D100-270AS 270,000 Btu/hr. input, 80% efficiency Grundfos pump no other details
	Lighting	Dwelling Units - 1,881 Watts (0.06 W/sf) Common Area/Hallways - 1,254 Watts Exterior - 2,678 Watts	Dwelling Units - Itron accessed two of the thirty dwelling units for a sample of lighting and the lamp types, wattages, and counts generally align with the REN values in the custom calculation workbook. Dwelling unit is not a measure as well, so ex-post is not adjusting dwelling unit lighting.
	Exterior Equipment	Laundry	
	Operating schedules		
Measure Verification	1. Aerators 2. Exterior lighting 3. Windows - 0.34 u-value 0.31 SHGC	1. Aerators: (30) 1.5 gpm kitchen aerators and (39) 1.5 gpm bath aerators 2. Exterior LED lighting a) Entry breezeway (11) 10W recessed cans b) Carports - (9) 18W LED flood lamps. Two on 8,760 and the other two on timeclock upgraded with photocell control. 3. Windows: 4,272 s.f. U-0.34 SHGC-0.31	1. Surveyor verified 1.5 gpm faucet aerators in bathrooms and kitchens in the (2) surveyed units. 2. Verified as installed. a) (11) ceiling mount 10W LED fixtures located in building entry area b) (10) 18W lamps on carports with photocells verified. 3. 2,493 s.f. new double pane vinyl frame windows. Areas by orientation are significantly different as identified above in the exterior surfaces.
Dwelling Unit Sampling and Verification Summary	(21) 1 BD-RM (9) 2 BR-RM		Itron surveyed one of each type
Modeling Approach	General Observations	EnergyPro for windows custom measures	Assessment report dated 5-23-14, test out memo dated 12-3-14 so it is unclear if 2008 or 2013 Title 24 standards apply to window prescriptive requirements since 2013 T24 is effective after July 31 2014.
	Errors		
	Eligibility Considerations		Test-out EPL indicates 8.8% improvement which does not make this project eligible for incentives since the requirement is 10% improvement.
Change Log	Initial Comparison - modeled to metered ratio		
	Adjustments and Impact - building characteristics and measures		Building Characteristics 1. Window and wall areas, changed roof to flat roof, changed floor to raised floor over open 2. 30 cfm/occ ventilation and changed HVAC fan control from continuous to intermittent. Measures 1. Window area adjusted to actual configuration.
	Calibration Adjustments - modeled to metered ratio		
	Adjustments and Impact - ER/ROB		Windows, ROB, U-0.4 SHGC-0.4 (2008 T24)
Tracking Ex-Ante 1st Year Savings	Total Energy Savings (% Improvement)	8.70%	
	kW	4.4	
	kWh	20302.20	
	Therms	155.7	
Ex-Post 1st Year Savings	kW		1.22
	kWh		10,691.00
	Therms		173
Realization Rates	kW		28%
	kWh		53%
	Therms		111%

Site ID: BayREN_80382			
Element	**Details**	**REN**	**Itron Review Summary**
Model Inputs and Building Characteristics	Building and Appliances	10,500 s.f. total area evenly split between two levels. 24 dwelling units Dwelling Unit area: 10,018 s.f. Hallways/common area: 432 s.f	10,950 s.f. total 1st floor: 4,050 s.f. 2nd floor: 6,900 s.f. 24 dwelling units Laundry: 432 s.f.
	Exterior Surface Areas	Total Wall: 5,800 s.f. Total Window: 2,028 s.f. Walls: 725 s.f. per floor per orientation Windows: 254 s.f. per floor per orientation Raised floor over crawlspace: 5,250 s.f. Roof: 5,250 s.f.	Total Wall: 16,500 s.f. Total Window: 1,624 s.f. Walls: between 1,836 s.f. and 2,430 s.f. Windows: between 72 s.f. and 348 s.f. Raised floor over crawlspace: 4,050 s.f. Roof: 6,900 s.f.
	Exterior Surface Construction and Performance Values	Walls: default prior to 1978, R-0 wood framed Windows: single paned metal clear Floor: default prior to 1978, R-0 wood framed Roof: R-30 attic	Walls: wood frame, insulation not accessible Windows: Dual paned vinyl Floor: raised floor over crawl, insulation not verified Roof: 2x4 wood framed attic with 17" blow-in insulation (at least R-30)
	HVAC Equipment Type and Efficiency	Gravity wall furnace, 69% AFUE No cooling on 1st floor Room A/C on 2nd floor, 8.7 EER,	Gravity wall furnace in two units surveyed. A Williams m/n 3509622 in one unit, 69% AFUE per manufacturer specs. The other nameplate was not visible. No cooling verified in the two units surveyed located on the 2nd floor and photos do not show any window or wall air conditioners. Possible there were some plug in a/c units when the REN surveyed the spaces, but there are no photos in documentation supporting the 2nd floor cooling systems are installed.
	DHW Equipment Type and Efficiency	MF Central system consisting of (3) small storage DHW units with an average energy factor of 0.51. No recirc pump	(3) Rheem m/n 42V100F, 75 kBtuh input, 0.49 EF
	Lighting	Dwelling units: 1.499 kW (0.11 W/sf) Hall: 0.164 kW (1.64 W/sf) Exterior: 1.158 kW	Itron surveyor verified a mix of CFQ, LED, and incandescent lamps in lighting fixtures located in the two dwelling units accessed during the survey. This does not agree with the REN documentation which indicates all 26W CFQ lamps and it appears there may have been a lighting remodel since the REN audit. Because of this, and because lighting is not a measure, the model is not updated for this discrepancy.
	Exterior Equipment		
	Operating schedules		
Measure Verification	1. Low-flow fixtures (custom) 2. Windows 3. Vending machine control (custom) 4. Exterior lighting (custom) 5. Pipe insulation (custom)	1. Low-flow fixtures: (24) 2.0 gpm shower aerators and (24) 1.5 gpm kitchen aerators 2. Windows: 2,028 s.f. of 0.34 u-value 0.23 SHGC windows 3. Vending machine control: Vending Miser 4. Exterior lighting: (9) 70W HPS to 19W LED 5. Pipe insulation: 2' of DHW pipe insulation	1. Verified 1.8 gpm showerhead 2. Verified new windows, 1,624 s.f. 3. This measure was not verified and the site contact indicated they did not want to install the device. 4. Verified (3) 23W Lithonia LED fixtures m/n TWS LED per building x3 tbuildings. 5. Verified installed.
Dwelling Unit Sampling and Verification Summary	(18) 1-bed 450 s.f units (6) 2-bed 475 s.f. units		Itron surveyor accessed one of each unit type
Modeling Approach	General Observations		
	Errors		
	Eligibility Considerations		Plug loads per ED advice not modeled.
Change Log	Initial Comparison - modeled to metered ratio		
	Adjustments and Impact - building characteristics and measures		Building Characteristics 1. Update floor areas by floor, windows and walls by orientation. 2. Removed cooling from 2nd floor HVAC systems since no cooling was verified during ex-post survey. Measures 1. Adjusted window area by orientation to actual values. 2. Changed LED Parking lot fixture wattage from 19W to 23W. 3. Remove vending miser savings from custom measures alternative.
	Calibration Adjustments - modeled to metered ratio		
	Adjustments and Impact - ER/ROB		1. ER, No code requirement and no adjustments. 2. ER, U-0.35 SHGC-0.25. 3. ROB, No code requirement and no adjustments. 4. Not surveyed, no adjustments. 5. Not surveyed, no adjustments.
Tracking Ex-Ante 1st Year Savings	Total Energy Savings (% Improvement)	10.70%	
	kW	2.0	
	kWh	9475.20	
	Therms	260.1	
Ex-Post 1st Year Savings	kW		0.65
	kWh		2,657.00
	Therms		258
Realization Rates	kW		33%
	kWh		28%
	Therms		99%

Site ID: BayREN_80399			
Element	**Details**	**REN**	**Itron Review Summary**
Model Inputs and Building Characteristics	Building and Appliances	4,520 s.f. low-rise; Distributed evenly across two floors 6 dwelling units	4,520 s.f. low-rise; 3,375 1st floor, 2,260 2nd floor 6 dwelling units
	Exterior Surface Areas	Total Wall: 5,800 s.f. Total Window: 1,328 s.f. Walls: 475 s.f. all orientations all floors Windows: 166 s.f. all orientations all floors Slab - 2,260 s.f., perimeter - 90.4 linear feet Roof - 2,260 s.f.	Total Wall: 3,582 s.f. Total Window: 552 s.f. Walls: between 351 and 657 s.f. per orientation per floor. Windows - between 36 s.f. and 102 s.f. per orientation Slab - 3,375 s.f., perimeter - 256' linear feet Roof - 3,375 s.f.
	Exterior Surface Construction and Performance Values	Walls: Default Wall 1978 to 1991 Windows: Single metal clear (measure) Roof: R-19 attic Floor: Slab on grade	Walls: Wood Framed, insulation not accessible Windows: double vinyl Roof: 2x4 wood framed attic, insulation not accessible Floor: Slab on Grade
	HVAC Equipment Type and Efficiency	Gravity wall furnace 65% AFUE PTAC 8.73 EER, 316 cfm, 0.05 hp supply fan, continuous control	Gas Wall Furnace (6) 1 in each dwelling unit Ductless / No Fan; No Make / Model Info Available PTAC Frigidaire FFRE1233Q1 (6) 1 in each dwelling unit Ductless; 12000 BTU, 11.3 EER
	DHW Equipment Type and Efficiency	MF Central system Rheem T75-75, large storage, 80% thermal efficiency, 1.39% SBL No pump modeled	MF central system RHEEM T75-75; Pump: Grundfos 59896775P1
	Lighting	Dwelling Units - 0.293 kW (0.064 W/sf) Halls - 0.039 kW (0.975 W/sf) Exterior - 0.379 kW	
	Exterior Equipment		
	Operating schedules		
Measure Verification	1. Exterior and laundry room lighting (custom) 2. Windows 0.34 u-value 0.30 SHGC 3. DHW pipe insulation (custom) 4. HVAC -11.3 EER PTAC	1. Lighting: (5) 60W porch lights and (1) F41LL in laundry room replaced with 13W LED. Other exterior locations had additional lamp added and increased wattage. 2. Windows: 0.34 u-value 0.30 SHGC, 1,328 s.f. total area windows per EPL assumption 3. Pipe Insulation: 1" of insulation on 10' feet of DHW piping within 10' of the water heater. 75% efficient water heater used even though the modeled DHW is 80%. 4. HVAC: (6) new 11.3 EER systems	1. Verified six (6) porch/walkway 13W LED fixtures and (1) 13W ceiling mounted LED fixture in laundry room. Verified five (5) CF13W/2 in various exterior location. All except laundry are on time clock which matches control assumptions in custom calculator. Savings increased from 751 kWh to 943 kWh 2. Verified new double pane vinyl windows, 552 s.f. total area 3. 80% water heater verified on-site and calculations updated with this efficiency. Savings decreased 23.8 to 22.3. 4. Verified Frigidaire FFRE1233Q1 each dwelling unit 12,000 BTU, 11.3 EER
Dwelling Unit Sampling and Verification Summary	(6) 2- BDRM		Itron surveyed one unit
Modeling Approach	General Observations		70% outside of throttling range as submitted
	Errors		
	Eligibility Considerations		Plug loads not modeled per ED guidance impacting % improvement calculation
Change Log	Initial Comparison - modeled to metered ratio		
	Adjustments and Impact - building characteristics and measures		Building Characteristics 1. window wall areas, 1st and 2nd floor areas, slab area/perimeter and roof areas. 2. Changed the HVAC system fan control from continuous to intermittent for existing PTAC and proposed PTAC unit. 3. added 0.594 w/sf plugs per ED guidance calculation. Measures 1. Adjusted pre and post exterior lighting to account for six porch lights instead of five. 2. See #2 above - applies here also
	Calibration Adjustments - modeled to metered ratio		
	Adjustments and Impact - ER/ROB		1. Not surveyed - no changes 2. ER, U-0.40 SHGC-0.40 3. ER, no code requirement for alterations - no changes 4. Not surveyed - no changes
Tracking Ex-Ante 1st Year Savings	Total Energy Savings (% Improvement)	14.70%	
	kW	1.7	
	kWh	4674.60	
	Therms	75.6	
Ex-Post 1st Year Savings	kW		0.81
	kWh		3,226
	Therms		52
Realization Rates	kW		47%
	kWh		69%
	Therms		69%

Site ID: BayREN_80424			
Element	**Details**	**REN**	**Itron Review Summary**
Model Inputs and Building Characteristics	Building and Appliances	Six story building, 30,060 s.f. total Dwelling units: 27,054 s.f distributed equally across six floors Hallway/common area: 3,006 s.f. distributed equally across six floors 42 dwelling units	Six stories Dwelling units: 26,400 s.f. Hallway/common area: 3,006 42 dwelling units
	Exterior Surface Areas	Total Walls: 12,893 s.f. Total Windows: 4,512 s.f. Walls: 537.2 s.f. per floor per orientation Windows: 188 s.f. per floor per orientation Floor: 4.509 s.f. Roof: 4,509 s.f.	Total Walls: 17,712 s.f. Total Windows: 3,356 s.f. Walls: 774 s.f. N and S orientations per floor, 702 s.f. N and S orientations per floor. Windows: Between 0 and 240 s.f. per orientation per floor Floor: Roof:
	Exterior Surface Construction and Performance Values	Walls: R-0 wood framed wall, 0.356 u-value Windows: Double metal clear and single metal clear which are replaced double non-metal as a measure. Floor: Over crawlspace default prior to 1978, 0.097 u-value Roof: R-0 attic roof, 0.305 u-value	Walls: Concrete walls Windows: Double metal clear and single metal clear which are replaced double non-metal as a measure. Floor: mostly raised concrete deck over garage Roof: Attic roof w/6"-8" blow-in insulation (measure)
	HVAC Equipment Type and Efficiency	Steam radiators with central boiler Peerless PB LC6007, 81% recovery efficiency, 881 kBtuh input	Steam radiators with central boiler
	DHW Equipment Type and Efficiency	Lochinvar CFN1441PM-M7, gas-fired boiler, 85% recovery efficiency, with a 50% solar savings fraction (2) 0.13 hp recirc pumps	(2) Heliodyne solar thermal assist 1,000 gallon storage tank
	Lighting	Dwelling units: 0.676 W/sf Hallway/common: 0.332 W/sf Exterior/Garage: 1.301 kW	Itron surveyor accessed one dwelling unit and the lighting is a mix of incandescent, linear fluorescent, CFL and halogen. There has not been a building wide lighting retrofit in the dwelling units for at least 30 years. Using the wattage for the one unit and extrapolating to total dwelling unit area. Dwelling units: 0.63W/sf Hallway/common: 0.205 W/sf Exterior/Garage: .980 kW existing 0.285 kW post-retrofit It is not clear how the REN calculated the dwelling unit wattage because the custom calculator does not show dwelling unit lighting and it also appears the REN did not include the garage lighting nor exterior lighting in the baseline model.
	Exterior Equipment	None	None
	Operating schedules	All default HR residential schedules.	3,285 HOU for dwelling unit lighting is too high. Adjusting to reflect 541 HOU.
Measure Verification	1. Windows 0.33 u-value 0.4 SHGC 2. Attic Insulation R-38 3. Lighting in exterior, parking garage, common area	1. Windows: 0.33 u-value 0.4 SHGC, 256 s.f. of single paned metal glazing on 1st and 2nd floors. Appears to be repair. 2. Attic Insulation: R-38, 4,509 s.f. attic 3. Lighting in exterior, parking garage, common area	1. Verified all dual pane glazing 2. verified 6"-8"" of blow in insulation 3. Lighting in exterior, parking garage, common area
Dwelling Unit Sampling and Verification Summary	(12) 1-bed (30) studios		Surveyor accessed one dwelling unit
Modeling Approach	General Observations		Occupancy assumptions not set to high-rise residential defaults: 333 s.f. / occ and 0 cfm/occ are values used in submitted model. The result of this is that the roof insulation measure is saving 54% of heating energy which does not thermodynamically make sense considering the amount of wall and window area and roof area to floor area ratio since it is a six story building. Using 30 cfm/occ the roof insulation measure saves 6% of heating energy.
	Errors		
	Eligibility Considerations		ED guidance on including plug load w/sf not implemented.
Change Log	Initial Comparison - modeled to metered ratio		Meter data not comprehensive to compare.
	Adjustments and Impact - building characteristics and measures		Building Characteristics 1. Walls and window areas by orientation to reflect actual conditions. 2. Changed walls from R-0 wood framed to concrete CMU walls. 3. 200 sf/occ and 30 cfm/occ. 4. Changed the dwelling unit lighting schedule to reflect more reasonable annual HOU of 541 and the hallway to 8,760. 5. Added exterior/garage lighting Watts to exterior tab. Measures 1. Revised post-retrofit garage lighting fixture from 25W LED to 24W LED. 2. Revised post-retrofit hallway lighting fixture from 9W LED to 13W CFL.
	Calibration Adjustments - modeled to metered ratio		Meter data not comprehensive to compare.
	Adjustments and Impact - ER/ROB		Windows: ROB, U-value 0.40 SHGC 0.40 Attic Insulation: ER, R-30 Lighting: ER, no changes.
Tracking Ex-Ante 1st Year Savings	Total Energy Savings (% Improvement)	20.70%	
	kW	0.6	
	kWh	6840.00	
	Therms	1364.4	
Ex-Post 1st Year Savings	kW		0.52
	kWh		6,906.00
	Therms		501
Realization Rates	kW		81%
	kWh		101%
	Therms		37%

Site ID: BayREN_80447			
Element	**Details**	**REN**	**Itron Review Summary**
Model Inputs and Building Characteristics	Building and Appliances	Total area: 30,975 s.f. Dwelling units: 29,406 s.f. Hallway/common (unconditioned): 1,569 s.f. Low-rise, 27 dwelling units Refrigerators - 478 kWh	Total area: 32,819 Dwelling Units: 25,650 s.f. Hallway/common area: 130 s.f. Low-rise, 27 dwelling units
	Exterior Surface Areas	Walls - 1,2,12 s.f. all orientations all floors (9,696 s.f. total) Windows - 424 s.f. all orientations all floors (3,392 s.f. total) Slab - 14,703 s.f., perimeter - 588 Roof - 14,703 s.f.	Walls - 15,273 s.f. total Windows - 3,420 s.f. total Slab - 12,247 s.f., perimeter - 699 Roof - 14,703 s.f.
	Exterior Surface Construction and Performance Values	Default Wall Prior to 1978 Wood Framed; Default Roof 1978 to Present R-19 Wood Framed Attic; Single Metal Clear Windows; Slab on Grade	Walls - 2x6 wood frame wall, insulation not verifiable; Roof - 2x6 attic roof, R-19 insulation; Slab on Grade and raised floor over carports
	HVAC Equipment Type and Efficiency	Hot water fan coil units, Raypack H1-0962 boiler, 82% recovery efficiency, with 3.0 hp/130 gpm recirculation pump Ducted distribution No cooling	Hot water fan coil units, Raypack H1-0962 boiler with 3.0 hp/ not verifiable gpm recirculation pump Ducted distribution No cooling
	DHW Equipment Type and Efficiency	MF Central system with (2) Rinnai RC98HPI instantaneous units with storage tanks. 95% recovery efficiency. Temp control on recirculation pump	MF Central system with (2) Rinnai RUC981 instantaneous units with storage tanks. 95% recovery efficiency. Demand control on recirculation pump
	Lighting	Dwelling Units - 2.066 kW Halls - 0 kW Exterior - 2.436 kW	Dwelling Units - accessed one unit and there are (2) 9W lamps. Surveyor indicated all units are the same for a total 0.486 kW. However, ex-post is not adjusting the dwelling unit lighting since we only accessed one unit and dwelling lighting it is not a measure. Halls - Exterior -
	Exterior Equipment	none	
	Operating schedules		
Measure Verification	1. Windows 0.29 u-value 0.30 SHGC 2. Lighting 3. Piping insulation 4. Heating hot water supply temp outdoor air reset control	1. Windows: 0.29 u-value 0.30 SHGC, 4,017 s.f. (117 windows) 2. Lighting: apartment halls - (36) 20W LED A-lamp, Parking lot 38W LED flood lights 3. DHW pipe insulation: 9.5 linear feet 1.5" 4. Tekmar 256 outdoor air reset control	1. New windows verified, unable to verify performance. Square feet is approximately 3,240. 2. Verified these lights as installed. 3. Verified presence of pipe insulation, savings passed thru. 4. Tekmar 256 outdoor air reset control. PG&E DEER measure D03-45 Hot Water Reset deemed savings values used.
Dwelling Unit Sampling and Verification Summary	(27) 2-BDRM / 1- BATH 950 s.f. units		Itron surveyed one dwelling unit
Modeling Approach	General Observations		REN used EPL only for the analysis.
	Errors		
	Eligibility Considerations		
Change Log	Initial Comparison - modeled to metered ratio		
	Adjustments and Impact - building characteristics and measures		1. windows and walls, floor areas
	Calibration Adjustments - modeled to metered ratio		
	Adjustments and Impact - ER/ROB		1. Windows, ROB, U-value 0.40 SHGC-0.40 2. Water heater boiler controls, ROB, no T24 code requirement for alterations. 3. Pipe Insulation, ROB, no T24 code requirements for adding insulation. 4. Lighting, not surveyed, no T24 code requirement for changing out lamps in outdoor applications.
Tracking Ex-Ante 1st Year Savings	Total Energy Savings (% Improvement)		
	kW	0.3	
	kWh	4930.20	
	Therms	1308.6	
Ex-Post 1st Year Savings	kW		0.28
	kWh		7,907.00
	Therms		857
Realization Rates	kW		111%
	kWh		160%
	Therms		65%

Site ID: BayREN_80540			
Element	**Details**	**REN**	**Itron Review Summary**
Model Inputs and Building Characteristics	Building and Appliances	3 story town house style building 3,796 s.f. equally distributed across all floors 5 dwelling units Refrigerator: 775 kWh/yr	3 story town house style building 6,863 s.f. equally distributed across all floors 5 dwelling units Refrigerator: 775 kWh/yr
	Exterior Surface Areas	Walls: modeled actual wall and window area Windows: modeled actual wall and window area Floor: 1,266 s.f. Roof:	Spot checks indicate the wall and window areas are accurate so not making changes.
	Exterior Surface Construction and Performance Values	Walls: R-0 wood frame Windows: Single Metal Clear (measure) Roof: R-11 Wood Framed Attic Floor: R-11 Crawlspace	Surveyor verified: Walls -Wood Framed, R-15 insulation (per contact) Windows- Dual paned vinyl Roof - 2x8 Wood Framed, R-15 insulation 1st Floor - Slab above open garage, 2x6 framing, R-15 insulation 2nd Floor - Crawlspace, 2x6 framing, R-15 insulation
	HVAC Equipment Type and Efficiency	Forced air central furnaces 80% (although report and Itron verified wall furnaces) and electric baseboards 3.413 HSPF	Natural gas wall furnaces and electric baseboards
	DHW Equipment Type and Efficiency	(5) small storage units, 0.575 energy factor	
	Lighting	Exterior: 374 watts	
	Exterior Equipment		
	Operating schedules		
Measure Verification	1. R-15 wall insulation 2. R-30 crawlspace insulation 3. Windows - 0.32 u-value 0.65 SHGC 4. Lighting - dwelling unit and unconditioned common area	1. R-15 wall insulation 2. R-30 crawlspace insulation 3. Windows - 0.32 u-value 0.65 SHGC 4. Interior: replaced (27) I60/1 recessed cans and (9) CFQ22/1 with (36) 20W LED A lamps. Exterior: replaced (18) HPS70/1 with (18) 38W LED flood lamps. Exterior is majority of lighting savings.	1. Contact indicated insulation was added to the walls, but unable to physically verify. 2. Verified 3. Verified new windows 4. All verified as installed
Dwelling Unit Sampling and Verification Summary	(5) 2 BDRM		Surveyed one Unit
Modeling Approach	General Observations		
	Errors		Wall furnaces modeled as central furnace.
	Eligibility Considerations		
Change Log	Initial Comparison - modeled to metered ratio		
	Adjustments and Impact - building characteristics and measures		1. Change heating system to gravity wall furnaces instead of central furnaces.
	Calibration Adjustments - modeled to metered ratio		
	Adjustments and Impact - ER/ROB		Windows, ER, U-0.40 SHGC-0.65 Floor Insulation, ER, R-19 Wall Insulation, ER, R-13
Tracking Ex-Ante 1st Year Savings	Total Energy Savings (% Improvement)	23.20%	
	kW	1.2	
	kWh	13881.60	
	Therms	231.3	
Ex-Post 1st Year Savings	kW		0.07
	kWh		15,420.00
	Therms		279
Realization Rates	kW		6%
	kWh		111%
	Therms		121%

Site ID: BayREN_80668			
Element	**Details**	**REN**	**Itron Review Summary**
Model Inputs and Building Characteristics	Building and Appliances	17,555 s.f. 3 story low-rise equally distributed across all floors 36 dwelling units Refrigerator: 605 kWh/yr existing, 591 kWh/yr proposed measure	18,144 s.f. 3 story low-rise 36 dwelling units Refrigerator:
	Exterior Surface Areas	Walls - 726 s.f. per floor per orientation, 8,712 s.f. total Windows - 254 per floor per orientation, 3,048 s.f. total Floor: 5,267 s.f. Roof - 5,267 s.f.	Walls - 1,260 s.f. N and S orientations all floors, 480 s.f. E and W orientations all floors, 10,440 s.f. total. Windows - 270 s.f. N and S orientations all floors, 80 s.f. E and 100 s.f. W all floors, 2,160 s.f total. Floor: 5,760 s.f. Roof - 5,760 s.f.
	Exterior Surface Construction and Performance Values	Walls: Wood frame (Default Wall Prior to 1978) Windows: Single Non Metal Clear Roof: R-38 Wood Framed Attic Floor: R-0 Floor wood framed w/ Crawlspace	Surveyor verified: Walls -2x6 Wood Framed, insulation not accessible Windows- single paned wood framed Roof - Wood Framed, insulation not accessible Floor - Floor over garage, insulation not accessible
	HVAC Equipment Type and Efficiency	Peerless 64-08 399,000 Btuh, 79.6% thermal efficiency	HVAC heating equipment not verified, NO cooling
	DHW Equipment Type and Efficiency	(1) Central DHW Indirect gas A.O. Smith BC225 840 400 gallon, 225 kBtuh input, 78% recovery efficiency	Verified (1) large central DHW, however, unable to collect full nameplate data and it appears to match the REN documentation. Manuf. HTP 199,000 Btuh
	Lighting	Dwelling Units: 0.033 W/sf Hall/common: 0.307 W/sf	
	Exterior Equipment	Laundry	
	Operating schedules		
Measure Verification	1. Refrigerators 2. Low-flow showerheads 3. Water heating boiler 4. Hot water pipe insulation 5. DHW and Heating hot water improvements	1. Refrigerators: 591 kWh/yr 2. Low-flow fixtures: (36) 1.5 gpm showerheads and 1.5 gpm kitchen faucets 3. Water heating boiler: HTP PH199-119, 199 kBtuh input, 96% thermal efficiency, 0.0036 standby loss. 4. Hot water pipe insulation 5. 5. DHW and Heating hot water improvements: TRV's, New hot water tank, addition of DHW recirculation pump	1. The surveyor accessed one dwelling unit during the survey and there was not a refrigerator in the unit at the time because it was being replaced. Savings passed through since surveyor was only able to access one unit and there is no way to know if the units all have the new refrigerators or not. 2. 1.5 gpm showerheads and 1.5 gpm kitchen faucets found in the one unit accessed during survey. ED deemed savings guidance applied correctly. 3. Verified (1) large central DHW, however, unable to collect full nameplate data and it appears to match the REN documentation 4. Pipe insulation not seen during the survey. 5. Macon MTW-28 TRV's verified. The new hot water tank and DHW recirculation pump were not captured by the surveyor so these savings and penalties are being passed thru.
Dwelling Unit Sampling and Verification Summary	(25) Studio (11) 1 BDRM		Itron was able to survey 1 of the Studio Units
Modeling Approach	General Observations		The REN documentation did not include pictures of the installed measures or existing conditions. Additionally, there are not supporting calculations for the kWh penalty of adding a DHW recirc pump. Evaluator recommends improving project documentation to support future evaluation activities.
	Errors		
	Eligibility Considerations		
Change Log	Initial Comparison - modeled to metered ratio		No meter data
	Adjustments and Impact - building characteristics and measures		Building Characteristics 1. Wall and window areas 2. Changed floor R-0 floor over crawl to R-0 floor no crawl since it is over the unconditioned garage.
	Calibration Adjustments - modeled to metered ratio		No meter data
	Adjustments and Impact - ER/ROB		DHW, ER, 82%
Tracking Ex-Ante 1st Year Savings	Total Energy Savings (% Improvement)	25.90%	
	kW	0.1	
	kWh	-1499.40	
	Therms	2164.3	
Ex-Post 1st Year Savings	kW		0.06
	kWh		(1,666.00)
	Therms		2349
Realization Rates	kW		67%
	kWh		111%
	Therms		109%

Site ID: BayREN_80892			
Element	**Details**	**REN**	**Itron Review Summary**
Model Inputs and Building Characteristics	Building and Appliances	Two two-story building Dwelling Units: 20 Total conditioned floor area: 9,933 s.f. equally distributed across two floors Hall/common area (unconditioned): 100 s.f. Refrigerator: 556 kWh/yr (measure)	Two two-story building Dwelling Units: 20 Total conditioned floor area: 10,008 s.f. Hall/common area (unconditioned): 240 s.f. Refrigerator:
	Exterior Surface Areas	Walls: 5,638 s.f. total, 705 s.f. per floor per orientation Windows: 1,973 s.f. total, 247 s..f. per floor per orientation Slab: 4,966 s.f., 198.6 linear feet perimeter Roof: 4,966 s.f.	Walls: 8,640 s.f. total, 1,260 s.f. per floor per N and S orientations, 960 s.f. per floor per E and W orientations. Windows: 1,041 s.f. total, between 48 s.f.-195 s.f. per floor per orientation Slab: 5,040 s.f., 272.0 linear feet perimeter Roof: 4,966 s.f.
	Exterior Surface Construction and Performance Values	Walls: R-11 wood frame (Default 1978 - 1991) Windows: double non-metal clear Floor: slab on grade Roof: R-30 attic	Walls: R-19 wood frame Windows: double non-metal clear Floor: slab on grade Roof: 2x6 attic R-30
	HVAC Equipment Type and Efficiency	Electric baseboards 3.413 HSPF No cooling	Electric baseboards No cooling
	DHW Equipment Type and Efficiency	MF Central with (1) large storage DHW. 98 gallons, 199 kBtuh input, 80% recovery efficiency. 2.3% stand by loss. (measure)	AO Smith Cyclone m/n BTH 199 200. 199 kBtuh input, 97% recovery efficiency, 1.8% standby loss (1) one horsepower recirc pump
	Lighting	Dwelling units: 871 Watts (0.088 W/sf) and 3,952 HOU Exterior: 461 Watts	Dwelling units: 5,292 Watts (0.533 W/sf) and 541 HOU Exterior: 461 Watts
	Exterior Equipment	none	
	Operating schedules		
Measure Verification	1. Refrigerators 2. Low-flow fixtures (custom) 3. Lighting, dwelling units and exterior (custom) 4. DHW	1. Refrigerators: (7) units rated at 379 kWh/yr and (7) units rated at 373 kWh/yr 2. Low-flow fixtures: (20) 0.5 gpm bathroom faucet aerators 3. Lighting (see below) (20) Vanity - 18W CFL to 13W CFL, (40) Vanity - 65W Inc. to 13W CFL, (18) kitchen 60W Inc to 14W CFL, (4) laundry 22W T9 to 16W LED, (6) exterior porch 60W Inc to 9.5W LED, (14) exterior porch 13W CFL to 9.5W LED 4. DHW: AO Smith BTH 199 200. 100 gallon, 199 kBtuh input, 97% recovery efficiency and 1.8% stand by loss.	1. Verified two new refrigerators (manufactured 2014), however, unable to obtain Energy Guide ratings for the products as they have been discontinued. Frigidaire m/n FFTR1514QW Frigidaire m/n FFHT1826LWC manufacturer specs indicate 383 kWh/yr. Savings passed thru. 2. Verified 0.5 gpm aerators in the bathroom faucets. ED guidance applied correctly. Savings passed thru. 3. Verified all lighting measure types and quantities except in the two dwelling units accessed; the bathroom vanity fixtures still had 18W CFL lamps and have been removed as the proposed fixture type from the custom lighting savings calculations. Lighting savings reduced from 1,685 kWh to 1,617 kWh. 4. Verified AO Smith Cyclone m/n BTH 199 200 as installed
Dwelling Unit Sampling and Verification Summary	(20) 1-bed/1-bath dwelling units		Surveyor accessed (4) dwelling units
Modeling Approach	General Observations		HR residential default occupancy assumptions not set (model using 333 s.f./occ and 0 cfm/occ)
	Errors		
	Eligibility Considerations		
Change Log	Initial Comparison - modeled to metered ratio		88% kWh, no therm data
	Adjustments and Impact - building characteristics and measures		Building Characteristics 1. Update exterior wall area, window area, and slab on grade perimeter based on site verified dimensions and listed above in the Exterior Surface Areas section. 2. Update existing dwelling unit and hallway LPD's based on ex-post evaluation approach to lighting. 3. Occupancy assumptions Measures 1. Lighting LPD in dwelling units to account for 18W CFL's still in the bathroom vanity fixture.
	Calibration Adjustments - modeled to metered ratio		122% kWh, no therm data
	Adjustments and Impact - ER/ROB		DHW - 82% thermal efficiency
Tracking Ex-Ante 1st Year Savings	Total Energy Savings (% Improvement)	22.80%	
	kW	0.4014	
	kWh	4330.80	
	Therms	532.8	
Ex-Post 1st Year Savings	kW		0.52
	kWh		4,640.00
	Therms		592
Realization Rates	kW		129%
	kWh		107%
	Therms		111%

Site ID: BayREN_80921			
Element	**Details**	**REN**	**Itron Review Summary**
Model Inputs and Building Characteristics	Building and Appliances	7,425 s.f. low-rise, 6 dwelling units	7,980 s.f. low-rise, 6 dwelling units
	Exterior Surface Areas	Walls - 473 s.f. all orientations all floors (5,244 s.f. total) Windows - 166 s.f all orientations all floors (1,922 s.f. total) Raised floor - 2,242 s.f. Roof - 2,242 s.f.	Walls - 252 s.f. N and S orientations all floors, 855 s.f. E and W orientations all floors (6,642 s.f. total) Windows - between 0 and 300 s.f. per orientation (1,440 s.f. total) Raised floor - 2,660 s.f. Roof - 2,660 s.f.
	Exterior Surface Construction and Performance Values	R-0 Wall, Wood Framed; R-0 Roof Attic, Wood Framed; Double Non-Metal Clear R-0 Floor Crawlspace	Surveyor verified: Walls - Wood framed, insulation not accessible Windows - Single Pane Non-Metal Clear Roof - 2x8 Wood Framed Rafter Raised floor over unconditioned space/basement
	HVAC Equipment Type and Efficiency	Radiators Peerless 61-07-SPRK-5 Baseboard Distribution	Gas Fired Boiler Peerless 61-07-SPRK-S 240 kBtuh input Baseboard Distribution
	DHW Equipment Type and Efficiency	Central DHW, (1) Large A O Smith HW 120M 894 indirect gas 77% Recovery Efficiency 120,000 Btu Volume: 119 Gallons 0.3 hp recirc pump, temp control	LAARS LUHE60T12SE3N 125,000 Btu 60 Gallon Capacity 95% thermal efficiency Demand control
	Lighting	Dwelling units - 0.22 W/sf Hallway Zone - 0.29 W/sf	Dwelling unit lighting consists of incandescent. Not a measure and not changing the w/sf used in ex-ante.
	Exterior Equipment	None	None
	Operating schedules		
Measure Verification	1. TRV's 2. DHW and Heating HW pipe insulation 3. DHW boiler 4. Indoor lighting	1. TRV's: (17) total 2. DHW and Heating HW pipe insulation: 1.5" on 36 linear feet of steam heating pipe, 1" on 219 linear feet of DHW piping 3. DHW boiler" 95% 60 gallon MF central system 4. Indoor lighting: Common area: 9.5W A19 LED (16 total), 4W E26 chandelier type bulbs (6 total)	1. Verified per documentation 2. Verified per documentation. However, the DHW pipe calculations are using the existing equipment efficiency of 75%. Ex-post changed the efficiency to that of new DHW equipment, or 95%. 3. Verified per documentation 4. Verified per documentation
Dwelling Unit Sampling and Verification Summary	(1) 1- BDRM / 1 Bath (5) 2 BDRM / 1 Bath		Itron surveyed one two bedroom unit
Modeling Approach	General Observations		1 Hallways are conditioned space per evaluation survey and the lighting calculator also indicated the halls are conditioned. EPL assumes unconditioned hallways and does not model exterior surfaces.
	Errors		
	Eligibility Considerations		
Change Log	Initial Comparison - modeled to metered ratio		Meter data not comprehensive enough to use for comparison.
	Adjustments and Impact - building characteristics and measures		Building Characteristics 1. wall and window areas, total conditioned floor area Measures No changes
	Calibration Adjustments - modeled to metered ratio		Meter data not comprehensive enough to use
	Adjustments and Impact - ER/ROB		DHW boiler, ROB, 82%
Tracking Ex-Ante 1st Year Savings	Total Energy Savings (% Improvement)	20.10%	
	kW	0.0	
	kWh	1479.60	
	Therms	620.1	
Ex-Post 1st Year Savings	kW		0.16
	kWh		1,644.00
	Therms		551
Realization Rates	kW		#DIV/0!
	kWh		111%
	Therms		89%

Site ID: BayREN_80921			
Element	**Details**	**REN**	**Itron Review Summary**
Model Inputs and Building Characteristics	Building and Appliances	7,425 s.f. low-rise, 6 dwelling units	7,980 s.f. low-rise, 6 dwelling units
	Exterior Surface Areas	Walls - 473 s.f. all orientations all floors (5,244 s.f. total) Windows - 166 s.f all orientations all floors (1,922 s.f. total) Raised floor - 2,242 s.f. Roof - 2,242 s.f.	Walls - 252 s.f. N and S orientations all floors, 855 s.f. E and W orientations all floors (6,642 s.f. total) Windows - between 0 and 300 s.f. per orientation (1,440 s.f. total) Raised floor - 2,660 s.f. Roof - 2,660 s.f.
	Exterior Surface Construction and Performance Values	R-0 Wall, Wood Framed; R-0 Roof Attic, Wood Framed; Double Non-Metal Clear R-0 Floor Crawlspace	Surveyor verified: Walls - Wood framed, insulation not accessible Windows - Single Pane Non-Metal Clear Roof - 2x8 Wood Framed Rafter Raised floor over unconditioned space/basement
	HVAC Equipment Type and Efficiency	Radiators Peerless 61-07-SPRK-5 Baseboard Distribution	Gas Fired Boiler Peerless 61-07-SPRK-S 240 kBtuh input Baseboard Distribution
	DHW Equipment Type and Efficiency	Central DHW, (1) Large A O Smith HW 120M 894 indirect gas 77% Recovery Efficiency 120,000 Btu Volume: 119 Gallons 0.3 hp recirc pump, temp control	LAARS LUHE60T12SE3N 125,000 Btu 60 Gallon Capacity 95% thermal efficiency Demand control
	Lighting	Dwelling units - 0.22 W/sf Hallway Zone - 0.29 W/sf	Dwelling unit lighting consists of incandescent. Not a measure and not changing the w/sf used in ex-ante.
	Exterior Equipment	None	None
	Operating schedules		
Measure Verification	1. TRV's 2. DHW and Heating HW pipe insulation 3. DHW boiler 4. Indoor lighting	1. TRV's: (17) total 2. DHW and Heating HW pipe insulation: 1.5" on 36 linear feet of steam heating pipe, 1" on 219 linear feet of DHW piping 3. DHW boiler" 95% 60 gallon MF central system 4. Indoor lighting: Common area: 9.5W A19 LED (16 total), 4W E26 chandelier type bulbs (6 total)	1. Verified per documentation 2. Verified per documentation. However, the DHW pipe calculations are using the existing equipment efficiency of 75%. Ex-post changed the efficiency to that of new DHW equipment, or 95%. 3. Verified per documentation 4. Verified per documentation
Dwelling Unit Sampling and Verification Summary	(1) 1- BDRM / 1 Bath (5) 2 BDRM / 1 Bath		Itron surveyed one two bedroom unit
Modeling Approach	General Observations		1 Hallways are conditioned space per evaluation survey and the lighting calculator also indicated the halls are conditioned. EPL assumes unconditioned hallways and does not model exterior surfaces.
	Errors		
	Eligibility Considerations		
Change Log	Initial Comparison - modeled to metered ratio		Meter data not comprehensive enough to use for comparison.
	Adjustments and Impact - building characteristics and measures		Building Characteristics 1. wall and window areas, total conditioned floor area Measures No changes
	Calibration Adjustments - modeled to metered ratio		Meter data not comprehensive enough to use
	Adjustments and Impact - ER/ROB		DHW boiler, ROB, 82%
Tracking Ex-Ante 1st Year Savings	Total Energy Savings (% Improvement)	20.10%	
	kW	0.0	
	kWh	1479.60	
	Therms	620.1	
Ex-Post 1st Year Savings	kW		0.16
	kWh		1,644.00
	Therms		551
Realization Rates	kW		#DIV/0!
	kWh		111%
	Therms		89%

Site ID: BayREN_81403			
Element	**Details**	**REN**	**Itron Review Summary**
Model Inputs and Building Characteristics	Building and Appliances	(5) buildings with (20) Dwelling units 17,160 s.f. distributed evenly across two floors Hallway/common area: 420 s.f. distributed evenly across two floors Refrigerator: 461 kWh/yr.	(5) buildings with (20) Dwelling units 18,620 s.f. distributed evenly across two floors Hallway/common area: 420 s.f. ground floor Refrigerator: Frigidaire m/n FFTR1814QSO. 404 kWh/yr.
	Exterior Surface Areas	Total Walls: 7,408 s.f. Total Windows: 2,592 s.f. Walls: 926 s.f. per orientation per floor Windows: 324 s.f. per orientation per floor Slab on grade floor: 8,580 s.f. 343 linear feet Roof: 8,580 s.f.	Total Walls: 15,660 s.f. Total Windows: 2,160 s.f. Walls: 2,205 s.f. N and S orientations per floor, 1.710 s.f. E and W orientations per floor Windows: 336 s.f. North per floor, 240 s.f. East and West per floor, 264 s.f. South per floor Slab on grade: 9,310 s.f., 880 linear feet Roof: 9,310 s.f.
	Exterior Surface Construction and Performance Values	Walls: R-1 wood framed wall (0.285 u-value) Windows: single metal clear (measure) Floor: slab on grade Roof: R-0 cathedral (0.297 u-value)	Walls: wood framed wall - insulation not visible Windows: double non-metal Floor: slab on grade Roof: Flat cathedral - insulation not visible
	HVAC Equipment Type and Efficiency	Gravity wall furnace and PTAC's - average efficiency 66.8% AFUE. PTAC's - average efficiency 9.4 EER, 750 cfm and .05 hp supply fan	Gravity wall furnace Williams m/n GWT-25-2 PTAC's - Frigidaire mode l number not recorded/visible (REN EER value of 9.4 appears to be almost average of Table R3-50 vintage based defaults). cfm and fan power not verifiable
	DHW Equipment Type and Efficiency	(20) small storage units, average energy factor 0.567, average capacity of 32,429 Btu/hr and 33 gallon tank.	(3) DHW units verified: AO Smith m/n GCNH301000, 30 gallon Craftmaster m/n UG1A4040T3NV, 40 gallon Whirlpool m/n NV40T61-403, 40 gallon, 0.59 energy factor 1" insulation on pipes verified. Not making changes since Itron was only able to verify efficiency for one of three DHW units.
	Lighting	Dwelling Units: 1,086 Watts (0.063 W/sf) Hallways/common: 383 Watts (0.911 W/sf) Exterior: 1,987 Watts	Dwelling Units: 1,086 Watts (0.063 W/sf) Hallways/common: 383 Watts (0.911 W/sf) Exterior: 1,987 Watts
	Exterior Equipment		
	Operating schedules		
Measure Verification	1. Dishwashers 2. Low-flow fixtures (custom) 3. Windows 4. Dwelling unit lighting (custom)	1. Dishwashers 2. Low-flow fixtures: (20) 1.5 gpm showerheads, (20) 1.0 gpm kitchen faucet aerators, (20) 1.0 gpm bathroom faucet aerators 3. Windows:: Ameriglass AG3 Low E 3, 0.28 u-value 0.22 SHGC, 2,592 s.f. total area	1. Frigidaire m/n TH43161584 can not locate efficiency rating, even on the Frigidaire website. 2. Verified the low-flow fixtures as documented in REN custom calculator. Application of ED guidance is accurate. 3. Verified new double paned vinyl windows, 2,160 s.f. total area
Dwelling Unit Sampling and Verification Summary	(20) 2-bed 1-bath units		(2) 2-bed 1-bath units
Modeling Approach	General Observations	EPL+ EnergyPro used	continuous fans 750 cfm, 0.05 cfm and intermittent control occupancy assumptions not set
	Errors		
	Eligibility Considerations		Input of actual wall and window area causes % improvement to drop to 7.9%.
Change Log	Initial Comparison - modeled to metered ratio		
	Adjustments and Impact - building characteristics and measures		Building Characteristics 1. Occupancy assumptions 2. Update exterior surface areas 3. Set PTAC supply fans to intermittent Measures 1. Bathroom vanity lighting
	Calibration Adjustments - modeled to metered ratio		
	Adjustments and Impact - ER/ROB		Windows, ER, U-0.32 SHGC-0.22
Tracking Ex-Ante 1st Year Savings	Total Energy Savings (% Improvement)	10.90%	
	kW	5.0	
	kWh	11371.50	
	Therms	479.7	
Ex-Post 1st Year Savings	kW		4.60
	kWh		10,315.00
	Therms		409
Realization Rates	kW		92%
	kWh		91%
	Therms		85%

Site ID: BayREN_81768			
Element	**Details**	**REN**	**Itron Review Summary**
Model Inputs and Building Characteristics	Building and Appliances	(3) story garden style square shaped building 11,422 s.f. total and dwelling units distributed equally across three floors no common area (12) dwelling units Refrigerator: 491 kWh/yr	3 story garden style rectangle shaped building 11,422 s.f. total and dwelling units no common area (12) dwelling units
	Exterior Surface Areas	Total Walls: 7,404 s.f. Total Windows: 2,592 s.f. Walls: 617 s.f. per orientation per floor Windows: Per floor per orientation: 136 s.f. single metal to remain, 12.7 double non-metal s.f. to remain, and 67.8 single metal to be replaced Windows: between 53 s.f. and 114 s.f. per orientation per floor Floor: 3,600 s.f. Roof: 3,600 s.f.	Total Walls: 8,100 s.f. Total Windows: 921 s.f. Walls: 270 s.f. per N and S orientation per floor, 1,080 s.f. per E and W orientation per floor Windows: between 53 s.f. and 114 s.f. per orientation per floor (921 s.f. total) Floor: 3,600 s.f. Roof: 3,600 s.f.
	Exterior Surface Construction and Performance Values	Walls: R-0 wood framed (default prior to 1978) Windows: single metal and double non-metal Floor: uninsulated raised slab Roof: R-11 attic (default prior to 1978)	Walls: Windows: Floor: uninsulated raised slab Roof:
	HVAC Equipment Type and Efficiency	Gravity wall furnace 65% AFUE No cooling	Gravity furnace, Williams, nameplate not visible No cooling
	DHW Equipment Type and Efficiency	MF Central system AO Smith BTR 198 110 80% thermal efficiency 0.11 hp recirculation pump, no control (measure)	MF Central system
	Lighting	Dwelling units: 0.041 W/sf Exterior: 567 Watts	LED and CFL lighting in the two dwelling units accessed by surveyor and since dwelling unit lighting is not measure, the input value is not being changed.
	Exterior Equipment	Laundry	
	Operating schedules		
Measure Verification	1. Low-flow fixtures 2. DHW Recirc demand controls 3. Windows 0.31 u-value 0.22 SHGC 4. Refrigerators 464 kWh/yr 5. Exterior lighting	1. Low-flow fixtures: (7) showerheads, (10) bathroom faucets, (5) kitchen faucets 2. DHW Recirc: REN documentation does not include pictures of the DHW system and pump. 3. Windows: 0.31 U-value 0.22 SHGC, 813.6 s.f. total area to be replaced (67.8 s.f. per orientation) 4. Refrigerators: (10) total 5. Parking area LED's, Porch LED's, and Security light 14W LED	1. Surveyor indicated new aerators had been installed on shower heads and faucets in dwelling units accessed during the survey. 2. Surveyor was not able to access the area where the DHW equipment is located to verify the DHW system and recirculation pump and controller and evaluator can not definitively prove this measure was installed or not, and therefore, is being passed thru. REN needs to provide photo documentation of every measure included in the work scope. 3. Surveyor indicated all dual paned non-metal windows (921 s.f. total window area compared to REN total of 2,592 s.f.). Because the REN indicated about half the windows were single pane and will be replaced, and there is no way to verify the existing conditions, the ex-post modeled half the site verified windows as single pane (461 s.f.) to be replaced and half as double pane non-metal (461 s.f.) to remain. 4. Accessed three dwelling units and verified one Electrolux FFTR18140W0 (not able to find kWh/yr rating) and two Hotpoint HTS18GBSARWW (480 kWh/yr). According to the REN documentation, it appears the replaced refrigerators were in dwelling units not accessed by evaluation surveyor and the savings are passed thru. 5. Spot check of exterior lighting indicated LED lamps in the garages, porch/exteriors, and security lighting.
Dwelling Unit Sampling and Verification Summary	(12) 2-bed 1-bath dwelling units		(1) 2-bed 1-bath dwelling units
Modeling Approach	General Observations		Epro used to model some window replacements.
	Errors		
	Eligibility Considerations		Project drops below eligibility threshold to 9% when updated actual wall and window areas.
Change Log	Initial Comparison - modeled to metered ratio		
	Adjustments and Impact - building characteristics and measures		Building Characteristics 1. Wall and window areas. Measures 1. Window area
	Calibration Adjustments - modeled to metered ratio		
	Adjustments and Impact - ER/ROB		Windows, ROB, U-0.32 SHGC-0.25
Tracking Ex-Ante 1st Year Savings	Total Energy Savings (% Improvement)	11.50%	
	kW	0.4	
	kWh	1558.78	
	Therms	502.7	
Ex-Post 1st Year Savings	kW		0.35
	kWh		1,732.00
	Therms		417
Realization Rates	kW		97%
	kWh		111%
	Therms		83%

Site ID: BayREN_83048			
Element	**Details**	**REN**	**Itron Review Summary**
Model Inputs and Building Characteristics	Building and Appliances	10,800 s.f. two-story low-rise equally distributed across two floors 14 dwelling units Refrigerator: 363 kWh/yr	9,740 s.f. two-story low-rise, 1st floor: 4,600 2nd floor: 5,140 s.f. 14 dwelling units Refrigerator:
	Exterior Surface Areas	Total Walls: 5,864 s.f. Total Windows: 2,053 s.f. Walls: 733 s.f. per floor per orientation Windows: 257 per floor per orientation Floor: 5,375 s.f. Roof - 5,375 s.f.	Total Walls: 9,018 s.f. Total Windows: 1,067 s.f. Walls: between 810 and 1,440 s.f. Windows: between 24 s.f. and 212 s.f. Floor: wood framed over crawl, 4600 s.f. Roof - 5140 s.f.
	Exterior Surface Construction and Performance Values	Walls: R-0 wood frame (Default Wall Prior to 1978) Windows: Single Metal Clear (measure) Roof: R-0 Cathedral/Wood Framed Rafter Floor: R-0 Floor Crawlspace	Surveyor verified: Walls -Wood Framed, insulation not accessible Windows- Dual paned vinyl Roof - 2x4 Wood Framed Rafter, insulation not accessible Floor - Crawlspace, insulation not accessible
	HVAC Equipment Type and Efficiency	Natural gas gravity wall furnace, 68% AFUE Ductless / No Fan No cooling	Gas gravity wall furnace (14) 1 in each dwelling unit, nameplate data not visible No cooling
	DHW Equipment Type and Efficiency	Central DHW (2) large storage units with average 80% recovery efficiency, 1.53% stand by loss.	Surveyor verified (2) large storage DHW units American G62-100T774NOV, 75,100 Btuh, 80% thermal efficiency Rheem G100UN, 75,100 Btuh, 80% thermal efficiency
	Lighting	Dwelling Units - 0.034 W/sf (0.371 kW) Halls - 0.9 W/sf (0.045 kW) Exterior - 0.669 kW	Surveyor verified: Dwelling Units - (3) fixtures in the 1 BR Units and (4) fixtures in the 2 BR Units; (2) 13w CFL in dwelling unit bathrooms and CIR Fluorescents in kitchens and bedrooms, wattage not verified; Relatively consistent with the lighting workbook however REN claims an additional CIR in each unit hall that was not verified and the quantity is only 10 rather than the claimed 14 for fixtures in the second bedroom. Laundry Room - Custom Measure (2) 13.5w LED Exterior - Pictures taken onsite support the lighting described in the lighting workbook
	Exterior Equipment	None	
	Operating schedules		
Measure Verification	1. Windows: 0.34 u-value 0.31 SHGC 2. Laundry room lighting and control (custom) 3. Washing machine (custom) 4. Low-flow fixtures (custom)	1. Dual paned windows: 2,054 s.f. 2. Laundry Room Lighting: (2) CFL replaced with 10W LED A-lamps and twist-time control installed 3. Replaced existing washing machine with CEE Tier 3 washing machine 4. 1.5 GPM kitchen aerators in (13) dwelling units	1. Windows measure verified as dual paned, vinyl frame, low-e, 1,067 s.f. total area to be updated in model 2. Laundry room lighting and control - (2) 13.5W LED A-lamps with (1) MSW control 3. Washing machine - verified SFNNCASP113TW01 2.9 MEF and 3.8 WF which meets TIER 3 MEF (2.4 or greater) and WEF requirements (4.0 or less). 4. Verified low-flow aerators installed on kitchen faucets in two dwelling units accessed during survey.
Dwelling Unit Sampling and Verification Summary	(4) 1- BDRM (10) 2- BDRM		Itron surveyed one of each type
Modeling Approach	General Observations		High-rise residential default occupancy assumptions not set (e.g. occ density 333 s.f./occ and 0 cfm/occ ventilation)
	Errors		
	Eligibility Considerations		
Change Log	Initial Comparison - modeled to metered ratio		Incomplete billing data
	Adjustments and Impact - building characteristics and measures		Characteristics and Other Adjustments: 1. Total floor area, exterior surfaces, and window areas per values on the Exterior Surfaces Verification tab. Measure Adjustments: 1. Laundry room lighting savings adjusted from 74.65 kWh to 49.13 kWh to account for 13.5 W LED verified on-site. 2. Window areas.
	Calibration Adjustments - modeled to metered ratio		Incomplete billing data.
	Adjustments and Impact - ER/ROB		Windows: U-0.35 SHGC-0.22
Tracking Ex-Ante 1st Year Savings	Total Energy Savings (% Improvement)	12.20%	
	kW	0.1	
	kWh	590.36	
	Therms	665.4	
Ex-Post 1st Year Savings	kW		0.08
	kWh		630.00
	Therms		495
Realization Rates	kW		111%
	kWh		107%
	Therms		74%

Site ID: BayREN 803234			
Element	**Details**	**REN**	**Itron Review Summary**
Model Inputs and Building Characteristics	Building and Appliances	79,300 s.f. four story (high-rise) 68 dwelling units	77,000 s.f. four story 68 dwelling units
	Exterior Surface Areas	Walls - Total area 9,792 s.f.. 1,088 s.f. all orientations all floors Windows - Total area 3,429 s.f.. 380.8 s.f all orientations all floors Slab - 18,500 s.f., perimeter - 740' Roof - 18,500 s.f.	Walls - Total area 13,185 s.f.. 650 s.f. per floor east and west orientation. 765 s.f. per floor north and south orientations Windows - Total area 2,818 s.f. 2,340 s.f. per floor east and west orientation. 94 s.f. per 2-4th floors south orientation, 15. s.f per 2-4th north Slab - 18,525 s.f., perimeter - 690' Roof - 18,525 s.f.
	Exterior Surface Construction and Performance Values	Default Wall 1992 to Present R-13 wood wall Double Non Metal Clear 0.55 u-value 0.67 SHGC no overhangs Default Roof 1978 to Present R-19 wood framed attic Slab on grade	Walls - 2x6 wood frame wall, insulation not verifiable Windows - double pane vinyl Verified 6' overhangs on patio slider doors Roof - 2x6 attic roof, insulation not verifiable Slab on grade Appears REN modeled construction assemblies appropriately, except the overhangs which ex-post will model.
	HVAC Equipment Type and Efficiency	Split heat pump 6 HSPF 13.0 SEER, (17) units per floor Ducted distribution, ducts in attic Setback t-stat	Surveyor verified split heat pumps Bryant m/n 661CJ series for dwelling units and common area. (68) 030C in dwelling units, (1) 048 and (3) 036 in common areas. VERIFY EFFICIENCY
	DHW Equipment Type and Efficiency	Central DHW, (2) large indirect boiler 80.2% recovery efficiency. R-12 insulation on external tank. (2) .15 hp recirc pumps, temp controlled.	State SBN100200NC 250,000 Btu/hr input American Standard m/n ND100210AS 270,000 Btu/hr input VERIFY EFFICIENCY Another State w/out model number Grundfos pump no other details
	Lighting	Dwelling units - 0.042 W/sf (3.088 kW) Hallway Zone - 3.719 W/sf (19.712 kW)	Dwelling Units- Hallways- see measure verification below.
	Exterior Equipment	4.878 kW Exterior Lighting 978 Watts Laundry 7,332 Btu/hr Laundry	
	Operating schedules	All default except heating and cooling set points and 24/7 process load	
Measure Verification	1. pool pump 2 and 3. Appliances 4. Showerheads and aerators (custom) 5. Exterior and common area lighting (custom) 6. Pipe insulation (custom)	1. pool pump: 3.0 hp VSD 2 and 3 Appliances: (6) dishwashers CEE TIER 1 units, (15) refrigerators 358 kWh/yr, (3) clothes washers CEE TIER 3 in common area 4. Showerheads and aerators: (84) 1.0 gpm bath aerators, (68) 1.5 gpm kitchen aerators, (84) 1.7 gpm shower heads. 5. Exterior and interior common area lighting: LED fixtures throughout (see supporting calcs). 4,340 HOU for exterior, 7,474 HOU for interior hallways, and 1,556 HOU for support. 6. Pipe insulation: 1.5" on 14 linear feet	1. Verified a 3.0 hp Pentair Intellaflow pool pump. 2 and 3: Appliances 4. Itron surveyor verified low flow fixtures in the bathrooms and ED guidance applied correctly. 5. Itron surveyor surveyed the lighting throughout the common area and exterior and determined the measure is installed with the following exceptions: a) Fitness room - (6) ceiling mount fixtures with (3) 15W LED linear per fixture and a fixture wattage of 45W. REN calculated three fixtures at 15W per fixture. b) Laundry room - (3) ceiling mount fixtures with (2) 15W LED linear per fixture for a fixture wattage of 30W. REN calculated three fixtures at 15W per fixture 6. Pipe insulation verified, savings passed thru without reviewing calculations since they are minor.
Dwelling Unit Sampling and Verification Summary	(43) 1-bed (16) 2-bed (9) 1-bed loft		Itron surveyed one of each type.
Modeling Approach	General Observations		EnergyPro for appliances, pool pump + custom measures.
	Errors		
	Eligibility Considerations		
Change Log	Initial Comparison - modeled to metered ratio		
	Impact on Building Total Consumption when Running NR PERF		
	Adjustments and Impact - building characteristics and measures		1. Adjusted wall and windows per floor and orientation per the values listed above. 2. Lighting Measure - adjusted post-retrofit fixture wattage from 15W to 45W for six fitness room fixtures.
	Adjustments and Impact - ER/ROB		none
	Final Comparison		
Tracking Ex-Ante 1st Year Savings	Total Energy Savings (% Improvement)	11.90%	
	kWh	50899.5	
	kW	5.8	
	Therms	1024.7	
Ex-Post 1st Year Savings	kWh		55,260.00
	kW		6.80
	Therms		1139
1st Year Realization Rates	kWh		109%
	kW		117%
	Therms		111%

Site ID: BayREN_83482			
Element	**Details**	**REN**	**Itron Review Summary**
Model Inputs and Building Characteristics	Building and Appliances	Six story building, 15 dwelling units. Total floor area - 37,518 s.f. Dwelling unit floor area - 29,692 s.f. Unconditioned hallway floor area - 5,228 s.f. Refrigerators - 775 kWh	Six story building, 15 dwelling units. Total floor area - 34,920 s.f. Dwelling unit floor area - 31,890 s.f. Unconditioned hallway floor area - 5,628 s.f. Refrigerators - dwelling units not accessed
	Exterior Surface Areas	Walls - 583 s.f. per floor per orientation Windows - 204.13 s.f. per floor per orientation Roof - 5,315 s.f. (unconditioned halls do not have a roof assigned) Floor - 5,315 s.f. (unconditioned halls do not have a roof assigned)	Walls - 927 s.f north and south / 900 s.f. east and and west Windows - 216 s.f north, 126 s.f east and west, 244 s.f. south Roof - 5,802 s.f. Floor - 5,802 s.f.
	Exterior Surface Construction and Performance Values	Wals - 8" CMU Windows - Single pane non-metal clear Roof - Concrete deck Uninsulated raised slab	Wals - concrete Windows - Single pane non-metal clear Roof - Concrete deck
	HVAC Equipment Type and Efficiency	Hot water radiant, (1) steam boiler, 80% recovery/thermal efficiency. No cooling	Peerless m/n LC-05-WIS 80.3% recovery/thermal efficiency. No cooling
	DHW Equipment Type and Efficiency	(2) Large storage central, 84% recovery efficiency, temperature control recirc pump	Verified two units: 1) Pennant with tags not visible 2) Laars/Bradford White AD078000 - not in AHRI and specs not found otherwise. The modeled efficiency is relatively high so accepting as-is. Demand control (but no pictures to confirm).
	Lighting	Dwelling units - 0.135 W/sf Hallways - 3.810 W/sf	
	Exterior Equipment	Exterior lighting 22 Watts Laundry - 326 Watts and 2,444 Btuh/hr	
	Operating schedules	All default except for receptacle, process, and heating using the "CA 24 Hour"	
Measure Verification	1. Common area lighting 2. Pipe insulation	1. Common Area Lighting 1a. Stairwells 1st through 6th floors - (6) 12W LED replacing 60W incandescent and 23W screw in CFL, 7474 annual HOU in spreadsheet calcs. 1b. Hallways 2nd-6th floors - (15) 5W LED replacing (15) 40W candelbra lamps (five 3-lamp fixtures) 7474 annual HOU in spreadsheet calcs. 1c. Common-Storage/Utility/Mechanical - (10) 12W LED replacing (10) 23W CFL 2. Pipe Insulation Steam heating - 1" insulation on 75.6 linear feet, 1.5" insulation on 315 linear feet, 2" insulation on 150.6 linear feet. DHW - 1" insulation on 170 linear feet, 1.5" insulation on 237.6 lineare feet.	1a and 1b. Surveyor verified fixture counts and LED lamp wattages as 5W and 9.5W. It is not clear if the 12W LED's indicated inthe close-out memo were replaced with 9W throughout, or just the one verified lamp was changed out. Either way, the savings are passed trhough as-is since LED lamps were installed. 1c. Common Storage/Utility/Mechanical - it appears there was an error in the calculcation spreadsheet as the fixture wattage was input as 368 W per fixture when the lamps are 23W CFL's resulting in inflated kWh savings. 2. surveyor verified installation of piping insulation, however did not measure the pipe lengths so this measure is passed thru as installed.
Dwelling Unit Sampling and Verification Summary	(15) dwelling units		Site contact would not allow Itron surveyor into the dwelling units.
Modeling Approach	General Observations		EPL used to model existing conditions, measure savings calculated with spreadhseets and modeled as custom measure on the alternatives tab. When exported from EPL to EnergyPro, the default loads assumptions were not made. Upon replacing all, the heating therm usage increased primarily due to ventilation rate increasing from 0 cfm/occ to 30 cfm/occ. % improvement drops from 27% to 17%.
	Errors		
	Eligibility Considerations		
Change Log	Initial Comparison - modeled to metered ratio		
	Adjustments and Impact - building characteristics and measures		1. Walls - 927 s.f north and south / 900 s.f. east and and west 2. Windows - 216 s.f north, 126 s.f east and west, 244 s.f. south 3. Changed the existng fixture wattage in the common storage/utility/mechanical room from 0.368 kW to 0.0230 kW for each of the ten fixtures retrofit.
	Calibration Adjustments - modeled to metered ratio		
	Adjustments and Impact - ER/ROB		None
Tracking Ex-Ante 1st Year Savings	Total Energy Savings (% Improvement)		
	kW	0.0	
	kWh	10165.50	
	Therms	2737.8	
Ex-Post 1st Year Savings	kW		0.74
	kWh		5,926
	Therms		3,042
Realization Rates	kW		#DIV/0!
	kWh		58%
	Therms		111%

Site ID: BayREN_83482			
Element	**Details**	**REN**	**Itron Review Summary**
Model Inputs and Building Characteristics	Building and Appliances	Six story building, 15 dwelling units. Total floor area - 37,518 s.f. Dwelling unit floor area - 29,692 s.f. Unconditioned hallway floor area - 5,228 s.f. Refrigerators - 775 kWh	Six story building, 15 dwelling units. Total floor area - 34,920 s.f. Dwelling unit floor area - 31,890 s.f. Unconditioned hallway floor area - 5,628 s.f. Refrigerators - dwelling units not accessed
	Exterior Surface Areas	Walls - 583 s.f. per floor per orientation Windows - 204.13 s.f. per floor per orientation Roof - 5,315 s.f. (unconditioned halls do not have a roof assigned) Floor - 5,315 s.f. (unconditioned halls do not have a roof assigned)	Walls - 927 s.f north and south / 900 s.f. east and and west Windows - 216 s.f north, 126 s.f east and west, 244 s.f. south Roof - 5,802 s.f. Floor - 5,802 s.f.
	Exterior Surface Construction and Performance Values	Wals - 8" CMU Windows - Single pane non-metal clear Roof - Concrete deck Uninsulated raised slab	Wals - concrete Windows - Single pane non-metal clear Roof - Concrete deck
	HVAC Equipment Type and Efficiency	Hot water radiant, (1) steam boiler, 80% recovery/thermal efficiency. No cooling	Peerless m/n LC-05-WIS 80.3% recovery/thermal efficiency. No cooling
	DHW Equipment Type and Efficiency	(2) Large storage central, 84% recovery efficiency, temperature control recirc pump	Verified two units: 1) Pennant with tags not visible 2) Laars/Bradford White AD078000 - not in AHRI and specs not found otherwise. The modeled efficiency is relatively high so accepting as-is. Demand control (but no pictures to confirm).
	Lighting	Dwelling units - 0.135 W/sf Hallways - 3.810 W/sf	
	Exterior Equipment	Exterior lighting 22 Watts Laundry - 326 Watts and 2,444 Btuh/hr	
	Operating schedules	All default except for receptacle, process, and heating using the "CA 24 Hour"	
Measure Verification	1. Common area lighting 2. Pipe insulation	1. Common Area Lighting 1a. Stairwells 1st through 6th floors - (6) 12W LED replacing 60W incandescent and 23W screw in CFL, 7474 annual HOU in spreadsheet calcs. 1b. Hallways 2nd-6th floors - (15) 5W LED replacing (15) 40W candelbra lamps (five 3-lamp fixtures) 7474 annual HOU in spreadsheet calcs. 1c. Common-Storage/Utility/Mechanical - (10) 12W LED replacing (10) 23W CFL 2. Pipe Insulation Steam heating - 1" insulation on 75.6 linear feet, 1.5" insulation on 315 linear feet, 2" insulation on 150.6 linear feet. DHW - 1" insulation on 170 linear feet, 1.5" insulation on 237.6 lineare feet.	1a and 1b. Surveyor verified fixture counts and LED lamp wattages as 5W and 9.5W. It is not clear if the 12W LED's indicated inthe close-out memo were replaced with 9W throughout, or just the one verified lamp was changed out. Either way, the savings are passed trhough as-is since LED lamps were installed. 1c. Common Storage/Utility/Mechanical - it appears there was an error in the calculcation spreadsheet as the fixture wattage was input as 368 W per fixture when the lamps are 23W CFL's resulting in inflated kWh savings. 2. surveyor verified installation of piping insulation, however did not measure the pipe lengths so this measure is passed thru as installed.
Dwelling Unit Sampling and Verification Summary	(15) dwelling units		Site contact would not allow Itron surveyor into the dwelling units.
Modeling Approach	General Observations		EPL used to model existing conditions, measure savings calculated with spreadhseets and modeled as custom measure on the alternatives tab. When exported from EPL to EnergyPro, the default loads assumptions were not made.
	Errors		
	Eligibility Considerations		
Change Log	Initial Comparison - modeled to metered ratio		
	Adjustments and Impact - building characteristics and measures		1. Walls - 927 s.f north and south / 900 s.f. east and and west 2. Windows - 216 s.f north, 126 s.f east and west, 244 s.f. south 3. Changed the existng fixture wattage in the common storage/utility/mechanical room from 0.368 kW to 0.0230 kW for each of the ten fixtures retrofit.
	Calibration Adjustments - modeled to metered ratio		
	Adjustments and Impact - ER/ROB		None
Tracking Ex-Ante 1st Year Savings	Total Energy Savings (% Improvement)		
	kW	0.0	
	kWh	10165.50	
	Therms	2737.8	
Ex-Post 1st Year Savings	kW		0.74
	kWh		5,926
	Therms		3,042
Realization Rates	kW		#DIV/0!
	kWh		58%
	Therms		111%

Site ID: BayREN_84949			
Element	**Details**	**REN**	**Itron Review Summary**
Model Inputs and Building Characteristics	Building and Appliances	One 3-story block style building Dwelling Units: 14,035 s.f. Hallway/common: 1,559 s.f. (18) dwelling units Refrigerator: 571 kWh/yr	One 3-story block style building Dwelling Units: 14,880 s.f. Hallway/common: (18) dwelling units Refrigerator: not collected because accessed one unit which was vacant and did not have a refrigerator.
	Exterior Surface Areas	Walls: 684 s.f. per orientation per floor Windows: 239 s.f. per orientation per floor Floor: 4,678 s.f. Roof: 4,678 s.f.	Walls: 400 s.f. N and S orientations per floor, 12,40 s.f. E and W orientations per floor Windows: 104 s.f. N per floor, 208 s.f. E and W per floor, 52 s.f. S per floor Floor: 4,960 s.f. Roof: 4,960 s.f.
	Exterior Surface Construction and Performance Values	Walls: R-0 wood frame (default wall prior to 1978) Windows: Avg. of existing dbl and sgl pane 0.83 u-value and 0.72 SHGC Floor: R-0 wood framed raised floor no crawlspace (default floor prior to 1978) Roof: R-11 wood frame attic (default roof prior to 1978)	Walls: wood framed, insulation not visible Windows: double paned vinyl Floor: mainly raised floor over garage to right and left of main lobby, and the small lobby in the center is slab on grade Roof: Rafter roof, insulation not visible
	HVAC Equipment Type and Efficiency	Electric baseboard, 3.413 HSPF No cooling	Electric baseboard, 3.413 HSPF, (3) in unit 104 No cooling
	DHW Equipment Type and Efficiency	MF central system with (1) large storage DHW unit, 100 gallons, 270,000 Btuh input, 82% recovery efficiency, 5.2% standby loss 0.04 hp pump	MF central system with (1) Bradford White m/n UCG100H2703N large storage DHW unit, 100 gallons, 270,000 Btuh input, 82% recovery efficiency, 5.2% standby loss 0.125 hp pump
	Lighting	Dwelling units: 670 Watts (0.047 W/sf) Hall/common: 1,926 Watts (1.235 W/sf) Exterior: 410 Watts	Accessed only one unit and lighting is not a measure so ex-post is using the ex-ante wattage, but inputting actual LPD and 541 EFLH operating schedule for dwelling units and 8,760 for hallway.
	Exterior Equipment	Laundry: 326 Watts, 2.444 kBtuh	
	Operating schedules		
Measure Verification	1. Low-flow fixtures (custom) 2. Windows 3. DHW pump demand control (custom) 4. Insulate bare DHW pipes (custom)	1. 1. Low-flow fixtures: (16) 1.75 gpm showerheads, (5) 1.5 gpm kitchen sink aerators, (11) 0.5 gpm bathroom sink aerators. 2. Windows: 0.34 u-value and 0.27 SHGC, 2,872 s.f. total area 3. Demand control pumping 4. 20 linear feet of DHW pipes with 1" insulation	All measures appeared to be installed and functioning properly. 1. Verified 1.1. gpm bathroom faucet and kitchen faucet Niagra aerators and the picture of the showerhead taken during the on-site looks like the same one as REN close-out documentation. Calculations applied correctly. 2. Verified new dual pane vinyl windows, unable to collect NFRC labels, 1,716 s.f. total area. 3. Verified an Enovative AutoHot Model DCP-9913 demand controller. Calculations appear correct. 4. Verified between 0.5 - 1.0" pipe insulation on central DHW piping, length appears correct from pictures. Calculations appear correct.
Dwelling Unit Sampling and Verification Summary	(12) 1-bed 1-bath (6) 2-bed 1-bath		Surveyor accessed one vacant unit which did not have a refrigerator.
Modeling Approach	General Observations	EPL only + custom calculations	occupancy assumptions not set
	Errors		
	Eligibility Considerations		
Change Log	Initial Comparison - modeled to metered ratio		
	Adjustments and Impact - building characteristics and measures		Building Characteristics 1. Exterior surface areas 2. change roof to R-11 cathedral roof from default attic roof (R-11 attic) Measures 1. Window area updated to reflect conditions found on-site
	Calibration Adjustments - modeled to metered ratio		
	Adjustments and Impact - ER/ROB		Windows, ER, U-0.32 SHGC-0.65
Tracking Ex-Ante 1st Year Savings	Total Energy Savings (% Improvement)	13.40%	
	kW	0.14	Submitted EPL indicates 1.0 kW savings.
	kWh	5393.12	
	Therms	519.6	
Ex-Post 1st Year Savings	kW		2.94
	kWh		5,152.00
	Therms		577
1st Year Realization Rates	kW		2078%
	kWh		96%
	Therms		111%

Site ID: BayREN_84979			
Element	**Details**	**REN**	**Itron Review Summary**
Model Inputs and Building Characteristics	Building and Appliances	Two story 13,668 s.f. total 23 dwelling units 489 kWh/yr refrigerator using average of five units surveyed	2 two story buildings 23 dwelling units The three refrigerators in the dwelling units accessed are older and do not appear to have been one of the five units replaced. Hotpoint CTX14CYBBLAA is 624 kWh/yr and the kWh/yr for the two Kenmore 253.60609412 units could not be located through EnergyStar or www.kouba-cavallo.com database.
	Exterior Surface Areas	Walls - Total area is 6,608 s.f.. 826 s.f. per orientation per floor. Windows - Total area is 2,312 s.f.. 289 s.f. per orientation per floor. Slab on grade - 6,834 s.f., 273.36 linear feet perimeter Roof - 6,834 s.f.	Walls - total area is 9,715 s.f. between 1,044 and 1,536 s.f. per floor per orientation. Windows - total area is 1,533 s.f., between 156 and 252 s.f. per floor per orientation. Slab on grade - 6,300 s.f. 540 linear feet perimeter Roof -
	Exterior Surface Construction and Performance Values	Walls - default prior to 1978 - R-0 wood framed wall 0.356 u-value Windows - single metal clear Roof - default prior to 1979 - R-11 attic	Walls - wood framed, insulation not observed Windows - single metal clear Roof - flat rafter roof, insulation not observed Slab on grade
	HVAC Equipment Type and Efficiency	Cozy gravity wall furnace, 65% AFUE No cooling	Cozy gravity wall furnace, nameplate not visible No cooling
	DHW Equipment Type and Efficiency	Indirect boiler central system, 120 gallons, 300 kBtuh 82% recovery efficiency. (Replaced with measure DHW)	AO Smith BTH199 200, 97% thermal efficiency, central DHW with demand control on recirc pump.
	Lighting	Dwelling units - 0.113 W/sf (1,544 Watts) Halls - 0.476 W/sf	Dwelling units -
	Exterior Equipment	exterior lighting - 1.97 kW	
	Operating schedules	All default except for 24 hour heating, receptacle, and process	Lighting schedule should be changed to 2.5 EFLH
Measure Verification	1. Refrigerators 2. Large storage DHW 3. Low-flow showerheads, bath aerators, and kitchen aerators (custom) 4. Pipe insulation (custom)	1. (5) refrigerators rated at 363 kWh/yr (modeled as average of 463 kWh/yr accounting for all 23) 2. AO Smith BTH199 200. 100 gallons, 199 kBtuh, 97% recovery efficiency, 5% SBL 3. (23) 2.0 gpm showerheads, 1.0 gpm bath faucet aerators, 1.5 kitchen faucet aerators. 4. 30 linear feet, no insulation to 1"	1. Savings passed thru because Itron verified three older refrigerators and only five were replaced according to the REN documents and it cannot be definitively proved the five claimed as replaced were in dwelling units accessed during ex-post survey. 2. Verified. AO Smith BTH199 200, 97% thermal efficiency 3. Verified installed - 6.6 liters/min (1.75 gpm), 1.1 gpm bath faucet aerators, did not check kitchen. 4. Verified installed - 21 linear feet, however, savings are 7.5 therms and these savings are passed thru.
Dwelling Unit Sampling and Verification Summary	(23) dwelling units.		Itron surveyor accessed (3) dwelling units.
Modeling Approach	General Observations		0 cfm/occupant ventilation.
	Errors		
	Eligibility Considerations		
Change Log	Initial Comparison - modeled to metered ratio		
	Adjustments and Impact - building characteristics and measures		Building Characteristics 1. Walls and windows by orientation, slab perimeter 2. Changed R-11 attic roof to R-11 flat roof. 3. 30 cfm/occ Measures No changes
	Calibration Adjustments - modeled to metered ratio		
	Adjustments and Impact - ER/ROB		None DHW, ER, 82%
Tracking Ex-Ante 1st Year Savings	Total Energy Savings (% Improvement)	12.10%	
	kW	0.1	
	kWh	747.00	
	Therms	707.5	
Ex-Post 1st Year Savings	kW		0.10
	kWh		830.00
	Therms		791
Realization Rates	kW		111%
	kWh		111%
	Therms		112%

13 Appendix AA & AB: Standardized Savings Output

Gross Lifecycle Savings (MWh)

PA	Standard Report Group	Ex-Ante Gross	Ex-Post Gross	GRR	% Ex-Ante Gross Pass Through	Eval GRR
BAY	REN_MF_WholeBuilding	116,021	92,704	0.80	0.0%	0.80
BAY	**Total**	**116,021**	**92,704**	**0.80**	**0.0%**	**0.80**
SCR	REN_MF_WholeBuilding	38,046	23,410	0.62	0.0%	0.62
SCR	**Total**	**38,046**	**23,410**	**0.62**	**0.0%**	**0.62**
	Statewide	***154,067***	***116,114***	***0.75***	***0.0%***	***0.75***

Net Lifecycle Savings (MWh)

PA	Standard Report Group	Ex-Ante Net	Ex-Post Net	NRR	% Ex-Ante Net Pass Through	Ex-Ante NTG	Ex-Post NTG	Eval Ex-Ante NTG	Eval Ex-Post NTG
BAY	REN_MF_WholeBuilding	98,618	47,372	0.48	0.0%	0.85	0.51	0.85	0.51
BAY	**Total**	**98,618**	**47,372**	**0.48**	**0.0%**	**0.85**	**0.51**	**0.85**	**0.51**
SCR	REN_MF_WholeBuilding	32,339	11,963	0.37	0.0%	0.85	0.51	0.85	0.51
SCR	**Total**	**32,339**	**11,963**	**0.37**	**0.0%**	**0.85**	**0.51**	**0.85**	**0.51**
	Statewide	***130,957***	***59,334***	***0.45***	***0.0%***	***0.85***	***0.51***	***0.85***	***0.51***

Gross Lifecycle Savings (MW)

PA	Standard Report Group	Ex-Ante Gross	Ex-Post Gross	GRR	% Ex-Ante Gross Pass Through	Eval GRR
BAY	REN_MF_WholeBuilding	11.3	9.9	0.88	0.0%	0.88
BAY	**Total**	**11.3**	**9.9**	**0.88**	**0.0%**	**0.88**
SCR	REN_MF_WholeBuilding	19.0	9.3	0.49	0.0%	0.49
SCR	**Total**	**19.0**	**9.3**	**0.49**	**0.0%**	**0.49**
	Statewide	***30.3***	***19.2***	***0.63***	***0.0%***	***0.63***

Net Lifecycle Savings (MW)

PA	Standard Report Group	Ex-Ante Net	Ex-Post Net	NRR	% Ex-Ante Net Pass Through	Ex-Ante NTG	Ex-Post NTG	Eval Ex-Ante NTG	Eval Ex-Post NTG
BAY	REN_MF_WholeBuilding	9.6	5.1	0.53	0.0%	0.85	0.51	0.85	0.51
BAY	**Total**	**9.6**	**5.1**	**0.53**	**0.0%**	**0.85**	**0.51**	**0.85**	**0.51**
SCR	REN_MF_WholeBuilding	16.2	4.8	0.29	0.0%	0.85	0.51	0.85	0.51
SCR	**Total**	**16.2**	**4.8**	**0.29**	**0.0%**	**0.85**	**0.51**	**0.85**	**0.51**
	Statewide	***25.8***	***9.8***	***0.38***	***0.0%***	***0.85***	***0.51***	***0.85***	***0.51***

Gross Lifecycle Savings (MTherms)

PA	Standard Report Group	Ex-Ante Gross	Ex-Post Gross	GRR	% Ex-Ante Gross Pass Through	Eval GRR
BAY	REN_MF_WholeBuilding	8,199	5,898	0.72	0.0%	0.72
BAY	**Total**	**8,199**	**5,898**	**0.72**	**0.0%**	**0.72**
SCR	REN_MF_WholeBuilding	540	772	1.43	0.0%	1.43
SCR	**Total**	**540**	**772**	**1.43**	**0.0%**	**1.43**
	Statewide	***8,739***	***6,670***	***0.76***	***0.0%***	***0.76***

Net Lifecycle Savings (MTherms)

PA	Standard Report Group	Ex-Ante Net	Ex-Post Net	NRR	% Ex-Ante Net Pass Through	Ex-Ante NTG	Ex-Post NTG	Eval Ex-Ante NTG	Eval Ex-Post NTG
BAY	REN_MF_WholeBuilding	6,969	3,014	0.43	0.0%	0.85	0.51	0.85	0.51
BAY	**Total**	**6,969**	**3,014**	**0.43**	**0.0%**	**0.85**	**0.51**	**0.85**	**0.51**
SCR	REN_MF_WholeBuilding	459	394	0.86	0.0%	0.85	0.51	0.85	0.51
SCR	**Total**	**459**	**394**	**0.86**	**0.0%**	**0.85**	**0.51**	**0.85**	**0.51**
	Statewide	***7,428***	***3,408***	***0.46***	***0.0%***	***0.85***	***0.51***	***0.85***	***0.51***

Gross First Year Savings (MWh)

PA	Standard Report Group	Ex-Ante Gross	Ex-Post Gross	GRR	% Ex-Ante Gross Pass Through	Eval GRR
BAY	REN_MF_WholeBuilding	6,446	6,386	0.99	0.0%	0.99
BAY	**Total**	**6,446**	**6,386**	**0.99**	**0.0%**	**0.99**
SCR	REN_MF_WholeBuilding	1,628	1,613	0.99	0.0%	0.99
SCR	**Total**	**1,628**	**1,613**	**0.99**	**0.0%**	**0.99**
	Statewide	***8,073***	***7,999***	***0.99***	***0.0%***	***0.99***

Net First Year Savings (MWh)

PA	Standard Report Group	Ex-Ante Net	Ex-Post Net	NRR	% Ex-Ante Net Pass Through	Ex-Ante NTG	Ex-Post NTG	Eval Ex-Ante NTG	Eval Ex-Post NTG
BAY	REN_MF_WholeBuilding	5,479	3,263	0.60	0.0%	0.85	0.51	0.85	0.51
BAY	**Total**	**5,479**	**3,263**	**0.60**	**0.0%**	**0.85**	**0.51**	**0.85**	**0.51**
SCR	REN_MF_WholeBuilding	1,384	824	0.60	0.0%	0.85	0.51	0.85	0.51
SCR	**Total**	**1,384**	**824**	**0.60**	**0.0%**	**0.85**	**0.51**	**0.85**	**0.51**
	Statewide	***6,862***	***4,087***	***0.60***	***0.0%***	***0.85***	***0.51***	***0.85***	***0.51***

Gross First Year Savings (MW)

PA	Standard Report Group	Ex-Ante Gross	Ex-Post Gross	GRR	% Ex-Ante Gross Pass Through	Eval GRR
BAY	REN_MF_WholeBuilding	0.6	0.7	1.09	0.0%	1.09
BAY	**Total**	**0.6**	**0.7**	**1.09**	**0.0%**	**1.09**
SCR	REN_MF_WholeBuilding	0.6	0.6	1.09	0.0%	1.09
SCR	**Total**	**0.6**	**0.6**	**1.09**	**0.0%**	**1.09**
	Statewide	***1.2***	***1.3***	***1.09***	***0.0%***	***1.09***

Net First Year Savings (MW)

PA	Standard Report Group	Ex-Ante Net	Ex-Post Net	NRR	% Ex-Ante Net Pass Through	Ex-Ante NTG	Ex-Post NTG	Eval Ex-Ante NTG	Eval Ex-Post NTG
BAY	REN_MF_WholeBuilding	0.5	0.3	0.65	0.0%	0.85	0.51	0.85	0.51
BAY	**Total**	**0.5**	**0.3**	**0.65**	**0.0%**	**0.85**	**0.51**	**0.85**	**0.51**
SCR	REN_MF_WholeBuilding	0.5	0.3	0.65	0.0%	0.85	0.51	0.85	0.51
SCR	**Total**	**0.5**	**0.3**	**0.65**	**0.0%**	**0.85**	**0.51**	**0.85**	**0.51**
	Statewide	***1.0***	***0.7***	***0.65***	***0.0%***	***0.85***	***0.51***	***0.85***	***0.51***

Gross First Year Savings (MTherms)

PA	Standard Report Group	Ex-Ante Gross	Ex-Post Gross	GRR	% Ex-Ante Gross Pass Through	Eval GRR
BAY	REN_MF_WholeBuilding	455	406	0.89	0.0%	0.89
BAY	**Total**	**455**	**406**	**0.89**	**0.0%**	**0.89**
SCR	REN_MF_WholeBuilding	60	53	0.89	0.0%	0.89
SCR	**Total**	**60**	**53**	**0.89**	**0.0%**	**0.89**
	Statewide	***515***	***459***	***0.89***	***0.0%***	***0.89***

Net First Year Savings (MTherms)

PA	Standard Report Group	Ex-Ante Net	Ex-Post Net	NRR	% Ex-Ante Net Pass Through	Ex-Ante NTG	Ex-Post NTG	Eval Ex-Ante NTG	Eval Ex-Post NTG
BAY	REN_MF_WholeBuilding	387	208	0.54	0.0%	0.85	0.51	0.85	0.51
BAY	**Total**	**387**	**208**	**0.54**	**0.0%**	**0.85**	**0.51**	**0.85**	**0.51**
SCR	REN_MF_WholeBuilding	51	27	0.54	0.0%	0.85	0.51	0.85	0.51
SCR	**Total**	**51**	**27**	**0.54**	**0.0%**	**0.85**	**0.51**	**0.85**	**0.51**
	Statewide	***438***	***235***	***0.54***	***0.0%***	***0.85***	***0.51***	***0.85***	***0.51***

Per Unit (Quantity) Gross Energy Savings (kWh)

PA	Standard Report Group	Pass Through	% ER Ex-Ante	% ER Ex-Post	Average EUL (yr)	Ex-Post Lifecycle	Ex-Post First Year	Ex-Post Annualized
BAY	REN_MF_WholeBuilding	0	0.0%		14.5	394,486.6	27,175.7	27,175.7
SCR	REN_MF_WholeBuilding	0	100.0%		14.5	1,463,129.6	100,793.4	100,793.4

Per Unit (Quantity) Gross Energy Savings (Therms)

PA	Standard Report Group	Pass Through	% ER Ex-Ante	% ER Ex-Post	Average EUL (yr)	Ex-Post Lifecycle	Ex-Post First Year	Ex-Post Annualized
BAY	REN_MF_WholeBuilding	0	0.0%		14.5	25,097.5	1,728.9	1,728.9
SCR	REN_MF_WholeBuilding	0	100.0%		14.5	48,249.4	3,323.8	3,323.8

Per Unit (Quantity) Net Energy Savings (kWh)

PA	Standard Report Group	Pass Through	% ER Ex-Ante	% ER Ex-Post	Average EUL (yr)	Ex-Post Lifecycle	Ex-Post First Year	Ex-Post Annualized
BAY	REN_MF_WholeBuilding	0	0.0%		14.5	201,582.7	13,886.8	13,886.8
SCR	REN_MF_WholeBuilding	0	100.0%		14.5	747,659.2	51,505.4	51,505.4

Per Unit (Quantity) Net Energy Savings (Therms)

PA	Standard Report Group	Pass Through	% ER Ex-Ante	% ER Ex-Post	Average EUL (yr)	Ex-Post Lifecycle	Ex-Post First Year	Ex-Post Annualized
BAY	REN_MF_WholeBuilding	0	0.0%		14.5	12,824.8	883.5	883.5
SCR	REN_MF_WholeBuilding	0	100.0%		14.5	24,655.4	1,698.5	1,698.5