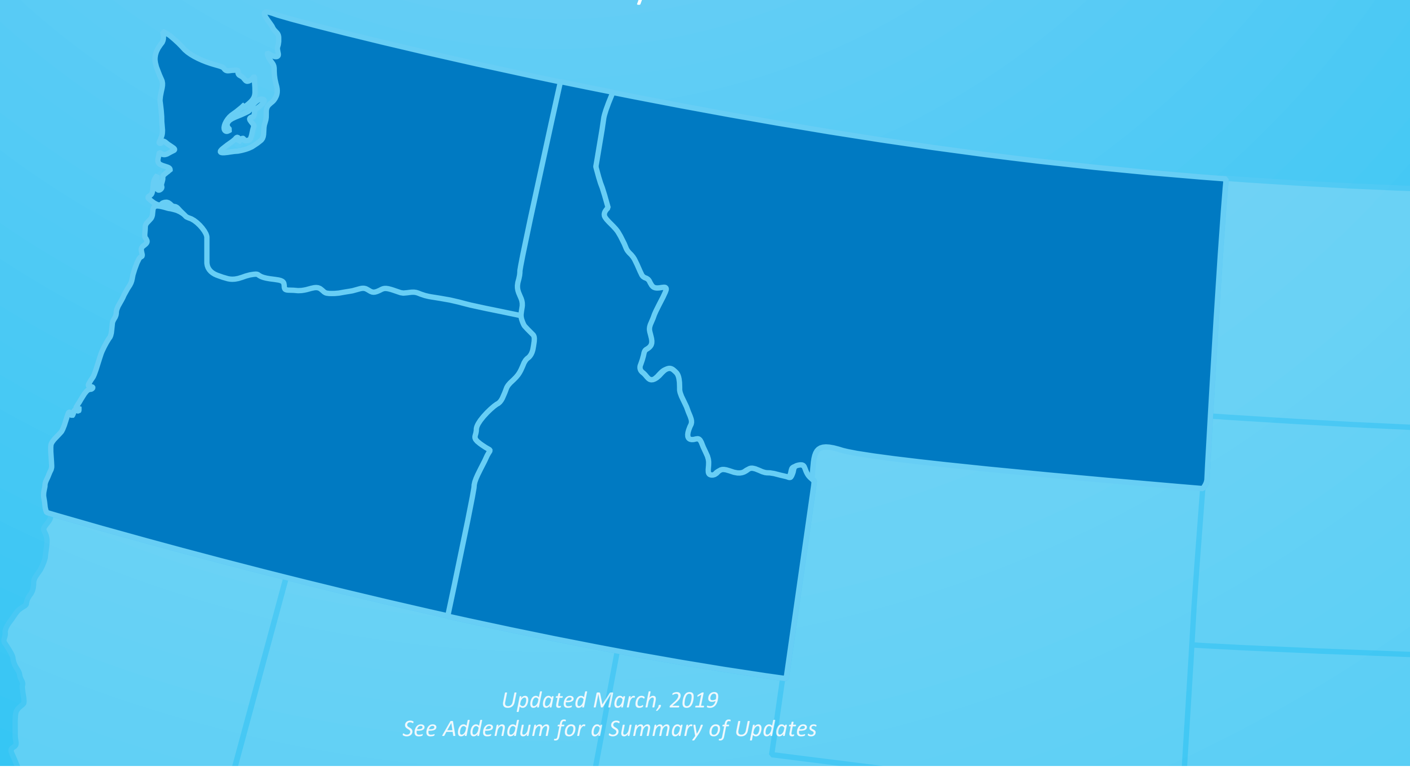
RESIDENTIAL BUILDING STOCK ASSESSMENT II

Multifamily Buildings Report

2016-2017

Revised 04/2019



Updated March, 2019
See Addendum for a Summary of Updates

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Acknowledgements

A study of this magnitude requires extensive coordination, thought leadership, and input from numerous organizations. Cadmus would like to thank the following people and organizations for their contributions:

Anu Teja
Northwest Energy Efficiency Alliance project manager

Anu provided countless hours of strategic guidance and management to Cadmus. Her overall leadership was critical to the success of this project.

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Northwest Energy Efficiency Alliance senior advisor

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Recruitment and Scheduling

Nexant's strategic and persistent effort to recruit and schedule more than 2,000 participants was crucial to the quality and breadth of findings.

RBSA Advisory Groups

The contributions of the RBSA advisory groups were essential to designing and planning another successful RBSA study.

NEEA is an alliance of more than 140 Northwest utilities and energy efficiency organizations working to accelerate the innovation and adoption of energy-efficient products, services and practices in the Northwest.

Many thanks to all of the Northwest utilities that participated in the quarterly meetings, provided billing data, and contributed suggestions throughout the course of the project.

Executive Summary

About this Study

The Northwest Energy Efficiency Alliance (NEEA) completed its second Residential Building Stock Assessment (RBSA) in the fall of 2017. The RBSA is a broad, regional study that characterizes the building stock within three housing types: single-family homes, manufactured homes, and multifamily buildings. This is NEEA's second residential building stock assessment since its first comprehensive, regionally representative study in the 2011-2012 timeframe. For this study, NEEA continued the work of the first RBSA (referred to as RBSA I in this report) and, wherever possible, data were collected in a similar manner to ensure continuity and comparability between the studies. Cadmus conducted the second RBSA (referred to as RBSA II in this report) and collected data in the 2016-2017 timeframe, with recruiting support from Nexant.

This report presents findings for multifamily homes, based on data collected from 523 site visits, which includes the core RBSA study (funded by NEEA), as well as data collected for two oversamples funded by Bonneville Power Administration (BPA) and Puget Sound Energy. Cadmus developed and applied sampling weights to ensure that all multifamily observations were weighted proportionally to the segment of the population represented by the sample; see the Database User Manual for a description of the weighting methods and procedures.

Primary Objective

The primary objective of the RBSA is to characterize the existing residential building stock in the Northwest region based on data from a representative sample of homes. NEEA and its partners designed the RBSA to account for regional differences, such as climate, building practices, and fuel choices, by using a large-scale residential sample. The characterization includes the principal characteristics of the buildings (e.g., square footage, insulation level, and heating systems), their occupants (e.g., unit size and income levels), and end-use equipment (e.g., lighting, appliances, electronics, and water heating). The sample size chosen for the RBSA II allows benchmarking of energy use within units at sufficient detail to assess the progress of changes in energy efficiency and home characteristics within the region. One of the key decisions made during these meetings is that multifamily buildings be categorized into only two groups (three or fewer floors and four or more floors) instead of the three groups used in RBSA I (low-, mid-, and high-rise). In the RBSA II, only limited data were collected for buildings with four or more floors.

Key Findings

The following section presents the study's key findings by end use. All values in this section are weighted to represent the northwest population. These key findings represent notable and statistically significant differences between the RBSA I and RBSA II, and in some cases, the emergence of new or different technologies that were not observed in RBSA I.

In-Unit Lighting

LED adoption has soared

The data from this study reveal a dramatic shift in the efficiency of residential lighting. LEDs have increased from less than one percent six years ago to nearly a quarter of all installed bulbs, with LEDs found in rooms of every type.The percentage of installed incandescent bulbs greatly declined, CFLs remained relatively flat, and the proportion of halogen lamps doubled to 7%.

	Incandescent	CFL	LED
RBSA I	62%	27%	Less than 1%
RBSA II	37%	30%	16%

Common Area Lighting

LEDs are found in common spaces

LEDs have emerged in common spaces. However, unlike in-unit lighting, the distributions of incandescent and CFL lamps remained relatively the same.

	Incandescent	CFL	LED
RBSA I	12%	31%	Less than 1%
RBSA II	13%	42%	12%

Connected Devices

Connected devices are starting to emerge

Wi-Fi and smart thermostats, which have been rebated through regional programs for several years, were only observed in a few instances. Additionally, connected lighting products were almost non-existent in multifamily homes.

	Smart/Wi-Fi Thermostats	Connected lighting
RBSA I	0%	0%
RBSA II	Less than 1%	1%

Envelope

Opportunities remain to improve building insulation

RBSA II data show that 13% of low-rise buildings with attics have less than R-11 attic insulation, and 9% of low-rise framed buildings have less than R-8 wall insulation.

	Attic Insulation (Less than R-11)	Wall Insulation (Less than R-8)
Low-Rise	13%	9%

HVAC

Baseboard heaters still dominate

Electric baseboard heaters and other electric resistance zonal equipment serve as the primary heat source for roughly 75% of multifamily buildings in the Northwest.

	Baseboard and Electric Resistance
RBSA I	81%
RBSA II	75%

Television Technology

Television technology has shifted

The share of televisions using cathode ray tube designs has plunged since RBSA I, as the older technology gives way to LCD and LED televisions. With the rapid adoption of these more-efficient technologies, there was a large drop in average television power draw.

	Cathode Ray Tubes	Power Draw (watts)
RBSA I	48%	109W
RBSA II	16%	79W

Electronic Devices

Fewer homes have set-top boxes and presence of game consoles increased

Consistent with single-family and manufactured homes, there are fewer set-top boxes in multifamily residences compared to RBSA I. However, unlike other home types, the percent of multifamily residences with game consoles increased.

	Set Top Boxes	Game Consoles
RBSA I	75%	21%
RBSA II	45%	28%

This is NEEA's second comprehensive multifamily building stock assessment.

NEEA conducted 10 working group sessions.

RBSA Overview

This report includes key findings and themes from the RBSA II, organized by building component and end-use equipment. Each report section provides a high-level summary of the multifamily data collection protocols, procedures, and findings. Where practical, these sections also highlight key differences between the RBSA II and RBSA I. Cadmus used two-sided t-tests for means and proportions to test the hypotheses that the current RBSA results were equal or not equal to the RBSA I results. We identified metrics where significant changes have occurred over time when tests resulted in p-values of $p<0.01$ and this is denoted by either ▲ or ▼ symbol, to indicate whether the value is higher or lower than in the previous study. We did not account for uncertainty of the RBSA I results and treated them as fixed values. Appendix A provides additional detail and supplemental data tables.

To streamline the results, the report includes only a snapshot of the collected and analyzed data. Readers may select the SEE THE DATA button (presented throughout the report) to view the detailed tables in the appendix. These tables provide the weighted multifamily results from the study, with sample sizes and error bounds. In some instances, Cadmus rounded values to whole numbers for better readability. In these instances, values may not sum exactly to 100%.

The RBSA II database contains additional data, including the full data from the inventory of each building or unit. For more details regarding the database go to neea.org/data or www.NEEA.org.

Facilitation of Working Group Sessions and Production Pretest

The RBSA provides data vital for planning and evaluation at the regional, state, and local utility levels. As such, NEEA engaged regional stakeholders in the study design and planning. Cadmus facilitated 10 working group sessions with NEEA funders and other regional stakeholders, including sessions focused on customer contact, sample design, data collection, and database development.

These sessions provided a mechanism for NEEA, Cadmus, and regional stakeholders to review and provide feedback on the proposed methods and activities planned for the RBSA II. Following the working groups, Cadmus delivered a set of interim protocols documenting the agreed-upon approach for all aspects of the RBSA data collection process such as procedures for customer engagement and interactions, the sample design, and the data points collected as part of the RBSA. One of the key decisions made during these meetings is that multifamily be categorized into only two groups (three or fewer floors and four or more floors) instead of the three groups used in RBSA I (low-, mid-, and high-rise). In the RBSA II, only limited data were collected for buildings with four or more floors.

As agreed upon with NEEA, the team pretested the recruiting and data collection protocols developed during the working group sessions to ensure that the processes and tools operated as designed. During the pretest period in February 2016, the Cadmus team identified and recommended a number of small changes to improve the recruitment and data collection processes. Over the course of the study, the team made minor adjustments to the original plan, with most changes aimed at improving the recruitment process.

Implementing the RBSA II

The RBSA data collection effort included recruiting and surveying participants, acquiring signed billing release forms, and collecting data on observed equipment and home characteristics. For the multifamily site visits, the team asked survey participants to provide contact information for a building manager in the same apartment building or complex. Field technicians recorded observed information on nearly every characteristic that impacts the energy consumption of the home—from construction details to the wattage of light bulbs. The field team implemented lessons learned from the previous RBSA to improve data collection and measurements, and in some cases, collected different types of data than in the RBSA I. These differences are called out throughout the report where applicable.

Customer Survey

Participants completed two short surveys about their home and its occupants: one as a part of a screening and opt-in process and another as part of the site visit. During the opt-in process, multifamily respondents also provided information about their building or complex and in a few instances, the contact information for a building manager. The in-home survey also collected information to help field technicians identify unusual types of equipment they should look for during the site visit such as Wi-Fi enabled equipment or seasonal heating and cooling equipment that may be kept in storage.

As the final step of the on-site interview, field technicians recorded the customer's utility (electric and gas) and utility account information and had the customer electronically sign a billing release form.

Manager Survey

In addition to surveying the resident or residents, Cadmus attempted to survey building managers but often found them unresponsive or the tenant would not provide their contact information. When reached, Cadmus asked building managers to participate in an on-site interview about energy-efficient improvements, tenant complaints, and high-level information about the building or complex.

Observed Equipment

Multifamily data collection varied with building size.

Observed Equipment and Characteristics

The RBSA on-site data collection was wide ranging and, while the data collected varied based on building size and the type of equipment on the site, they generally included the characteristics shown in Table 1.

Table 1: Observed Equipment and Characteristics by Category

Equipment and Characteristics	All Units	Buildings with Three or Fewer Floors	Buildings with Four or More Floors
Building configuration: number of floors, conditioned area		✓	✓
Building envelope (shell): insulation types and thicknesses, construction materials		✓	
HVAC: equipment characteristics, nameplate information, location	✓	✓	
Domestic hot water: equipment characteristics, nameplate information, flow rate measurements for showerheads and faucets	✓	✓	
Appliances: equipment size and configuration, nameplate information	✓	✓	
Electronics: equipment size and configuration, nameplate information	✓	✓	
Lighting: type, style, wattage, quantity, control type, location	✓	✓	

A comprehensive list of the types of equipment information field technicians collected by equipment category and building type, and specific details of how field technicians collected these data can be found at neea.org/data or www.NEEA.org.

Data Cleaning and Building and Equipment Characteristic Analysis

Throughout the field data collection process, Cadmus performed continuous quality assurance (QA) reviews on data collected for randomly selected units and buildings. The QA reviews focused on critical equipment categories, such as lighting and building construction, and emphasized identifying missing, incomplete, or inconsistent data (i.e., building construction attributes that were inconsistent with the other building characteristics). Where applicable, Cadmus updated data points based on data collection notes, photographs, or product lookup and provided feedback to its technicians to improve data collection.

After completing the site visits, Cadmus cleaned and analyzed the data. This process included reviewing the data for outliers, using field notes and photographs to determine whether a change to a data point was required, and correcting data where appropriate. The final data review also included a systematic review of each building or unit and its equipment to ensure internal consistency. If there was a discrepancy between these values, the team investigated the issue further and made appropriate changes if required.

The analysis relied on R statistical software to process, compile tables, and apply case weights to estimate population means and proportions as well as their error bounds. Each end-use table and reported statistic includes data on the associated population estimates and their error bounds (calculated at 90% confidence).

Database

Results for the RBSA II are derived from data collected through participant surveys, on-site data collection by trained technicians, and historical energy consumption data furnished by regional utilities. Cadmus cleaned, anonymized, and compiled these data, including a number of calculated fields, into a publicly available database. The database includes data from all three housing types—single-family, multifamily, and manufactured—and is available for download through the NEEA website. The RBSA database is a relational database provided in CSV format. Users can import the flat files into other database software (i.e., Access or SQL) or spreadsheet programs such as Excel.

Cadmus also developed a database user manual and data dictionary. The user manual provides guidance on how to effectively use the database and includes instructions for incorporating sampling weights. The data dictionary defines each field in the database and provides example data for each field to give the end user a better idea of what the data mean and represent.

The database and associated documents are available at neea.org/data or go to www.NEEA.org.

The RBSA II database contains complete data from the inventory of each building and unit.

Cadmus collected billing consumption data to develop an energy use intensity for each building and unit.

Billing Data Collection and Analysis

Cadmus conducted interviews to capture electric and gas billing information such as utility, account number, and meter numbers for the buildings and residents who participated in the site visits. Because not every unit was surveyed as part of the study, Cadmus requested anonymized data for each meter within each building—residential or otherwise—though utilities were not always able to provide the requested information due to company policy. This difficulty was compounded in the state of Washington, which recently passed a law restricting the information that utilities can disclose about their retail electric customers.

Cadmus aggregated the data for each building to develop an overall summary of the energy consumption for that building. Near the end of the field collection phase, Cadmus requested up to 24 months of participant billing data from utilities and reviewed them for completeness and to ensure Cadmus received data for every site, following up directly with utilities for clarification as necessary. Cadmus performed the following checks to assess the quality of the billing data:

- Reviewed the premise address and accounts for each requested building or unit to ensure they matched those in our database.
- Reviewed the data for inconsistencies such as duplicate reads, multiple readings on the same date, and missing data.
- Reviewed plots of each building or unit's usage data to identify anomalies in the data, such as vacancies or erroneous readings, and removing the consumption data or further investigating the sites as needed.

Cadmus investigated anomalous data and, if possible, corrected the issue. If unable to correct the issue, Cadmus removed the customer from the energy use intensity (EUI) analysis.

The billing analysis relied on a PRISM-type variable-based degree day model. Cadmus used this model to process each home's monthly billing data to produce weather-adjusted annual consumption values. For each meter, Cadmus modeled energy usage as a function of heating degree days and cooling degree days, collected from the nearest NOAA weather station. This allowed Cadmus to disaggregate energy into heating, cooling, and baseload components and then apply typical meteorological year (TMY)3 data to these components to derive a normalized annual usage for each meter. Finally, to calculate a building's EUI, Cadmus divided the building's normalized aggregate usage by the building's conditioned area.

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Sampling

Background

Cadmus designed the multifamily building sample to achieve the desired level of confidence and precision (90% confidence with ±10% precision) for population estimates within each of seven geographic sub-regions. The sampling plan was designed so that these targets and the requisite sample sizes would be met wholly through NEEA project funding. Although NEEA expected some utilities and regional organizations to fund oversamples for their individual service territories, the core sample design accepted by NEEA did not rely on oversamples to meet the desired confidence and precision. This is a key difference between the current study and the previous RBSA; that is, the RBSA I did incorporate an oversample (the BPA oversample) into the core sample design; this study did not.

The following sections describe Cadmus's approach to developing the sample frame, determining the sample sizes for the core and the oversamples, and estimating population quantities using post-stratification to incorporate data from the core and oversamples.

Sample Frame Development

The goal of the multifamily building sample design was to draw samples that were representative of the population within the following seven geographic sub-regions:

- Idaho
- Western Montana
- Western Oregon
- Eastern Oregon
- Western Washington
- Puget Sound
- Eastern Washington

To ensure that the sample was representative of the target population within each region, Cadmus purchased a randomized address-based sample generated by the U.S. Postal Service (USPS) within each geographic sub-region. Cadmus provided USPS with a list of counties and the number of residences required to reach the sample size targets in each geographic region. After identifying the total number of homes in each county that were proportional to the population of homes in the region, Cadmus requested those amounts from USPS. That is, if one county represented 50% of the total regional home population, approximately 50% of the address-based sample would be from that county.

Core Sample Sizes

Cadmus determined the sample sizes within each geographic sub-region for the core sample. The team calculated the target sample size for the region, and then divided the sample across the seven sub-regions proportional to the multifamily population in those regions.

Table 2 lists the target and achieved sample sizes for the RBSA II Multifamily core sample by sub-region. These targets were based solely on geography; the number of floors was not a consideration during the recruitment process.

Table 2. Target and Achieved Sample Sizes

Sub-Region	Multifamily Buildings	
	Target	Achieved
Western Montana	9	13
Idaho	15	20
Puget Sound/ Western Washington/ Eastern Washington	158	167
Eastern Oregon/ Western Oregon	76	76
Total	**258**	**276**

Utility and BPA Oversample Sample Sizes

Puget Sound Energy and BPA requested oversamples in their service territories to include additional multifamily homes. The Cadmus team calculated the sample sizes for the oversample using the same equation as used for the core sample, with inputs specific to Puget Sound Energy and BPA. Based on the population of homes served by Puget Sound Energy and BPA, relative to the population in the region, Cadmus predicted the number of homes that would eventually be included in the core sample from each oversample region and reduced the total oversample sample size by that amount. Table 3 shows the resulting oversample sample sizes for Puget Sound Energy and BPA.

Table 3. Utility Oversample Sample Sizes

Sub-Region	Puget Sound Energy	BPA
Western Montana/ Idaho		34
Puget Sound	49	30
Western Washington		43
Eastern Washington/ Eastern Oregon		46
Western Oregon		45
Totals	**49**	**198**

The goal of the multifamily home sample design was to draw samples that were representative of the population within seven sub-regions.

Sampling Weights

Cadmus used stratified sampling to select multifamily buildings for the core sample where strata were defined by geographic sub-regions. Cadmus calculated and applied sampling weights to estimate the overall population quantities and ensure that observations are weighted in proportion to the population represented by the sample. The oversamples introduced additional sampling within each core stratum and, thereby, the need for an adjustment to the core stratified sampling weights to account for sample size increases in the oversampled territories.

Cadmus used post-stratification to account for the combination of stratified sampling in the core and the additional sampling in the oversamples. To post-stratify, Cadmus divided the sub-regions into BPA, non-BPA, and oversample utility territories to determine the most accurate population size for each site. Cadmus determined the population of units in each post-stratification stratum from the 2014 American Community Survey (ACS).

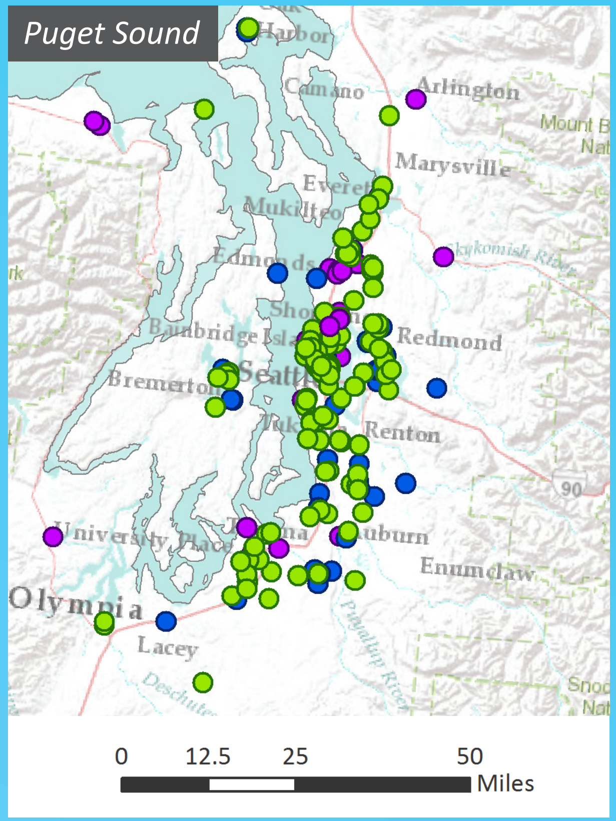
Cadmus calculated unit-level and building-level sample weights which were applied to create summary calculations depending on whether observations for the multifamily sample were within a unit or for the whole building (i.e. central and common area observations). Unit population estimates were provided by the ACS data and mapped to zip codes in each sub-region and service territory to determine stratum population sizes and counted the achieved sample sizes in each post-stratum. Cadmus estimated building population estimates within post-strata by assuming the ratio of the total number of units in the population to the number of units in sampled buildings is equivalent to the ratio of the total number of buildings in the population to the number of sampled buildings.

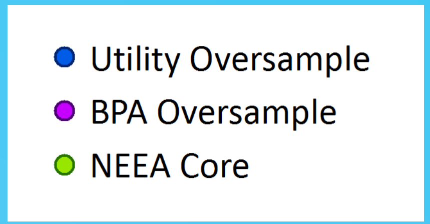
The team calculated unit- and building-level sampling weights within strata as the inverse of the probability of selection, then applied the weights to all observations within each stratum to estimate population totals, means, and proportions. Table 4 lists the post-stratification strata within each sub-region.

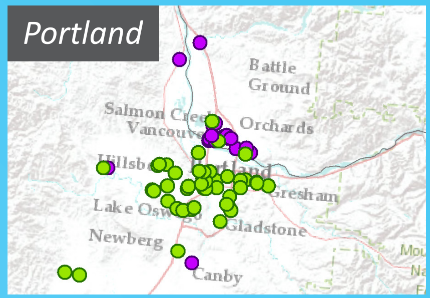
Table 4. Post-Stratification by Sub-Region

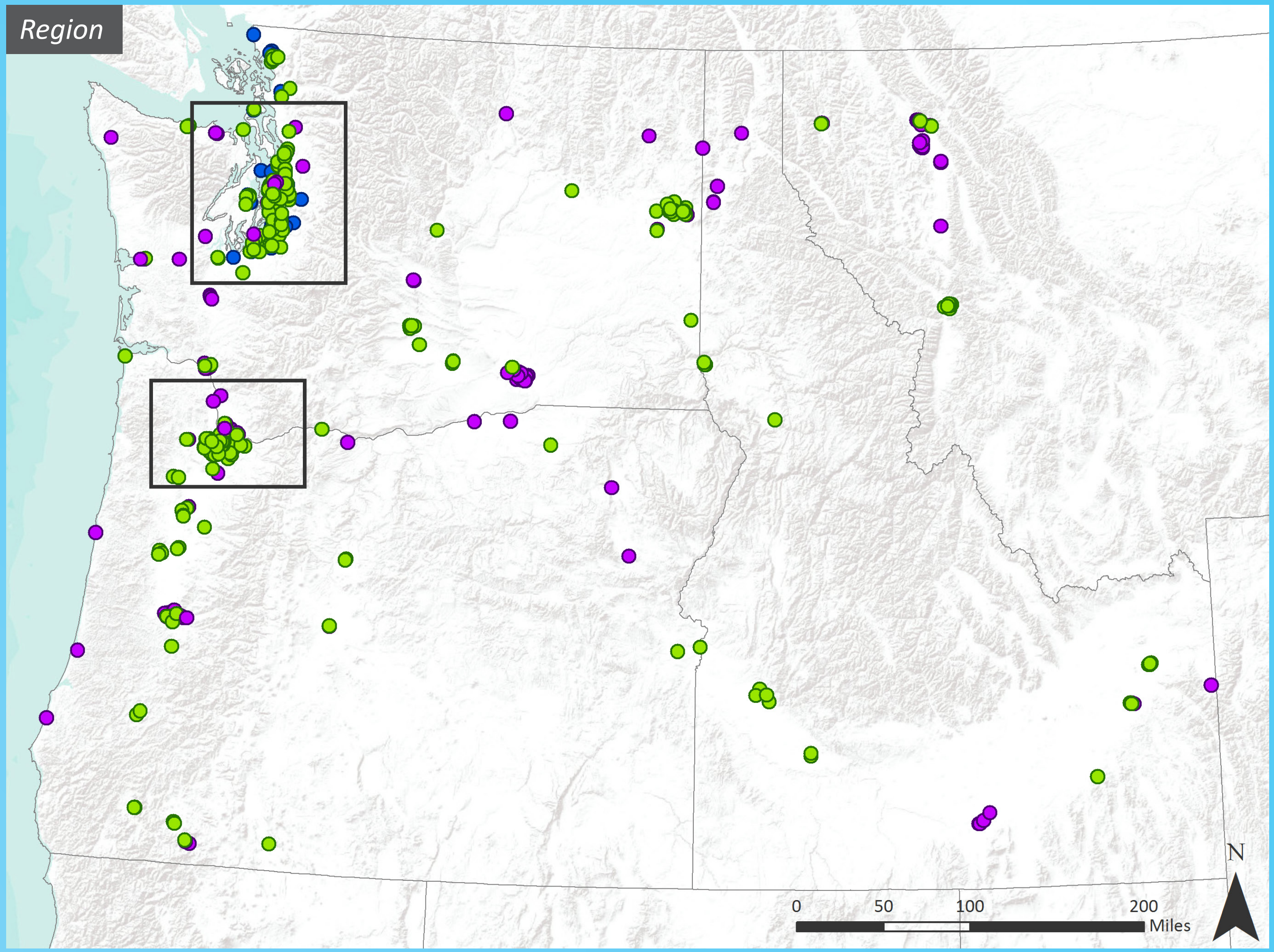
Sub-Region	Post-Stratification Strata
Western Montana	• Bonneville Power • Non-Bonneville
Idaho	• Bonneville Power • Non-Bonneville
Eastern Washington	• Bonneville Power • Non-Bonneville
Western Washington	• Bonneville Power • Non-Bonneville
Puget Sound	• Bonneville Power • Non-Bonneville
Eastern Oregon	• Bonneville Power • Non-Bonneville
Western Oregon	• Bonneville Power • Non-Bonneville

The following maps show the distribution of multifamily site visits across Idaho, Montana, Oregon, and Washington by NEEA's core RBSA II sample, as well as utility and BPA oversample sites. The maps also show a more detailed breakout of site visits for the Puget Sound and Portland areas.









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SUMMARY OF BUILDING CHARACTERISTICS

The following sections provide detailed findings by building characteristic, measurement, and end use. All values in these sections are weighted. These findings represent notable and statistically significant differences between the RBSA II and the previous RBSA, and in some situations, the emergence of new or different technologies not observed in RBSA I.

Where practical, these sections also highlight key differences between the RBSA II and RBSA I. Differences that are statistically significant are denoted by either an ▲ or ▼ symbol, to indicate whether the value is higher or lower than in the previous study. Where Cadmus observed new or different technologies, or if we developed tables for this RBSA that were not present in the RBSA I, we did not conduct statistical significance testing.

Appendix A provides additional detail and supplemental data tables, as well as references to comparable RBSA I table numbers.

Age and Type

Description

The RBSA II defined multifamily buildings as individual buildings comprising five or more units. Multi-unit buildings in complexes with common parking, grounds, and/or other facilities also qualified as multifamily. For this study, many buildings identified through the survey and recruiting process were linked to a complex of buildings. Buildings with seven or more floors were almost exclusively in urbanized areas, especially the Seattle and Eugene markets.

Building age was determined first by asking the participant and then verifying through online sources; building type was assessed during the site visit. Cadmus also collected information about common spaces such as hallways, lobbies, shared facilities (such as laundry rooms or kitchens), and the building exterior and parking areas. Non-residential spaces were also identified, though they were not fully characterized. Common spaces are found in most mid-rise and all high-rise buildings, but it is common for low-rise multifamily construction not to have shared tenant spaces.

While there are statistically significant differences between the distribution of building vintage, type, and other characteristics in RBSA I and RBSA II, these likely reflect differences in sampling and recruitment methodology. For instance, in the previous RBSA, building managers were recruited and then units within a building selected. In the RBSA II, tenants were randomly selected and offered the opportunity to participate. While subtle, these differences in recruitment approaches may have yielded slightly different building types.

Key Findings

Key findings for building type and vintage include:

- One- and two-bedroom units were the most common unit types.
- High-rise buildings have the highest percentage of non-residential floor area (51%) followed by mid-rise buildings (25%).
- Low-rise buildings are the most common type of multifamily construction (88%), followed by mid-rise (11%) and high-rise (2%).

Distribution of Buildings by Vintage and Type

*Building types are **evenly dispersed** across the seven vintage categories.*

	Pre-1955	1955-1970	1971-1980	1981-1990	1991-2000	2001-2010	Post 2010	All
Low-Rise (1–3)	77%	85%▼	86%▼	97%	85%▼	85%	74%	88%▼
Mid-Rise (4–6)	19%▼	13%▲	12%▲	3%	13%	14%	24%	11%▲
High-Rise (7+)	4%▲	1%	2%▲	0%	2%▼	1%▼	2%	2%

SEE THE DATA

Distribution of Building Type

*Low rise buildings were the **most commonly audited** building type.*

Low-Rise (1–3)
88%▼

Mid-Rise (4–6)
11%▲

High-Rise (7+)
2%

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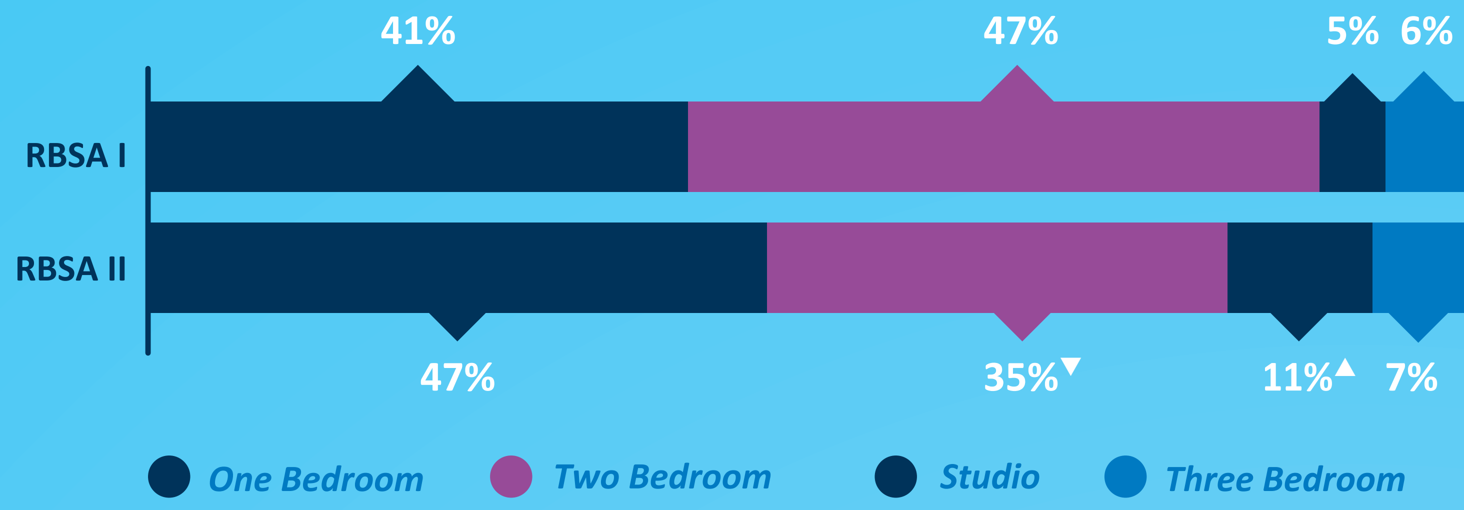
▲▼ *Statistically different from 2011 RBSA*

Distribution of Unit Types

*The RBSA II identified **more studio apartments** than the previous RBSA.*



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Distribution of Unit Size (sq. ft.)

*Residential unit size **decreased**.*

	RBSA I	RBSA II
Studio	396	374
One Bedroom	607	557▼
Two Bedroom	883	856▼
Three Bedroom	1,076	966▼

SEE THE DATA

▲▼ *Statistically different from 2011 RBSA*

Distribution of Building Floor Area by Floor Area Category and Building Size

***Approximately 7%** of building floor area is dedicated to shared spaces, with high-rise buildings having the largest proportion of common area space (15%).*

	Low-Rise (1–3)	Mid-Rise (4–6)	High-Rise (7+)
Common Area	4.7%	12.9%	14.7%
Non-Residential	1.8%	3.4%▼	1.3%
Residential	93.5%	83.7%▲	83.9%

SEE THE DATA

▲▼ *Statistically different from 2011 RBSA*

Building Envelope

Description

Field data collection for multifamily buildings with three or fewer floors included characterizing ceilings, walls, floors, and windows and doors. Unlike the RBSA I study, data collection did not include characterization of the building envelope for buildings with four or more floors.

Field technicians captured information about exterior surfaces using a variety of techniques. In accessible attics, crawlspaces, and basements, direct observation allowed collection of insulation type and thickness along with other relevant characteristics. With exterior walls, which are typically fully enclosed, field technicians used a combination of infrared thermography and probing around electrical boxes to determine whether a surface was insulated. Unless otherwise noted, R-values represent only the R-value of the insulation, not of the wall, attic, or floor assembly as a whole.

While Cadmus technicians made every reasonable effort to gain access to attics, crawlspaces, and basements, the RBSA II study was recruited by unit, not building, and building management personnel were often not available to provide access to unconditioned areas not accessible from the sampled unit. For buildings constructed recently enough to have been subject to energy codes in their location, the RBSA II study used building vintage and relevant codes to assign insulation levels for envelope components that could not be characterized through direct observation.

Direct comparisons between RBSA I and II summary ceiling insulation data are difficult because the RBSA II study focused on collecting envelope data for only low-rise buildings, while the RBSA I study presented findings for the combined population of low-rise, mid-rise, and high-rise buildings.

Key Findings

Key findings for multifamily building envelope include:

- For buildings with attics, RBSA II data show that 13% have insulation values less than R-11. Another 12% have insulation levels lower than R-31. The RBSA II collected data on type, thickness, and completeness of insulation in each attic space rather than estimation of an R-value.
- The RBSA II data show that 9% of framed walls in low-rise multifamily buildings have wall insulation of less than R-8.

Distribution of Ceiling Insulation R-Value in Low-Rise Buildings

Attic insulation data ***show room for improvement****, with 13% of low-rise buildings with attics in the Northwest having weighted average R-values less than 11.*

	R0-R10	R11-R15	R16-R20	R21-R25	R26-R30	R31-R40	R41-R50	R50+
Attic	13%	2%	4%	3%	3%	65%	9%	1%
Roof Deck	18%	0%	0%	0%	0%	82%	0%	0%
Sloped/ Vaulted (no attic)	4%	11%	0%	0%	0%	72%	0%	13%
All Types	12%	3%	3%	3%	2%	66%	9%	1%

SEE THE DATA

Distribution of Wall Insulation R-Value in Low-Rise Buildings

The RBSA II study found that ***15%*** *of low-rise multifamily buildings in the region have little or no wall insulation.*

	R0-R7	R8-R13	R14-R20	R21-R23	R24+
Frame	9%	50%	40%	0%	1%
Masonry/ Concrete	83%	17%	0%	0%	0%
Other	0%	0%	0%	100%	0%
All Types	15%	47%	37%	1%	1%

SEE THE DATA

▲▼ *Statistically different from 2011 RBSA*

Building and Common HVAC Systems

Description

Data collection included extensive characterization of any accessible heating, cooling, and ventilation equipment in low-rise buildings. Such equipment included central systems that served all units, such as boilers, and zonal or small central systems that served common areas. Field technicians collected information such as the make, model number, capacity, and year of manufacture of heating and cooling equipment, where practical. Where year of manufacture was not included on the manufacturer's label, technicians collected the serial number, which often included encoding that allowed the team to determine the year of manufacture after the site visit. Where practical, Cadmus also used post-visit lookups to provide equipment efficiency ratings.

Unlike the RBSA I study, for buildings with more than three stories the RBSA II study did not include characterizing any building-level HVAC systems or common areas, though all in-unit systems were characterized. In addition, while Cadmus technicians made every reasonable effort to gain access to mechanical rooms, basements, or other areas where building-level equipment might be found, the RBSA II study recruited by site, not building, and building management personnel were often not available to provide access to restricted areas.

Code Updates

Changes in federal efficiency standards since the RBSA I mandate higher minimum efficiency ratings for some HVAC equipment. For instance, as of September 1, 2012, the minimum annual fuel utilization efficiency (AFUE) of residential gas-fired hot water boilers increased from 80% to 82%, and the minimum AFUE for residential gas-fired steam boilers increased from 75% to 80%.

Key Findings

Key findings below include shared HVAC equipment, as well as in-unit equipment believed to be consistent for the building.

- Primary heating systems have changed only slightly since the RBSA I. As in that study, the RBSA II found that electric baseboard and wall heaters along with other electric resistance zonal heat account for the great majority of heating, at roughly 80%. The RBSA II groups electric baseboard and wall heaters together but characterizes electric ceiling heat, plug-in heaters, and other zonal systems as Other Zonal Heat.
- In-unit primary cooling equipment also remained similar to RBSA I. Package AC systems hold the largest share, followed by mini-split heat pumps. In the RBSA II, 72% of buildings lack mechanical cooling, compared with 63% in the RBSA I. This difference likely represents a difference in methodology rather than a decline in the use of air conditioners in multifamily buildings.

Distribution of Primary Heating Systems

The primary heating table characterizes the heating systems of buildings whether they rely on a central system, such as a boiler, or on unit-level equipment, such as baseboard heaters.

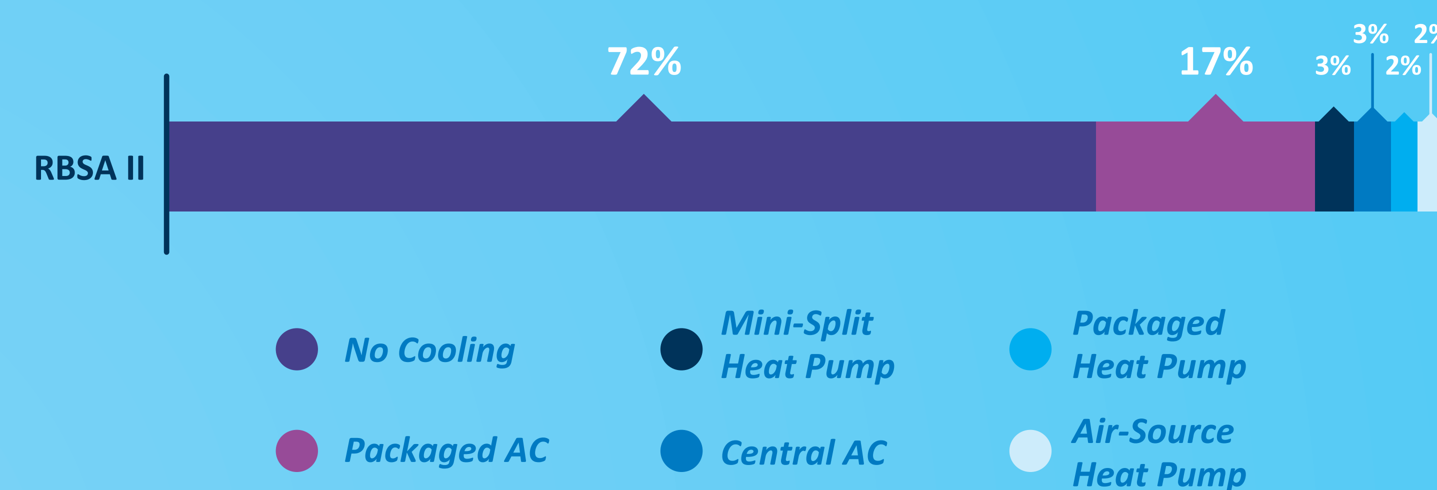
	Electric	Natural Gas	Wood
Central Boiler	0%	1%	0%
Central Furnace	0%	0%	0%
Air Source Heat Pump	2%	0%	0%
Boiler	0%	0%	0%
Electric Baseboard and Wall Heaters	58%	0%	0%
Furnace	4%▲	8%▲	0%
Mini-Split Heat Pump	3%	0%	0%
Other Zonal Heat	21%	0%	0%
Package Terminal Heat Pump	0%	0%	0%
Stove/Fireplace	0%	2%	1%

Units characterized above as Other Zonal Heat were counted as electric baseboard heating in RBSA I.

SEE THE DATA

Distribution of Unit Cooling Systems

*Packaged AC systems **dominate multifamily cooling**, but 72% of these buildings are not mechanically cooled.*



SEE THE DATA

▲▼ Statistically different from 2011 RBSA

Common Area Lighting

Description

Cadmus conducted a comprehensive walk-through of common spaces in low-rise buildings to capture details about lighting in every space that was accessible. Common areas include spaces such as hallways, lobbies, shared facilities (such as laundry rooms or kitchens), and the building exterior and parking areas. Exterior lamps controlled within a residence (such as lighting over patios and entryways) were attributed to the unit itself rather than the building common space.

Common spaces can be found in all building types, but low-rise multifamily construction has the lowest percent of shared tenant spaces. The type and quantity of exterior lighting also varies with building size: large buildings tend to have more exterior and parking lighting than smaller buildings.

Collected lighting details include lamp type, style, wattage, quantity, control type, and location. It can sometimes be difficult to identify the type of bulb due to accessibility or safety issues and the fact that many bulbs look like an incandescent but are in fact something different, such as a halogen. Where field technicians could not accurately assess the bulb type, they noted it as unknown.

Code Updates

The Energy Independence and Security Act of 2007 was phased in beginning in 2012. This standard impacted many lamps that would have been targets of utility lighting programs and likely accelerated the adoption of energy-efficient light bulbs.

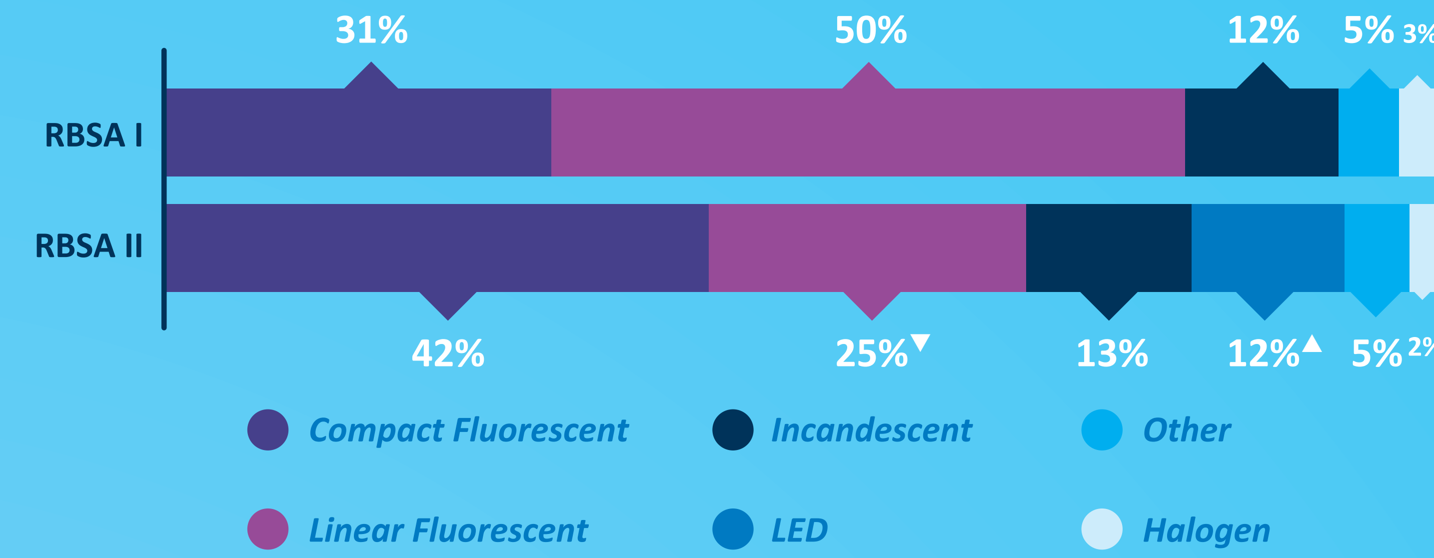
Key Findings

Key findings for common area lighting include:

- Direct comparison of the lamp type distributions between RBSA I and RBSA II shows a marked decrease in linear fluorescent proportions with an associated increase in LED proportions. While Cadmus did collect information about common area and exterior lighting in mid- and high-rise buildings whenever possible, it was not always possible to collect due to limited access to shared spaces. It is likely that these changes are driven by access limitations on-site and an increased focus on low-rise buildings in RBSA II, rather than substantial linear fluorescent to LED replacements.
- The average number of common area lamps per residential unit decreased from approximately 2.2 lamps per unit in RBSA I to 1.6 lamps per unit in RBSA II.
- LEDs, which were not found in sufficient quantities to be included in RBSA I report tables, represent a significant share of bulbs installed in multifamily buildings in RBSA II (12% regionally).
- There was an increase in the proportion of exterior incandescent, CFL, and LED lamps in RBSA II, likely attributable to the RBSA II's focus on low-rise buildings.

Distribution of Common Area Lamp Types in Low-Rise Buildings

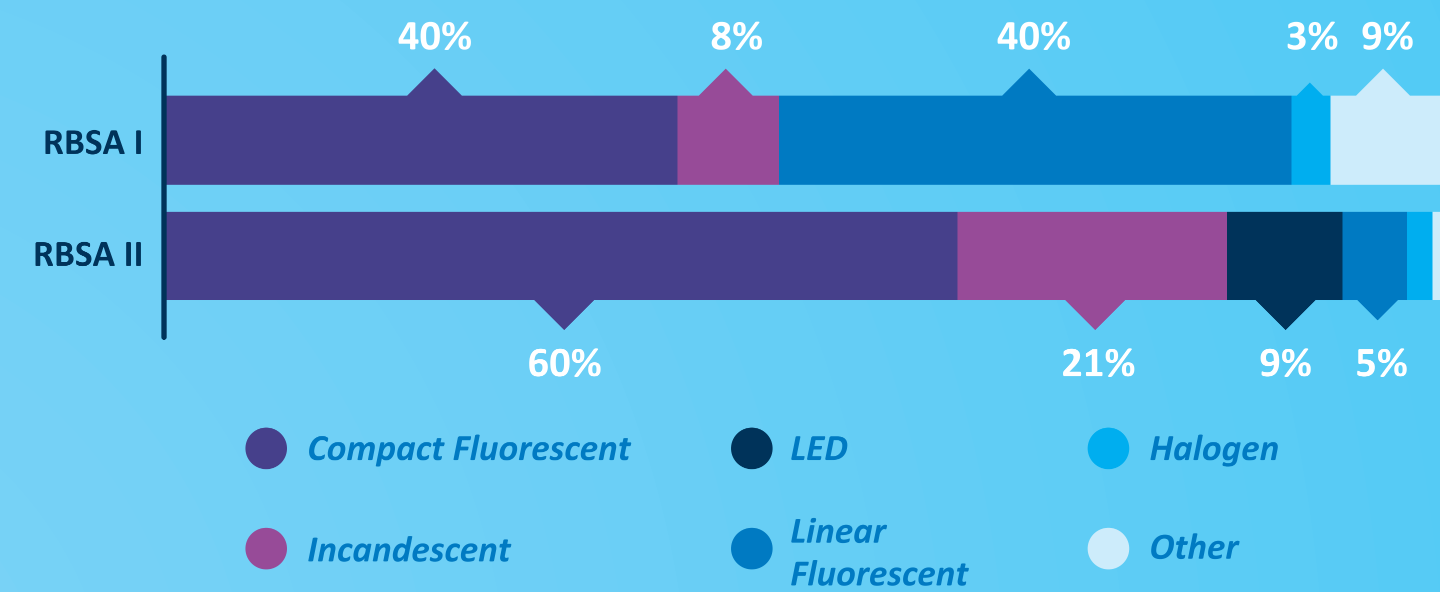
***Almost half** (54%) of common area light bulbs in RBSA II are either a CFL or LED compared to roughly 40% in the RBSA I study.*



SEE THE DATA

Distribution of Exterior Lamps by RBSA Study

*Exterior lamp distribution changed across **multiple lamp types.***



SEE THE DATA

▲▼ *Statistically different from 2011 RBSA*

Energy Benchmarking

Description

Similar to RBSA I, the RBSA II provides an opportunity to calculate energy-use profiles. Cadmus conducted the RBSA II billing analysis using procedures and methods similar to those used for the RBSA I to allow for direct comparison of the results. Cadmus requested 24 months of electric and gas billing data for all eligible residents and buildings. We removed sites from the analysis for several reasons: the utilities did not provide billing information (most common), there were inconsistencies in data collection (such as multiple readings on the same date or missing reads), or there were anomalies in the data (such as lengthy vacancies or apparently erroneous readings). The final analysis of electrical consumption included billing data for 15,687 residents and 361 buildings. The final analysis of gas consumption included billing data for 742 residents and 29 buildings.

Key Findings

Key energy usage findings include:

- The average electric consumption per unit decreased from 7,824 kWh to 7,456 kWh across the region. On average, the per-unit kilowatt-hour consumption decreased for low-rise and mid-rise buildings.
- The average per-unit gas consumption increased from 163 therms to 296 therms per unit. On average, per-unit therm consumption increased for low-rise and mid-rise buildings.
- Higher in-unit electric EUIs were largely driven by unit size: smaller units have the highest proportion of electric heat. Although these living spaces are smaller, they also typically contain a similar number of primary appliances and electronics (refrigerators, cooktops, and televisions) as larger residences.

Average Annual Residential Electric Consumption Per Square Foot

	Low-Rise (1–3)	Mid-Rise (4–6)	High-Rise (7+)	All
Electric Consumption	9.7	8.1▲	5.9	9.5
Gas Therms	0.3▲	0.3▲	0.3	0.3▲

SEE THE DATA

Residential Electric EUI Quartiles and Corresponding Unit Characteristics

	Conditioned Area (Mean)	Electric Heat	Efficient Lighting	Air Conditioning	Electric Hot Water
EUI Quartile 1 (< 7.15)	991	72%	50%	27%	32%
EUI Quartile 2 (7.15 – 9.17)	871	86%	45%	26%	55%
EUI Quartile 3 (9.17-11.58)	802	87%	46%	31%	67%
EUI Quartile 4 (> 11.58)	676	98%	47%	29%	65%

SEE THE DATA

▲▼ *Statistically different from 2011 RBSA*

Building Hot Water, Appliances, and Miscellaneous

Description

During the multifamily site visits, Cadmus collected information on building central and common area equipment such as water heater, laundry appliances, and other loads such as pools and elevators that impact the overall energy requirements of buildings.

Key Findings

Key findings include:

- The RBSA II observed a different mix of laundry facilities than seen in the RBSA I, with the majority of units and buildings lacking any sort of laundry equipment.
- Elevators were present in 79% of mid-rise buildings and 100% of high-rise. Only 10% of low-rise buildings contained at least one elevator.
- Approximately 3% of tenants reported having completed an energy audit in the last two years.
- The RBSA II observed a different mix of exterior and interior pools than seen in the RBSA I.

Distribution of Water Heaters

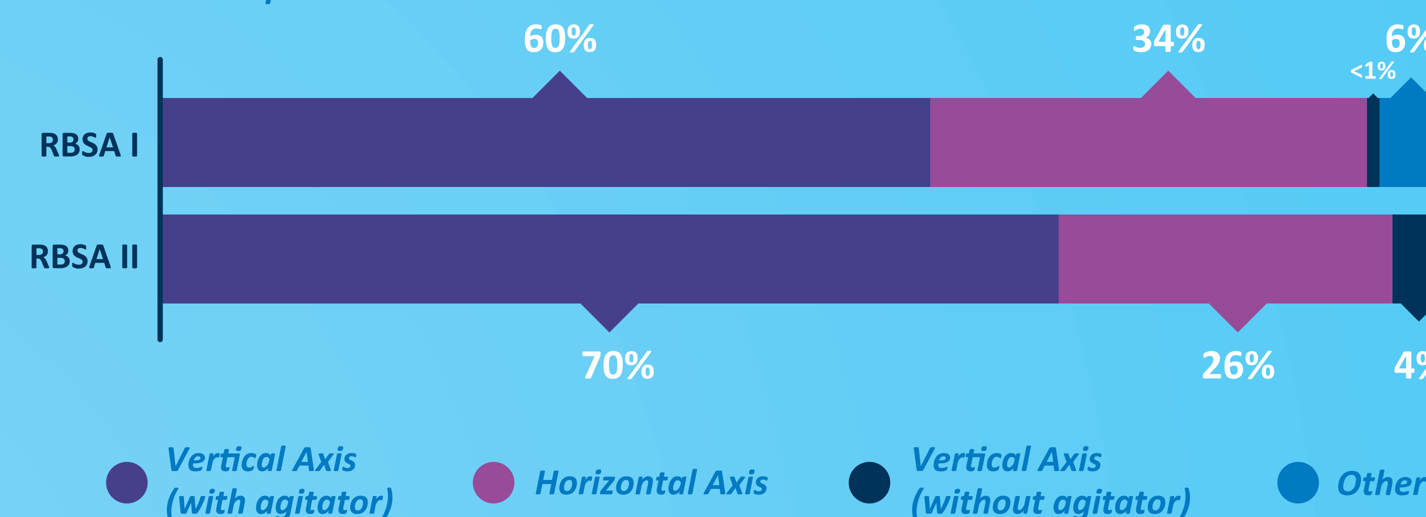
Central hot water systems are ***commonly seen*** *in mid-rise and high-rise buildings.*

	Low-Rise (1–3)	Mid-Rise (4–6)	High-Rise (7+)	All
Common Area Water Heater	30%	59%	98%	33%
In-Unit Water Heater	70%	41%	2%	67%

SEE THE DATA

Distribution of Common Area Clothes Washer Type by Study

No significant shifts *in common area clothes washer type since the previous RBSA.*



SEE THE DATA

▲▼ *Statistically different from 2011 RBSA*

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SUMMARY OF IN-UNIT END USES AND CHARACTERISTICS

The following sections provide detailed findings by unit characteristic and end use. All values in these sections are weighted. These findings represent notable and statistically significant differences between the RBSA II and the RBSA I, and in some situations, the emergence of new or different technologies not observed in RBSA I.

Where practical, these sections also highlight key differences between the RBSA II and RBSA I. Differences that are statistically significant are denoted by either an ▲ or ▼ symbol to indicate whether the value is higher or lower than in the previous study. Cadmus did not conduct statistical significance testing where we observed new or different technologies and where we developed tables for this RBSA that were not present in the RBSA I.

Appendix A provides additional detail and supplemental data tables, as well as references to comparable RBSA I table numbers.

Description

Code Updates

Key Findings

HVAC Systems

Data collection included extensive characterization of any heating, cooling, and ventilation equipment in each multifamily unit. These systems included central equipment such as forced-air furnaces and heat pumps as well as zonal equipment such as baseboard heaters, heating stoves, and ductless mini-split heat pumps. Field technicians also collected information such as the make, model number, capacity, and year of manufacture of heating and cooling equipment where practical. Where year of manufacture was not included on the manufacturer's label, technicians collected serial number data, which often included encoding that allowed the team to determine the year of manufacture after the site visit. Where practical, Cadmus also used post-visit lookups to provide equipment efficiency ratings.

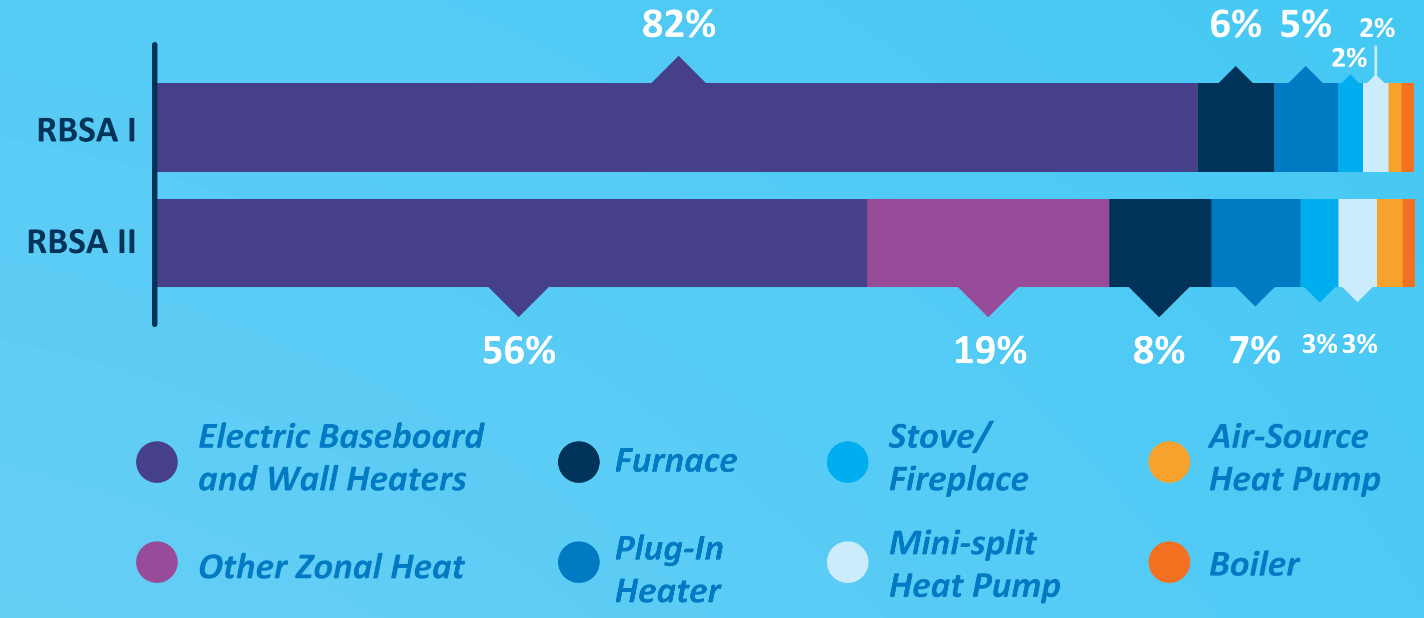
Changes in federal efficiency standards since the last RBSA mandate higher minimum efficiency ratings for some HVAC equipment. For instance, as of May 1, 2013, the minimum annual fuel utilization efficiency (AFUE) of non-weatherized gas furnaces increased from 78 to 80. As of January 1, 2015, the minimum seasonal energy efficiency ratio (SEER) of split system heat pumps increased from 13 to 14, and the minimum heating seasonal performance factor (HSPF) increased from 7.7 to 8.2.

Key findings for HVAC include:

- In-unit primary heating equipment remained much the same in RBSA II as in RBSA I, largely comprising electric zonal heating such as electric baseboard heaters. The RBSA II groups electric baseboard and wall heaters together but characterizes electric ceiling heat and other zonal systems as Other Zonal Heat.
- Similar to RBSA I, approximately 90% of living units use electricity as the primary heating fuel.
- Concentrations of mini-split heat pumps (HPs) have increased, but the difference between RBSA I and RBSA II results is not statistically significant.
- Almost all thermostats in multifamily residences are manual thermostats (91%), followed by programmable thermostats (9%). Less than 1% of in-unit thermostats are smart of wi-fi thermostats.

Distribution of In-Unit Primary Heating Systems

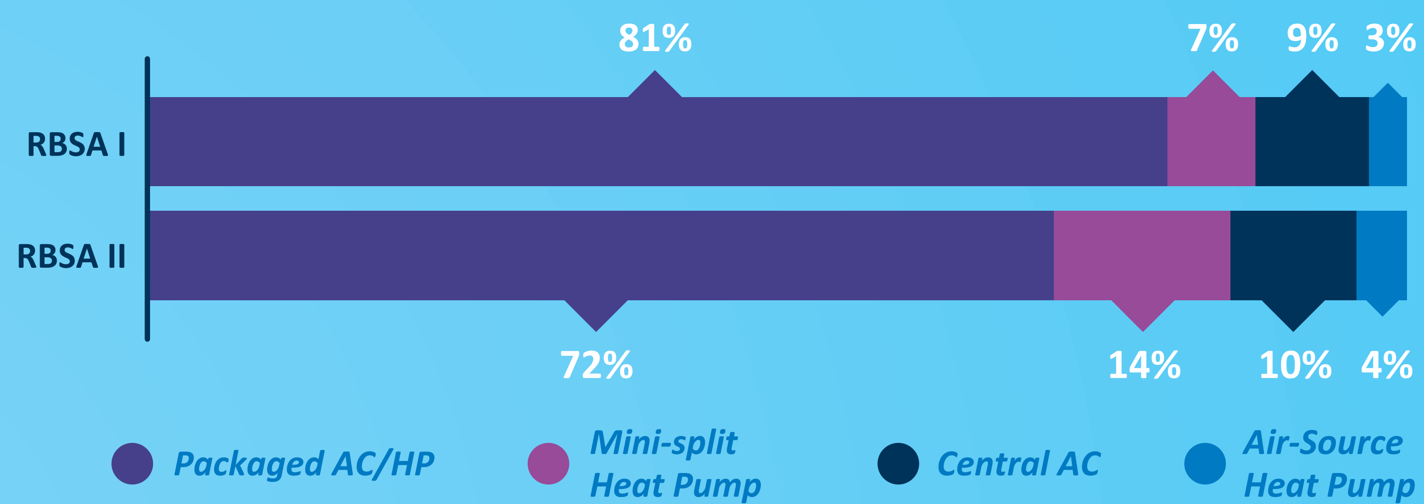
*The distribution of in-unit primary heating and cooling systems was **similar to the previous RBSA**. Units characterized below as Other Zonal Heat were counted as electric baseboard heating in RBSA I.*



SEE THE DATA

Distribution of In-Unit Primary Cooling Systems for Units with Cooling

*Approximately **one quarter of multifamily residences have cooling**. Packaged ACs and HPs are the predominant form of in-unit cooling.*



SEE THE DATA

▲▼ *Statistically different from 2011 RBSA*

Description

Code Updates

Key Findings

Lighting

Lighting data collection is a highly involved process, encompassing lighting inside and outside the residence as well as equipment kept in storage. Cadmus conducted a comprehensive lighting walk-through that captured details about lighting in every room accessible to the field technician. These details include lamp type, style, wattage, quantity, control, and location. In addition to bulbs currently installed, field technicians identified and recorded bulbs in storage.

Field technicians performed a systematic walk-through of the residence, beginning with asking the resident about spare bulbs. Identifying the type of bulb can be difficult due to accessibility or safety issues and the fact that many bulbs today look like incandescent but are in fact something different, such as a halogen. Where field technicians could not accurately assess the bulb type, they noted it as unknown.

Collecting information about LEDs and connected lighting, or lighting with an element of connectivity or intelligence, was new to this RBSA.

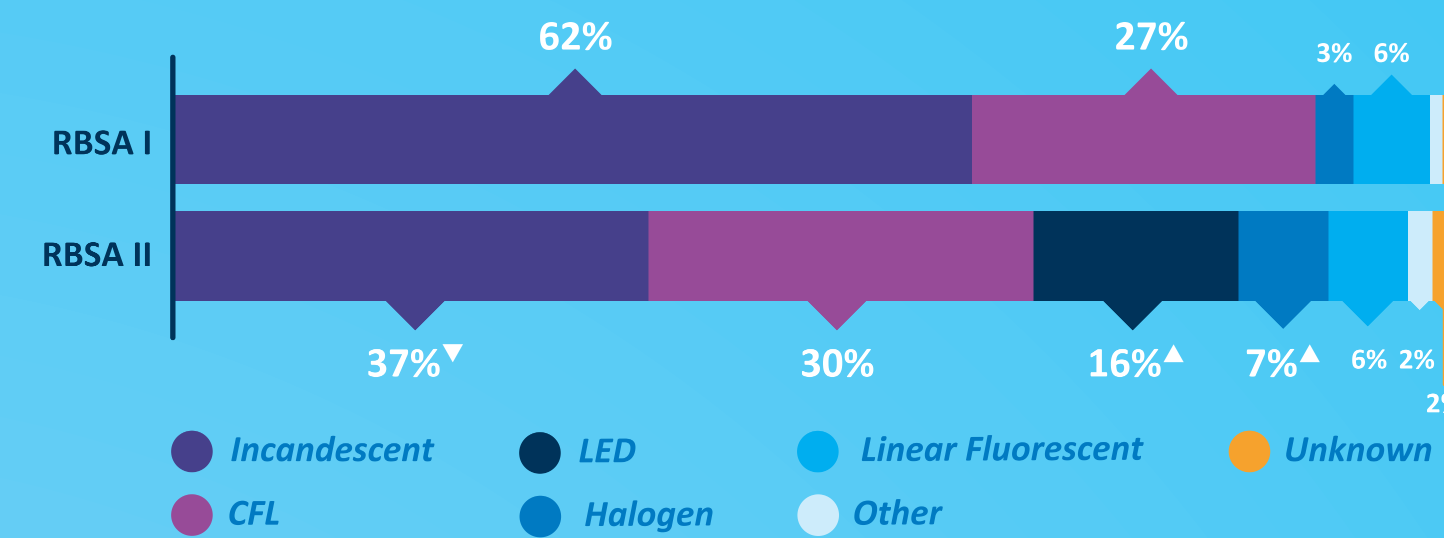
The Energy Independence and Security Act of 2007 was phased in beginning in 2012. This standard impacted many lamps that would have been targets of utility lighting programs and likely accelerated the adoption of energy efficient light bulbs.

Key findings for homes lighting include:

- The number of lamps per home decreased slightly compared to the RBSA I. Though there is nothing obviously different in the data collection protocols between RBSA I and RBSA II, this change may be a result of differences in methodology.
- LEDs represent a significant share of bulbs installed in multifamily residences (16% regionally). This is a substantial increase from the RBSA I, where LEDs were not found in sufficient quantities to be included in report tables.
- The percentage of incandescent lamps in multifamily homes decreased from 62% to 37%. Other bulb types such as CFLs and linear fluorescents remained about the same, with insignificant changes in proportional share, while the percentage of halogen lamps doubled to 7%.
- Connected lighting, bulbs that connect to the home Wi-Fi, were found in roughly 1% of multifamily residences.

Average Distribution of Lamp Type by RBSA Study

***Almost half** (46%) of all light bulbs are now either a CFL or LED compared to roughly 27% in the RBSA I study.*



SEE THE DATA

Lighting Characteristics

	RBSA II	RBSA I
Total Unit Fixtures	13.1	13.9
Total Unit Lamps	20.2▼	23.2
Compact Fluorescent Qty	6.1	6.3
Halogen Qty	1.2	0.9
Incandescent Qty	7.4▼	13.9
Light Emitting Diode Qty	3.2▲	-
Linear Fluorescent Qty	1.4▼	1.7
Other Lamp Qty	0.9▲	0.4

SEE THE DATA

▲▼ *Statistically different from 2011 RBSA*

Saturation of Lamp Type By Room

*LEDs are installed **throughout the home.***

*LEDs are installed throughout the home. Laundry rooms had the **highest percentage of LEDs**, though they are also commonly found in dining rooms, living rooms, and offices.*

BEDROOM
CFL **37%▲**
Halogen **5%**
Incandescent **38%▼**
LED **15%▲**
Linear Fluorescent **2%**

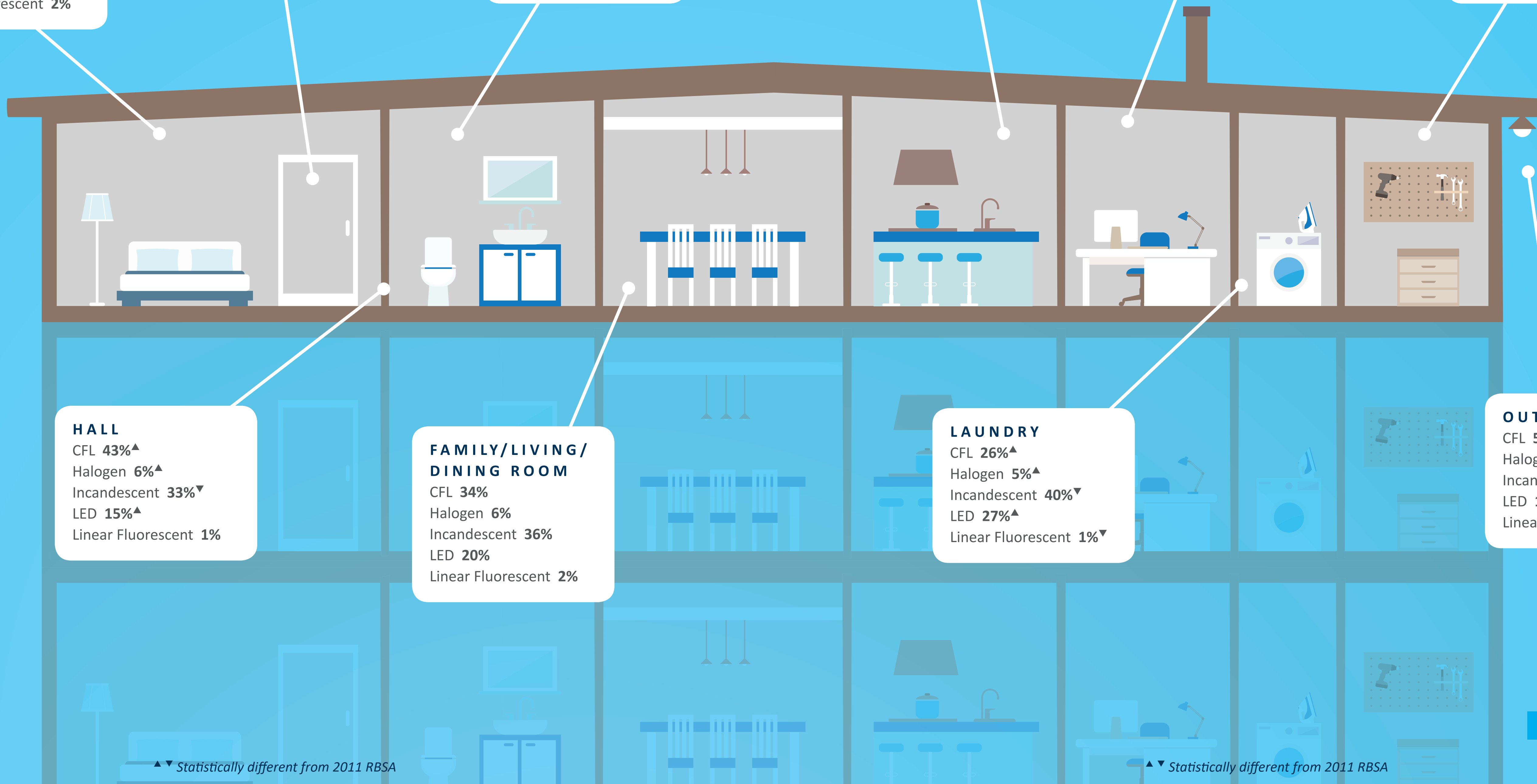
CLOSET
CFL **27%**
Halogen **3%**
Incandescent **42%▼**
LED **15%**
Linear Fluorescent **10%▲**

BATHROOM
CFL **24%**
Halogen **5%▲**
Incandescent **48%▼**
LED **14%▲**
Linear Fluorescent **4%**

KITCHEN
CFL **23%**
Halogen **10%**
Incandescent **24%▼**
LED **13%▲**
Linear Fluorescent **29%**

OFFICE
CFL **41%**
Halogen **7%**
Incandescent **27%▼**
LED **23%▲**
Linear Fluorescent **3%**

OTHER
CFL **32%▲**
Halogen **8%**
Incandescent **48%▼**
LED **3%**
Linear Fluorescent **2%▼**



HALL
CFL **43%▲**
Halogen **6%▲**
Incandescent **33%▼**
LED **15%▲**
Linear Fluorescent **1%**

FAMILY/LIVING/DINING ROOM
CFL **34%**
Halogen **6%**
Incandescent **36%**
LED **20%**
Linear Fluorescent **2%**

LAUNDRY
CFL **26%▲**
Halogen **5%▲**
Incandescent **40%▼**
LED **27%▲**
Linear Fluorescent **1%▼**

OUTSIDE
CFL **57%▲**
Halogen **0%**
Incandescent **26%**
LED **16%▲**
Linear Fluorescent **0%**

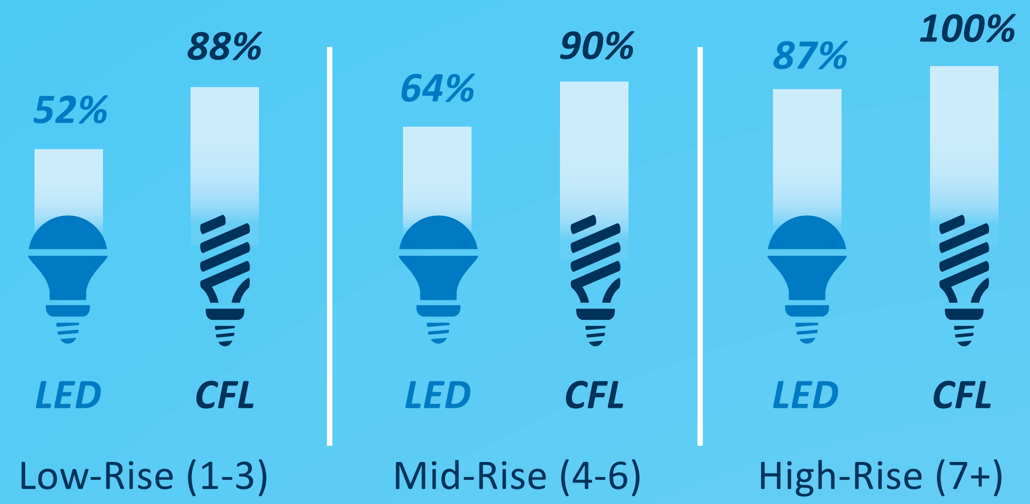
SEE THE DATA

▲▼ *Statistically different from 2011 RBSA*

▲▼ *Statistically different from 2011 RBSA*

Percent of Homes with CFLs and LEDs by Building Size

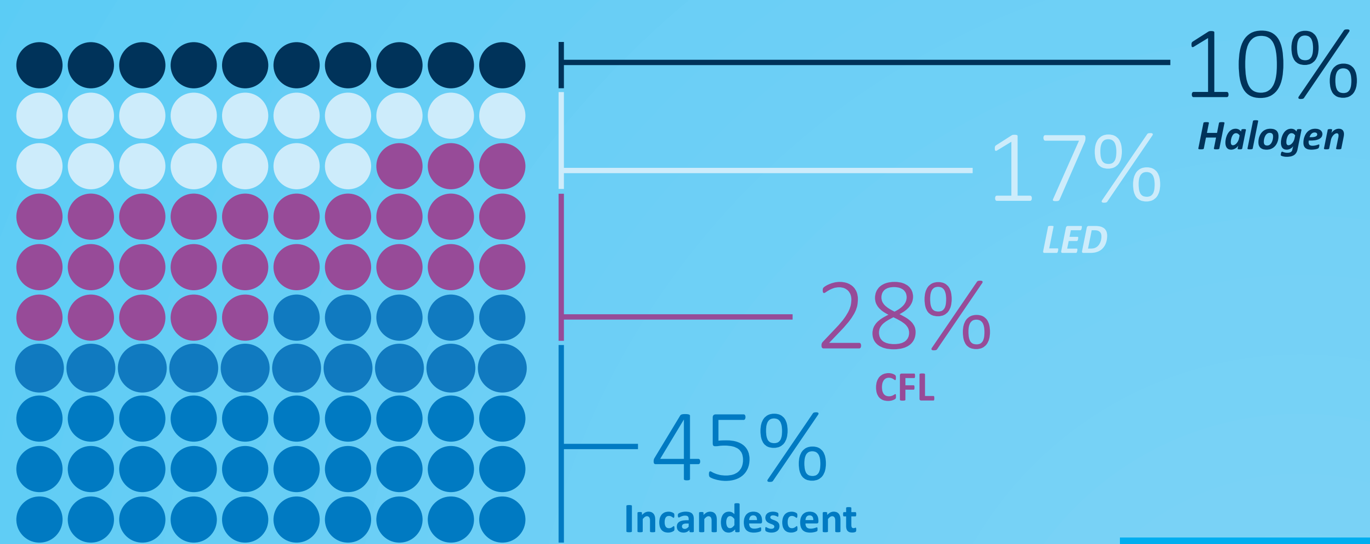
Nearly 90% of multifamily residences have at least one CFL, and over half of units have one or more LEDs. At least one CFL was identified in each unit surveyed in buildings with more than six floors.



SEE THE DATA

Distribution of Stored Bulbs

The typical multifamily residences has the same number of CFLs in storage (1.3) as incandescent lamps (1.3). LEDs are the third-most common lamp in storage (0.6).



SEE THE DATA

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Appliances

Description

The appliance data collection identified and characterized appliances in each multifamily residence, including kitchen and laundry appliances. This section includes distribution of appliances and specific characteristics such as age and size, and appliance configurations such as door position for refrigerators. In many instances, Cadmus identified characteristic data such as age, efficiency, and size after the site visit through a combination of databases and other secondary sources.

For the first time, the RBSA II collected information about connected appliances (that is, appliances that are connected to the homes' Wi-Fi). In addition to identifying the presence of clothes dryers and fuel type, the RBSA II captured more information regarding clothes dryer configurations and other details (included in Appendix A).

Code Updates

Federal energy efficiency standards can have a significant impact on appliance stock and efficiencies in particular. There have been a few federal efficiency standard changes since the previous RBSA. Appliances impacted by federal efficiency changes include the following equipment:

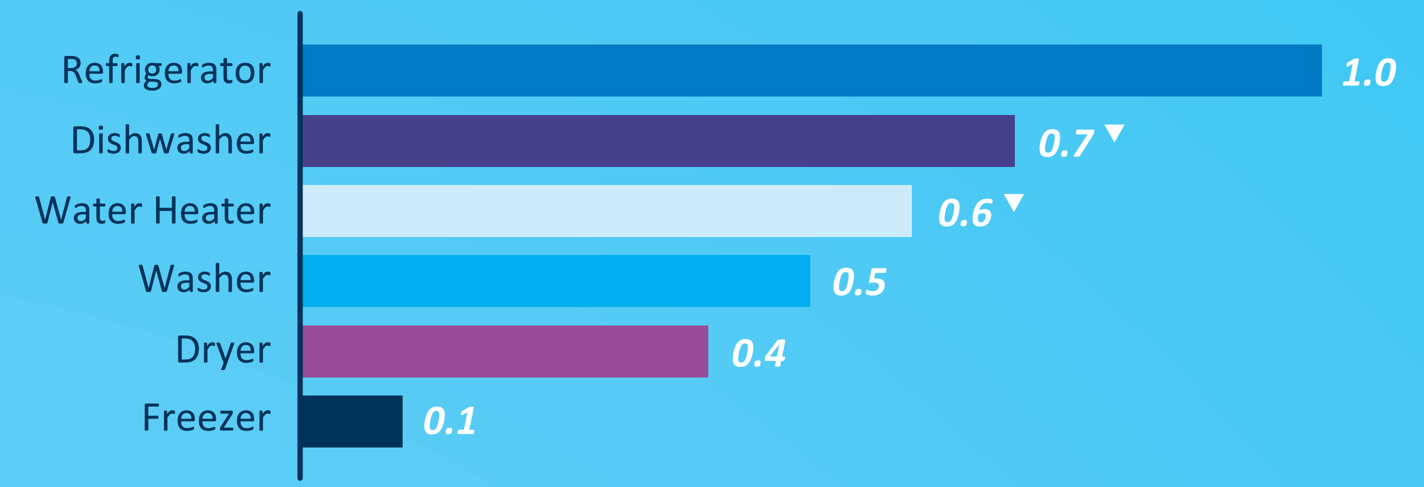
- Refrigerators and freezers (effective 2014)
- Clothes washers and dryers (effective 2015)
- Dehumidifiers (effective 2012)
- Dishwashers (effective 2013)

Key Findings

Key findings for appliances include:

- Approximately 29% of observed refrigerators and 27% of observed dishwashers were beyond their expected useful life. Expected useful life is based on Regional Technical Forum assumptions and ranges from 12 to 22 years, depending on the appliance.
- There were significant shifts in refrigerator configuration types: refrigerators with top freezers declined the most since RBSA I. Overall, the average refrigerator size increased from 17.0 cubic feet to 17.9 cubic feet.

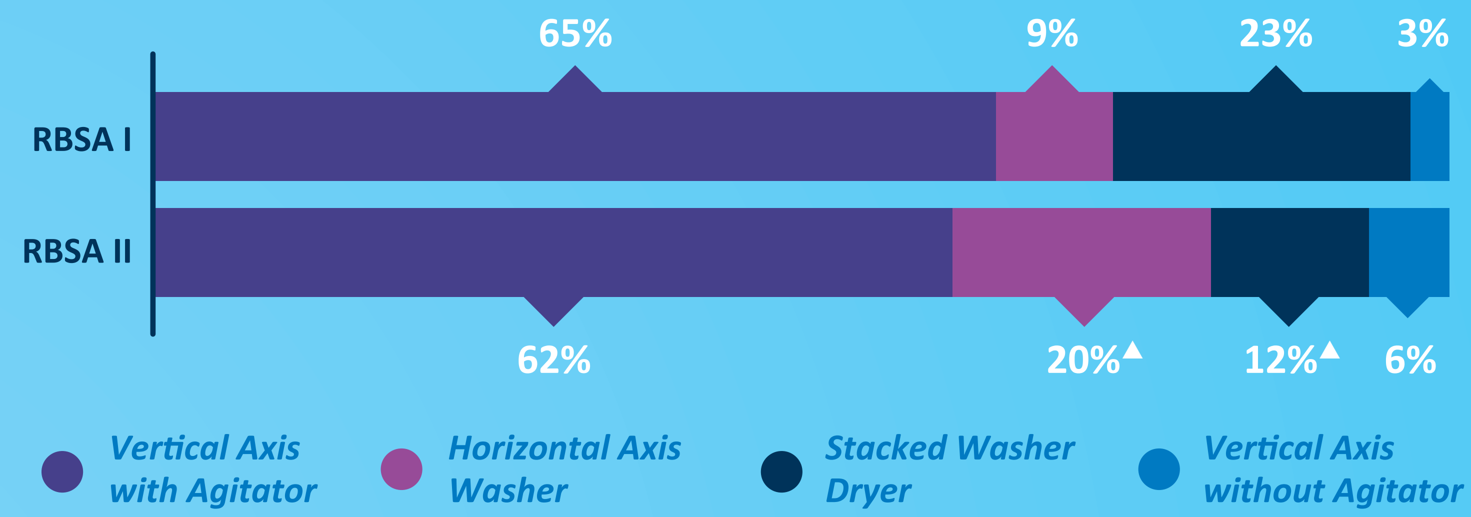
Average Number of Appliances per Unit



SEE THE DATA

Distribution of In-Unit Clothes Washer Types

*Horizontal and vertical axis (without agitator) washers increased from a combined share of **12% to 26%** across the region.*



SEE THE DATA

▲▼ *Statistically different from 2011 RBSA*

Distribution of Clothes Dryer Fuel Types

*The RBSA II found that nearly all in-unit clothes dryers **are electric**. Gas dryers were only identified in buildings with three or fewer floors.*

	Electric	Gas	Unknown	All Types
Apartment Building (3 or fewer floors)	97.1%	2.1%	0.8%	100.0%
Apartment Building (4 to 6 floors)	100.0%	0.0%	0.0%	100.0%
Apartment Building (More than 6 floors)	100.0%	0.0%	0.0%	100.0%

SEE THE DATA

Appliance Age

*Refrigerators and freezers tended to be the **oldest appliances** in multifamily residences.*

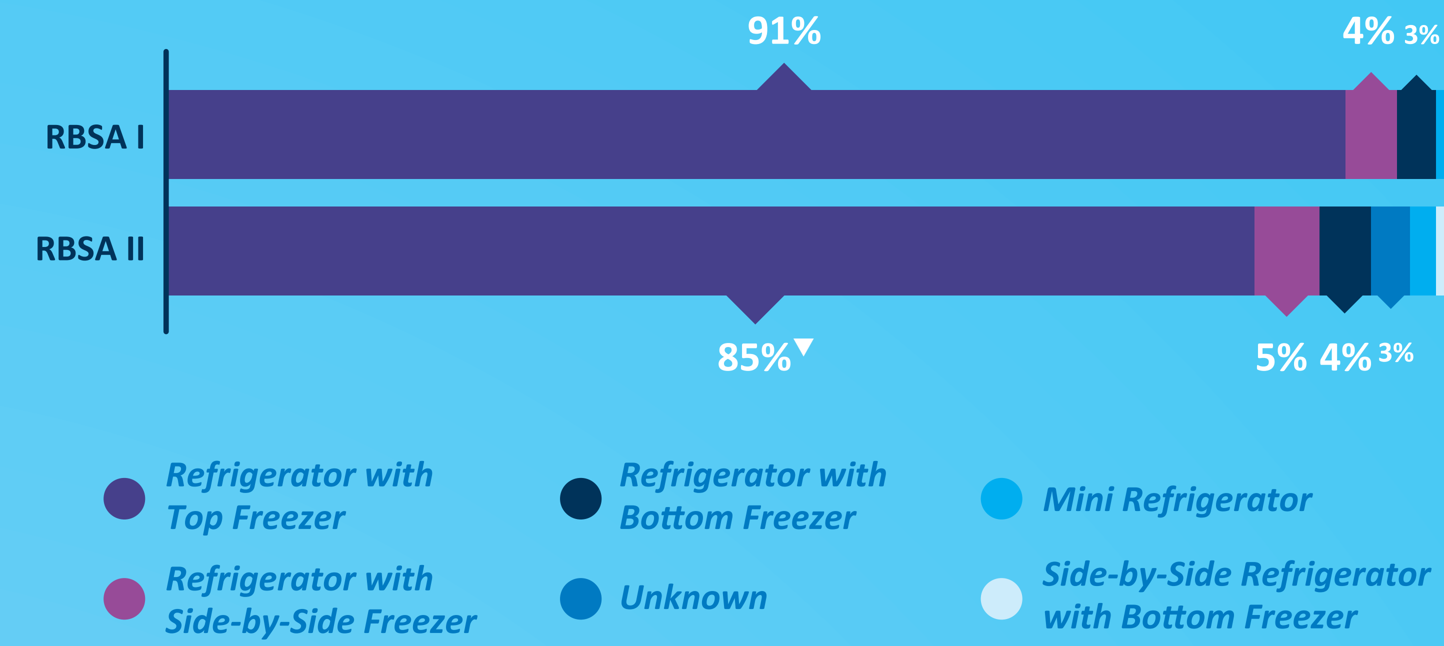
17 Years	11 Years	9 Years	9 Years	8 Years
Freezer	Refrigerator	Dishwasher	Dryer	Washer

SEE THE DATA

▲▼ *Statistically different from 2011 RBSA*

Distribution of Refrigerators by Type

*There were **few changes** in refrigerator configuration.*



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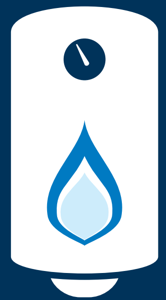


Description

Code Updates

Key Findings

Water End-Uses

Field technicians identified and characterized water heaters in each multifamily residence that had a dedicated water heater. Specifically, they collected information regarding the water heater type, size, fuel, make, model, and input capacity.

Field technicians also conducted a thorough walk-through for showerheads and faucet aerators. For these end uses, technicians captured the rated flowrate (if available) and measured flowrate using documented procedures and equipment. The end uses were classified as primary, secondary, or used about the same.

Federal energy efficiency standards can have a significant impact on water heater efficiencies. New federal efficiency changes for water heaters went into effect in 2015.

Key findings for water end-uses include:

- There were a few statistically significant shifts with water heaters, including water heater fuel type. The number of multifamily residences with an in-unit gas water heater increased by 7%, from 5% to 12%.
- Similar to the previous RBSA, almost no in-unit water heaters are instantaneous (less than 1%).

Distribution of Water Heater Fuel Type

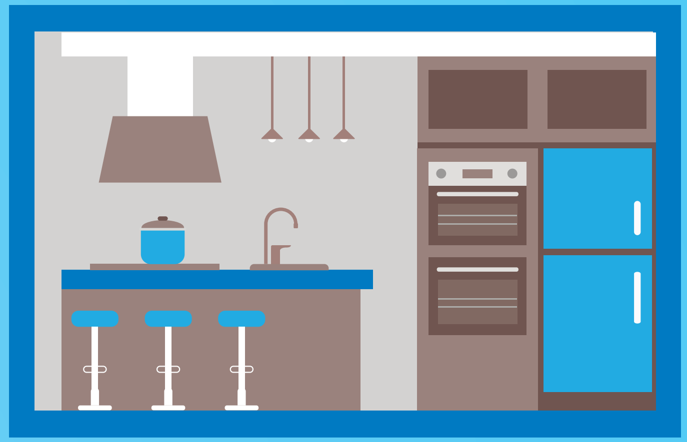
*The number of multifamily residences with an in-unit gas water heater **increased by 7%**, from 5% to 12%.*

	0–55 Gal	>55 Gallon	All Sizes
Electric	87%	2%	88%
Natural Gas	12%▲	0%	12%
All Types	98%	2%	100%

SEE THE DATA

Average Number of Showerheads and Faucets Per Home

*Multifamily residences have **1.3** bathroom sinks, **0.3** standalone showers, and **0.9** shower and bath combo units*



*On average, homes have **1.0** kitchen sinks*

SEE THE DATA

▲▼ *Statistically different from 2011 RBSA*

Electronics

Description

The electronics walk-through identified and characterized electronics in each residence. Equipment captured included a range of electronic devices from televisions to computers. Field technicians did not include portable devices such as iPads and phones because of their general mobility. This section includes distribution of electronics, along with specific characteristics such as size, type, and usage. In some instances, Cadmus identified characteristic data such as efficiency and size after the site visit by searching a third-party database, manufacturer data sheets, or other online resources.

The walk-through also included capturing information regarding power strips and auxiliary items that may be plugged into them. Field technicians measured the television wattage whenever possible, using a plug-through power meter, and recorded the presence of television peripherals such as Roku, Fire Stick, and Apple TV devices. Technicians asked participants about usage patterns (e.g., how many hours per day each television is typically on).

Key Findings

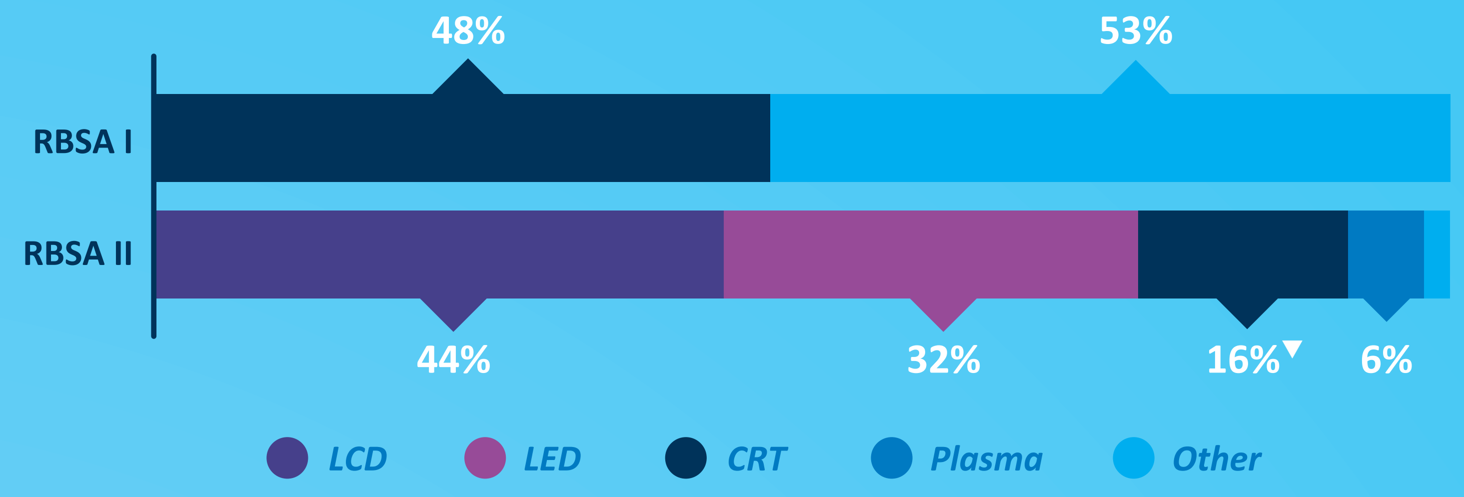
Key electronic findings include:

- There have been many advancements in television technology since the last RBSA. Cathode ray tube televisions represented about half of all televisions found in multifamily residences since the last RBSA, whereas currently they represent only 16% of televisions, with LED and LCD televisions representing over three-quarters of what is currently installed in homes.
- Consistent with the other home types, multifamily residences had fewer set-top boxes and audio systems.
    - The number of homes with set-top boxes declined from 75% in RBSA I to 45% in RBSA II.
    - The number of audio systems per home halved, from 0.8 in RBSA I to 0.4 in RBSA II.

These changes are likely due to the popularity of web-enabled televisions and streaming services such as Netflix and Spotify.

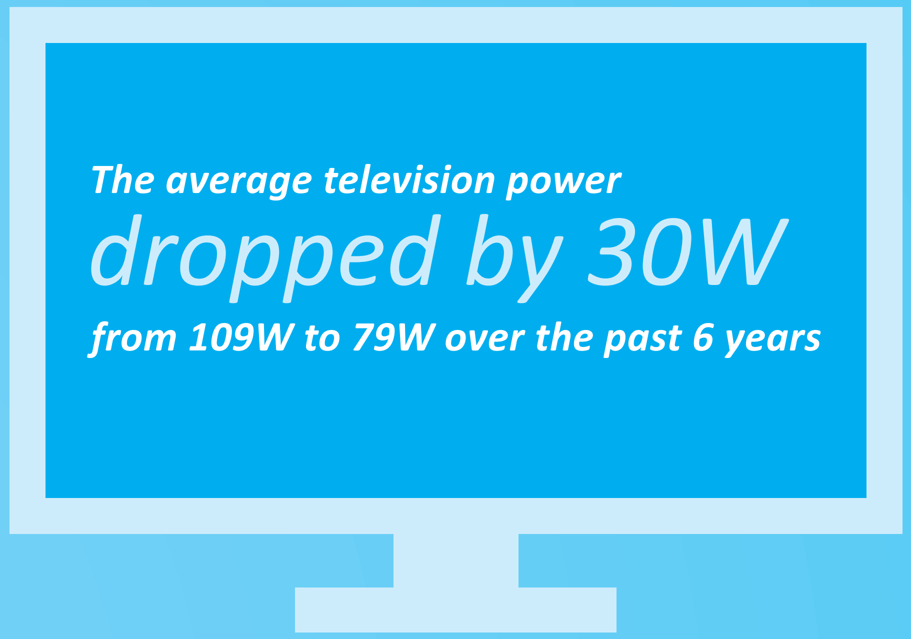
Distribution of Television Screen Types

*Over **three-quarters of televisions** now use LED or LCD technology*



SEE THE DATA

Television Power Draw

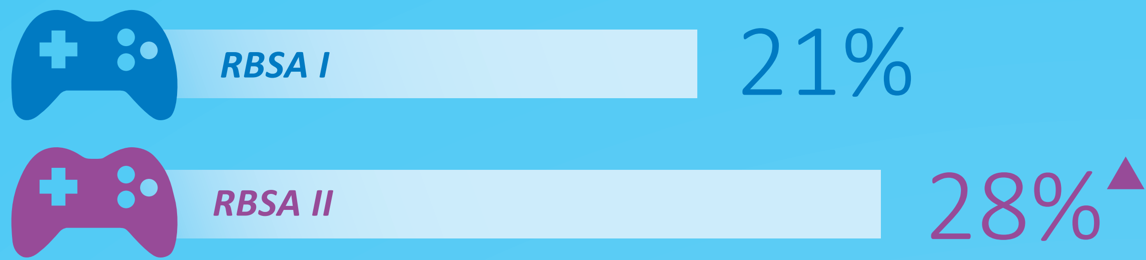


SEE THE DATA

▲▼ *Statistically different from 2011 RBSA*

Percent of Homes with Game Consoles

The percentage of homes with gaming systems ***increased from 21% to 28%.▲***



SEE THE DATA

***2%** of homes have at least one smart power strip*

SEE THE DATA

What are power strips being used for?

OTHER

Entertainment system	Office/ computer	Other devices
60%	23%	17%

SEE THE DATA

▲▼ *Statistically different from 2011 RBSA*

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▲▼ *Statistically different from 2011 RBSA*

RESIDENTIAL BUILDING STOCK ASSESSMENT

Appendix A: Report Tables

Introduction

This appendix presents findings for single-family homes based on data collected for the core RBSA II study (funded by NEEA) and on data collected for two oversamples funded by the Bonneville Power Administration, Seattle City Light, and Puget Sound Energy (PSE). Cadmus developed and applied sampling weights to ensure that all multifamily observations were weighted proportionally to the segment of the population represented by the sample; see the Database User Manual for a description of the weighting methods and procedures.

Where possible, Cadmus benchmarked the findings of the RBSA II against the findings presented in the RBSA I. Statistically significant differences between the two reports are denoted by either a ▲ or ▼ symbol, to indicate whether the RBSA II value is higher or lower than the value in the RBSA I study. This appendix identifies which table in the previous study was used to draw conclusions about each statistically significant difference.

While there are statistically significant differences between the distribution of building vintage, type, and other characteristics between RBSA I and RBSA II, the reader is cautioned that these may reflect differences in sampling and recruitment methodology. For instance, in the previous RBSA building managers were recruited and then units within a building selected. In the RBSA II, tenants were randomly selected and offered the opportunity to participate. While subtle, these different recruitment approaches may have yielded slight differences in building types.

New tables presented in this document that do not have a corollary in the RBSA I study do not have symbols indicating statistically significant increases or decreases from RBSA I, though statistically significant differences may exist. Without a comparable table in the RBSA I report, statistical testing could not be performed.

Unless otherwise noted, the following are true for all tables:

- Unknown, not applicable (N/A), and missing data are excluded from the analysis
- The presented sample size (n) represents the number of homes.
- Within a table, summing the sample size (n) across bins may result in a larger sample size than is shown in the 'Total' or summary row. This is intended and is possible because a home's equipment may fall into multiple bins within the same table. In these instances, the home will be counted towards the sample size for each bin it falls into.

Table A1 shows the complete sample and population sizes for each stratum and the case weight for each. The sample size is the number of homes that were observed in this study, the population size is the total number of homes in the stratum, and the case weight is the total number of homes that each sampled home represents.

Table A1. Multifamily Sample Sizes, Population Sizes, and Weights by Strata

State	Region	Territory	Sample Size – Number of Units (n)	Population Size – Number of Units (N)	Case Weight (N/n)
ID	-	BPA	15	11,604	774
ID	-	Non-BPA	19	43,178	2,273
MT	W	BPA	27	5,779	214
MT	W	Non-BPA	11	23,135	2,103
OR	E	BPA	9	7,379	820
OR	E	Non-BPA	8	10,456	1,307
OR	W	BPA	61	45,845	752
OR	W	Non-BPA	51	206,736	4,054
WA	E	BPA	46	31,641	688
WA	E	Non-BPA, Non-PSE	27	49,131	1,820
WA	PS	BPA	16	44,879	2,805
WA	PS	PSE - King County	52	126,906	2,441
WA	PS	PSE - Non-King County	32	47,486	1,484
WA	PS	SCL	74	148,177	2,002
WA	PS	Snohomish	28	56,059	2,002
WA	W	BPA	56	41,409	739
WA	W	PSE - Non-King County	10	14,912	1,491

* The sample and population sizes shown are residential units, not buildings.

For the RBSA II analysis, it is assumed that the sampled units (residences) are representative of the total population within each stratum. For example, in Table A1 there are 15 sampled units in the Idaho-BPA service territory that are representative of the 11,604 units in the population. This means that each of the 15 sampled units represent 774 homes in the population, which is the case weight for the strata. All analyses are weighted according to this ideology.

Many tables in the appendix use a subset of the data due to missing and unknown data. which are assumed to be missing completely at random. When performing the RBSA II analysis or working with the RBSA II database, the case weight needs to be re-calculated after sub-setting to remove missing or unknown data. The case weight needs to be recalculated because when sites are removed from the analysis, the sample size decreases, and each remaining sample point represents a larger proportion of the population. As an example, if only 10 out of the 15 sampled units in the Idaho-BPA service territory have known data in the variable of interest, the case weight for this stratum would be recalculated as 11,604 divided by 10, such that each sampled unit with known data would represent 1,160 total units.

Contents

Table 1. DISTRIBUTION OF BUILDINGS BY BUILDING SIZE AND VINTAGE (Compare to Table 4 in 2011 RBSA)

Vintage	Building Size (Stories)								
	Low-Rise (1–3)		Mid-Rise (4–6)		High-Rise (7+)		All Sizes		n
	%	EB	%	EB	%	EB	%	EB	
Pre 1955	77.4%	2.7%	19.0%▼	2.2%	3.6%▲	6.3%	7.5%	2.4%	41
1955-1970	85.4%▼	2.8%	13.5%▲	3.0%	1.1%	0.9%	18.2%	3.7%	85
1971-1980	86.0%▼	2.7%	11.6%▲	3.0%	2.4%▲	0.9%	25.3%	4.1%	117
1981-1990	96.9%	0.7%	3.1%	0.9%	0.0%	0.0%	13.2%▼	3.3%	54
1991-2000	84.9%▼	3.0%	12.6%	3.3%	2.5%▲	0.9%	15.7%	3.4%	69
2001-2010	84.8%	3.2%	13.9%	3.5%	1.2%▼	0.9%	13.8%▲	3.2%	70
Post 2010	73.7%	1.1%	24.4%	1.4%	1.9%	1.0%	6.3%	2.0%	36
All Vintages	87.5%▼	2.7%	10.9%▲	2.6%	1.6%	0.8%	100.0%	0.0%	472

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Table 2. DISTRIBUTION OF UNITS BY BUILDING SIZE AND VINTAGE (Compare to Table 5 in 2011 RBSA)

Vintage	Building Size (Stories)								
	Low Rise (1-3)		Mid Rise (4-6)		High Rise (7 Plus)		All Sizes		n
	%	EB	%	EB	%	EB	%	EB	
Pre 1955	67.4%▲	2.6%	26.3%▼	2.5%	6.3%	4.3%	6.2%	2.2%	40
1955-1970	70.9%▼	3.9%	26.6%▲	4.2%	2.5%	1.1%	15.4%	3.5%	84
1971-1980	75.9%▼	2.8%	17.9%▲	3.0%	6.2%	1.2%	22.0%	3.6%	116
1981-1990	96.7%▲	0.7%	3.3%▼	0.9%	0.0%	0.0%	10.7%	2.8%	54
1991-2000	66.5%	3.9%	29.2%▲	4.3%	4.3%	0.9%	18.4%	3.7%	69
2001-2010	65.2%▲	3.6%	32.4%▲	4.0%	2.4%	1.1%	18.8%	3.7%	70
Post 2010	73.9%	1.2%	23.3%	1.4%	2.9%	1.2%	8.6%	2.1%	36
All Vintages	68.2%▼	4.2%	27.5%▲	4.2%	4.3%	1.2%	100.0%	0.0%	469

Table 3. PERCENTAGE OF BUILDINGS IN MULTI-BUILDING FACILITIES BY BUILDING SIZE (Compare to Table 6 in 2011 RBSA)

Building Size (Stories)	Percentage Buildings in Multi-Building Facilities		
	%	EB	n
Low-Rise (1-3)	77.1%▲	3.8%	433
Mid-Rise (4-6)	29.8%	3.7%	71
High-Rise (7+)	5.1%	3.5%	16
Total	71.2%▲	3.3%	520

Table 4. PERCENTAGE OF UNITS IN MULTI-BUILDING FACILITIES BY BUILDING SIZE (Compare to Table 7 in 2011 RBSA)

Building Size (Stories)	Percentage Units in Multi-Building Facilities		
	%	EB	n
Low-Rise (1-3)	67.2%	4.2%	433
Mid-Rise (4-6)	22.7%▼	2.9%	71
High-Rise (7+)	6.0%	3.8%	16
Total	61.8%	3.5%	520

Table 5. DISTRIBUTION OF BUILDING FLOOR AREA BY FLOOR AREA CATEGORY AND BUILDING SIZE (Compare to Table 8 in 2011 RBSA)

Building Size (Stories)	Floor Area Category						
	Common Area		Non-Residential		Residential		n
	%	EB	%	EB	%	EB	
Low-Rise (1-3)	4.7%	1.9%	1.8%	1.6%	93.5%	1.6%	399
Mid-Rise (4-6)	12.9%	3.5%	3.4%▼	1.9%	83.7%▲	1.9%	68
High-Rise (7+)	14.7%	6.0%	1.3%	1.4%	83.9%	1.4%	16
All Sizes	7.1%	2.3%	2.2%	1.6%	90.7%	1.6%	483

Table 6. DISTRIBUTION OF UNIT TYPES BY VINTAGE (Compare to Table 9 in 2011 RBSA)

Vintage	Unit Type								
	Studio		One Bedroom		Two Bedroom		Three Bedroom		n
	%	EB	%	EB	%	EB	%	EB	
Pre 1955	40.7%	5.5%	31.0%▼	2.8%	15.9%▼	4.3%	12.4%▲	4.8%	36
1955-1970	1.8%	1.1%	53.8%	4.8%	38.8%	4.6%	5.5%	2.5%	78
1971-1980	3.5%	1.5%	52.8%▲	4.8%	41.1%▼	4.8%	2.4%▼	1.7%	105
1981-1990	3.4%	2.5%	42.7%	4.5%	47.5%	5.0%	6.5%	2.5%	48
1991-2000	19.2%▲	4.0%	33.3%	3.9%	39.1%▼	4.4%	7.6%	2.8%	54
2001-2010	10.1%▲	2.1%	30.8%▼	3.9%	40.6%	4.9%	17.6%▲	4.2%	61
Post 2010	3.4%	0.9%	37.4%	5.0%	53.8%	5.0%	4.5%	1.3%	34
All Vintages	11.1%▲	3.5%	46.6%	4.6%	35.0%▼	4.8%	7.0%	2.9%	416

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Table 7. AVERAGE CONDITIONED UNIT FLOOR AREA (SQ. FT.) BY VINTAGE AND UNIT TYPE (Compare to Table 10 in 2011 RBSA)

Vintage	Unit Type										n
	Studio		One Bedroom		Two Bedroom		Three Bedroom		All Types		
	Mean	EB	Mean	EB	Mean	EB	Mean	EB	Mean	EB	
Pre 1955	678.8	NA	687.4▲	17.9	945.1▲	3.0	949.5	NA	836.3▲	6.6	34
1955-1970	0.0	0.0	524.2▼	11.1	845.0	39.3	950.6	63.6	730.6▲	17.5	83
1971-1980	521.4	NA	526.1▼	9.2	749.6▼	12.3	1,119.5▲	26.2	740.3▼	6.6	115
1981-1990	0.0	0.0	530.8▼	7.3	888.9	96.3	888.3▼	10.0	702.2▼	34.3	53
1991-2000	228.0	NA	516.2▼	4.1	813.7▼	12.5	876.3▼	13.5	688.5▼	5.0	68
2001-2010	398.6	NA	582.4▼	11.8	958.1	31.5	953.3▼	7.2	786.0▼	12.3	69
Post 2010	0.0	0.0	575.2	3.9	822.6	12.2	1,021.0	18.5	718.5	3.0	34
All Vintages	373.6	NA	557.5▼	3.6	856.4▼	14.0	966.1▼	6.5	741.0▼	5.4	456

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Table 8. PERCENTAGE BUILDINGS WITH CONDITIONED COMMON AREA BY BUILDING SIZE (Compare to Table 11 in 2011 RBSA)

Building Size (Stories)	Percentage with Common Area		
	%	EB	n
Low-Rise (1-3)	21.7%▼	3.6%	436

Table 9. AVERAGE COMMON AREA ROOM TYPE FLOOR AREA (SQ. FT.) FOR LOW-RISE BUILDINGS (Compare to Table 12 in 2011 RBSA)

Room Type	Common Room Area		
	Mean	EB	n
Hall	1,238.6▲	211.8	57
Kitchen	502.6	NA	2
Laundry	202.8	32.3	68
Lobby	477.1▲	145.0	11
Mechanical	86.8	NA	2
Office	253.1▲	9.5	10
Other	193.9▲	23.4	11
Recreation	1,197.8▲	14.7	11
Store	170.3▲	10.6	5
All Rooms	597.1	48.3	102

Table 10. DISTRIBUTION OF BUILDING FLOOR AREA BY FLOOR CATEGORY AND BUILDING SIZE (Compare to Table 13 in 2011 RBSA)

Building Size (Stories)	Floor Area Category						
	Common Area		Non-Residential		Residential		n
	%	EB	%	EB	%	EB	
Low-Rise (1-3)	4.7%	1.9%	1.8%	1.6%	93.5%	1.6%	399
Mid-Rise (4-6)	12.9%	3.5%	3.4%▼	1.9%	83.7%▲	1.9%	68
High-Rise (7+)	14.7%	6.0%	1.3%	1.4%	83.9%	1.4%	16
All Sizes	7.1%	2.3%	2.2%	1.6%	90.7%	1.6%	483

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Table 11. AVERAGE NUMBER OF PARKING STALLS PER UNIT BY PARKING TYPE AND BUILDING SIZE (Compare to Table 14 in 2011 RBSA)

Building Size (Stories)	Percentage with Non-Residential Use		
	Mean	EB	n
Low-Rise (1-3)	1.6▲	0.1	351
Mid-Rise (4-6)	0.8	NA	4
All Sizes	1.6▲	0.1	355

Table 12. PERCENTAGE OF BUILDINGS WITH NON-RESIDENTIAL USES BY BUILDING SIZE (Compare to Table 15 in 2011 RBSA)

Building Size (Stories)	Percentage with Non-Residential Use		
	%	EB	n
Low-Rise (1-3)	2.7%	1.7%	436
Mid-Rise (4-6)	25.0%▼	3.7%	71
High-Rise (7+)	51.1%	6.2%	16
Total	5.7%▲	1.7%	523

Table 13. DISTRIBUTION OF NON-RESIDENTIAL FLOOR AREA (IN BUILDINGS WITH NON-RESIDENTIAL) BY USE TYPE AND BUILDING SIZE
(Compare to Table 16 in 2011 RBSA)

Non-Residential Use Type	Building Size (Stories)								
	Low-Rise (1–3)		Mid-Rise (4–6)		High-Rise (7+)		All Sizes		n
	%	EB	%	EB	%	EB	%	EB	
Grocery	0.0%	0.0%	0.0%	0.0%	3.0%	8.3%	0.3%	1.1%	29
Office	48.3%	27.2%	17.1% ▲	7.3%	14.8%	17.4%	35.6% ▲	13.7%	29
Other	38.7%	30.3%	60.1%	16.9%	23.1%	20.7%	42.3%	17.0%	29
Retail	13.0%	24.4%	21.3%	17.1%	52.8%	24.5%	20.6%	14.2%	29
Vacant	0.0%	0.0%	1.5% ▼	2.8%	6.2% ▼	11.8%	1.2% ▼	2.2%	29
Total	100.0%	0.0%	100.0%	0.0%	100.0%	0.0%	100.0%	0.0%	29

Table 14. DISTRIBUTION OF OWNERSHIP TYPE BY BUILDING SIZE
(Compare to Table 17 in 2011 RBSA)

Ownership Type	Building Size (Stories)								
	Low-Rise (1–3)		Mid-Rise (4–6)		High-Rise (7+)		All Sizes		n
	%	EB	%	EB	%	EB	%	EB	
Condo association	10.2%	5.8%	0.0%	0.0%	0.0%	0.0%	10.2%	5.8%	12
Cooperative	1.7%	1.7%	0.0%	0.0%	0.0%	0.0%	1.6%	1.7%	4
Corporation/REIT	38.0%	8.7%	0.0%	0.0%	0.0%	0.0%	36.8%	8.8%	44
Individual	35.5%	9.1%	31.6%	0.0%	0.0%	0.0%	35.0%	9.0%	45
Mixed	0.5%	2.9%	0.0%	0.0%	0.0%	0.0%	0.5%	2.9%	1
Private non-profit	8.7%	6.3%	0.0%	0.0%	0.0%	0.0%	8.7%	6.3%	7
Public agency	5.4%	3.6%	68.4%	0.0%	0.0%	0.0%	7.2%	4.5%	10
Total	100.0%	0.0%	100.0%	0.0%	0.0%	0.0%	100.0%	0.0%	123

Table 15. DISTRIBUTION OF UNITS BY TENANT TYPE AND INCOME RESTRICTION (Compare to Table 18 in 2011 RBSA)

Tenant Type	Income Restriction						
	Low Income Only		No Income Restrictions		All Types		n
	%	EB	%	EB	%	EB	
Senior Housing	42.6%▲	3.8%	5.4%▲	1.5%	13.4%▲	2.9%	48
No Demographic Restrictions	57.4%▼	3.7%	94.6%▼	1.5%	86.6%▼	2.9%	446
All Types	27.8%▲	4.1%	72.2%▼	4.1%	100.0%	0.0%	494

Table 16. AVERAGE NUMBER OF OCCUPANTS PER UNIT BY AGE CATEGORY (Compare to Table 19 in 2011 RBSA)

Age Category	Average Occupants		
	Mean	EB	n
18 or Younger	0.37	0.07	542
Between 18 and 65	1.19	0.07	542
65 or Older	0.26	0.04	542
All Categories	1.82	0.09	542

Table 17. REPORTED BUILDING VACANCY RATE BY VINTAGE (Compare to Table 20 in 2011 RBSA)

Vintage	Vacancy Rates		
	%	EB	n
Pre 1955	5.4%▼	1.0%	10
1955-1970	1.4%▼	0.7%	20
1971-1980	3.3%	1.2%	39
1981-1990	0.3%▼	0.5%	15
1991-2000	3.5%	1.2%	18
2001-2010	4.8%	1.2%	21
Post 2010	5.7%	0.0%	10
All Vintages	3.3%▼	0.3%	133

Table 18. DISTRIBUTION OF WINDOW AREA BY BUILDING VINTAGE AND WINDOW TYPE (Compare to Table 23 in 2011 RBSA)

Vintage	Window Type												n
	Metal Double		Metal Single		Metal Other		Wood, Vinyl, or Fiberglass Double		Wood, Vinyl, or Fiberglass Single		Wood, Vinyl, or Fiberglass Other		
	%	EB	%	EB	%	EB	%	EB	%	EB	%	EB	
Pre 1955	5.0%	2.0%	6.9%	2.8%	0.0%	0.0%	69.8%	2.9%	18.3%	2.5%	0.0%	0.0%	40
1955-1970	29.3%	4.5%	5.3%	2.1%	0.0%	0.3%	64.3%	4.4%	0.2%	0.3%	0.8%	3.6%	84
1971-1980	31.9%	4.4%	7.5%	2.5%	0.0%	0.0%	60.6%	4.4%	0.1%	0.3%	0.0%	0.2%	116
1981-1990	32.1%	4.3%	3.9%	1.7%	0.0%	0.0%	63.4%	4.4%	0.6%	0.7%	0.0%	0.0%	54
1991-2000	3.2%	2.0%	0.0%	0.0%	0.0%	0.0%	96.3%	1.5%	0.0%	0.0%	0.4%	1.1%	69
2001-2010	6.5%	0.8%	0.0%	0.0%	0.0%	0.0%	92.6%	0.9%	0.8%	0.9%	0.0%	0.0%	70
Post 2010	5.6%	2.4%	0.1%	0.6%	0.0%	0.0%	93.1%	1.4%	1.2%	3.2%	0.0%	0.2%	36
All Vintages	16.8%	3.7%	3.3%	1.6%	0.0%	0.1%	77.7%	3.9%	2.0%	1.3%	0.2%	0.5%	469

Table 19. WINDOW TO WALL AREA RATIO BY BUILDING SIZE
(Compare to Table 24 in 2011 RBSA)

Building Size (Stories)	Window to Wall Area Ratio		
	Mean	EB	n
Low-Rise (1-3)	0.18	0.05	373

Table 20. WINDOW TO FLOOR AREA RATIO BY BUILDING SIZE
(Compare to Table 25 in 2011 RBSA)

Building Size (Stories)	Window to Floor Area Ratio		
	Mean	EB	n
Low-Rise (1-3)	0.11	0.01	376

Table 21. DISTRIBUTION OF WALL AREA BY BUILDING SIZE AND WALL TYPE
(Compare to Table 26 in 2011 RBSA)

Building Size (Stories)	Wall Types										
	In-fill Steel		Masonry		Steel Frame		Wood Frame		Other		n
	%	EB	%	EB	%	EB	%	EB	%	EB	
Low-Rise (1-3)	0.0%	0.0%	4.3%	1.7%	0.0%	0.0%	90.3%▼	3.0%	5.4%▲	2.8%	414

Table 22. DISTRIBUTION OF WALL INSULATION BY WALL TYPE
(Compare to Table 27 in 2011 RBSA)

Wall Type	Wall Insulation Levels										
	R0-R7		R8-R13		R14-R20		R21-R23		R24+		n
	%	EB	%	EB	%	EB	%	EB	%	EB	
Frame	8.9%	3.2%	49.7%	6.1%	40.0%	5.8%	0.2%	1.2%	1.3%	1.7%	223
Masonry/Concrete	82.6%	4.7%	17.4%	5.5%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	24
Other	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	100.0%	0.0%	0.0%	0.0%	1
All Types	14.5%	4.1%	47.0%	6.2%	36.7%	5.9%	0.7%	1.7%	1.1%	1.6%	232

* No statistical testing was performed. This data was only gathered for low-rise (1-3 story) buildings in RBSA II.
* Walls with either unknown cavity insulation R-value or unknown continuous insulation R-value are excluded.

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Table 23. DISTRIBUTION OF CEILING AREA BY BUILDING SIZE AND CEILING TYPE
(Compare to Table 28 in 2011 RBSA)

Building Size (Stories)	Ceiling Type								
	Attic Ceiling		Roof Deck Ceiling		Vault Ceiling		Other Ceiling		n
	%	EB	%	EB	%	EB	%	EB	
Low-Rise (1-3)	83.0%▲	3.8%	11.8%	3.5%	3.5%	2.1%	1.6%	1.1%	413

Table 24. DISTRIBUTION OF CEILING INSULATION BY CEILING TYPE
(Compare to Table 29 in 2011 RBSA)

Ceiling Type	Ceiling Insulation Levels																
	R0-R10		R11-R15		R16-R20		R21-R25		R26-R30		R31-R40		R41-R50		R50+		n
	%	EB	%	EB	%	EB	%	EB	%	EB	%	EB	%	EB	%	EB	
Attic	13.2%	5.6%	2.3%	2.9%	3.9%	3.8%	2.8%	2.3%	2.6%	2.5%	65.2%	6.6%	8.8%	3.6%	1.3%	1.9%	162
Roof Deck	18.2%	2.8%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	81.8%	2.4%	0.0%	0.0%	0.0%	0.0%	8
Sloped / Vaulted (no attic)	3.7%	0.0%	11.2%	22.2%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	71.9%	8.3%	0.0%	0.0%	13.2%	0.0%	6
Other	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	100.0%	0.0%	0.0%	0.0%	0.0%	0.0%	1
All Types	12.4%	5.5%	2.7%	2.8%	3.4%	3.5%	2.6%	2.3%	2.4%	2.5%	66.4%	6.7%	8.6%	3.6%	1.5%	2.0%	172

* No statistical testing was performed. This data was only gathered for low-rise (1-3 story) buildings in RBSA II.

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Table 25. DISTRIBUTION OF FLOOR AREA BY BUILDING SIZE AND FLOOR TYPE (Compare to Table 30 in 2011 RBSA)

Floor Type	Building Size (Stories)								n
	Low-Rise (1–3)		Mid-Rise (4–6)		High-Rise (7+)		All Sizes		
	%	EB	%	EB	%	EB	%	EB	
Conditioned Basement	8.6%	2.7%	1.7%▼	1.0%	0.0%	0.0%	8.5%	2.7%	42
Floor Over Parking	0.2%	0.6%	0.0%	0.0%	100.0%	0.0%	0.5%	0.6%	3
Floor Over Unconditioned	2.2%	1.5%	44.7%	7.8%	0.0%	0.0%	3.0%	1.9%	57
Frame Floor Over Conditioned	0.0%▼	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%▼	0.0%	1
Frame Floor Over Crawlspace	26.7%	4.3%	16.3%	23.1%	0.0%	0.0%	26.0%	4.3%	132
Frame Floor Over Parking	1.1%▼	0.9%	0.0%	0.0%	0.0%	0.0%	1.0%▼	0.9%	17
Frame Floor Over Unconditioned	0.1%▼	0.4%	0.0%	0.0%	0.0%	0.0%	0.1%▼	0.4%	5
Slab Over Parking	0.1%▼	0.8%	0.0%	0.0%	0.0%	0.0%	0.1%▼	0.8%	1
Slab on Grade	61.1%	4.7%	37.2%▲	0.9%	0.0%	0.0%	60.9%	4.7%	249
Total	100.0%	0.0%	100.0%	0.0%	100.0%	0.0%	100.0%	0.0%	421

Table 26. DISTRIBUTION OF FLOOR INSULATION LEVELS BY FLOOR TYPE (Compare to Table 31 in 2011 RBSA)

Floor Type	Floor Insulation Levels														n
	None		R0-R3		R4-R10		R11-R15		R16-R22		R23-R27		R28-R35		
	%	EB	%	EB	%	EB	%	EB	%	EB	%	EB	%	EB	
Crawlspace	13.1%	7.5%	0.0%	0.0%	1.0%	5.1%	6.1%	11.7%	18.3%	7.6%	7.6%	7.8%	53.8%	10.6%	42
Floor over other area	34.5%	13.4%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	19.7%	34.3%	12.4%	0.0%	33.5%	4.0%	9
Basement	64.7%	7.5%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	6.1%	0.0%	0.0%	0.0%	29.2%	8.8%	29
Cantilever	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	31.9%	3.5%	33.3%	0.0%	34.8%	3.5%	10
All Types	38.5%	7.9%	0.0%	0.0%	0.5%	3.6%	4.1%	9.3%	11.4%	5.6%	6.9%	7.0%	38.6%	9.2%	80

* No statistical testing was performed. This data was only gathered for low-rise (1-3 story) buildings in RBSA II.

Table 27. AVERAGE UA PER UNIT BY BUILDING SIZE
(Compare to Table 32 in 2011 RBSA)

Building Size	Heat Loss Rate (UA per Unit)		
	Mean	EB	n
Low-Rise (1-3)	172.9▼	11.1	302

* Heat loss rates (UA) account for framing and building materials
* Storm windows are not accounted for in heat loss rate (UA)
* Heat loss rates (UA) account for buffer space heat loss reductions for unconditioned basements, floors over garages, and unvented crawlspaces

Table 28. AVERAGE UA PER UNIT BY VINTAGE
(Compare to Table 33 in 2011 RBSA)

Vintage	Heat Loss Rate (UA per Unit)		
	Mean	EB	n
Pre 1955	274.8	8.5	18
1955-1970	184.4	9.5	54
1971-1980	182.0	8.5	58
1981-1990	187.4	11.8	33
1991-2000	132.2	6.0	42
2001-2010	147.9	11.8	43
All Vintages	165.2	3.5	265

* No statistical testing was performed. This data was only gathered for low-rise (1-3 story) buildings in RBSA II.
* Heat loss rates (UA) account for framing and building materials
* Storm windows are not accounted for in heat loss rate (UA)
* Heat loss rates (UA) account for buffer space heat loss reductions for unconditioned basements, floors over garages, and unvented crawlspaces

Table 29. AVERAGE UA PER CONDITIONED SQ. FT. BY BUILDING SIZE (Compare to Table 34 in 2011 RBSA)

Building Size	Heat Loss Rate (UA per Sq. Ft.)		
	Mean	EB	n
Low-Rise (1-3)	0.21▼	0.01	302

* Heat loss rates (UA) account for framing and building materials
* Storm windows are not accounted for in heat loss rate (UA)
* Heat loss rates (UA) account for buffer space heat loss reductions for unconditioned basements, floors over garages, and unvented crawlspaces

Table 30. DISTRIBUTION OF PRIMARY HEATING SYSTEMS BY SYSTEM AND FUEL TYPE (Compare to Table 35 in 2011 RBSA)

Primary Heating System	Fuel Type										n
	Electric		Natural Gas		Oil		Wood		All Types		
	%	EB	%	EB	%	EB	%	EB	%	EB	
Central Boiler	0.0%	0.0%	0.8%	1.0%	0.0%	0.0%	0.0%	0.0%	0.8%	9.6%	4
Central Furnace	0.0%	0.0%	0.0%	0.3%	0.0%	0.0%	0.0%	0.0%	0.0%	13.8%	1
Air Source Heat Pump	2.1%	1.6%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	2.1%	8.8%	9
Boiler	0.0%	0.0%	0.2%	0.2%	0.0%	0.0%	0.0%	0.0%	0.2%	5.1%	4
Electric Baseboard	57.7%	4.5%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	57.7%	4.8%	290
Furnace	3.6%▲	1.7%	7.7%▲	2.4%	0.0%	0.0%	0.0%	0.0%	11.3%	8.0%	44
Mini-split HP	2.8%	1.8%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	2.8%	8.0%	13
Other Zonal Heat	21.2%	3.8%	0.2%	1.2%	0.0%	0.0%	0.0%	0.0%	21.4%	6.7%	104
Package Terminal Heat Pump	0.2%	0.4%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.2%	8.9%	2
Stove/Fireplace	0.3%	0.6%	2.0%	1.7%	0.0%	0.0%	1.0%	1.4%	3.3%	8.7%	13
All Systems	88.0%	6.5%	11.0%	2.9%	0.0%	0.0%	1.0%	1.4%	100.0%	0.0%	485

* Units characterized as Other Zonal Heat were counted as electric baseboard heating in RBSA I.

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Table 31. DISTRIBUTION OF PRIMARY HEATING SYSTEM BY BUILDING SIZE
(Compare to Table 36 in 2011 RBSA)

Primary Heating System	Building Size (Stories)								
	Low-Rise (1–3)		Mid-Rise (4–6)		High-Rise (7+)		All Sizes		n
	%	EB	%	EB	%	EB	%	EB	
Central Boiler	1.8%	1.2%	0.4%	0.5%	0.0%	0.0%	1.7%	1.1%	8
Central Furnace	0.0%	0.3%	0.0%	0.0%	0.0%	0.0%	0.0%	0.3%	1
Air Source Heat Pump	1.8%	1.7%	3.0%	1.4%	2.6%	6.6%	2.0%	1.5%	9
Boiler	0.7%	0.6%	0.2%	0.8%	0.0%	0.0%	0.5%	0.5%	6
Ceiling Radiant Heat	0.0%	0.0%	8.6%	0.0%	0.0%	0.0%	0.4%	2.4%	1
Electric Baseboard	56.7%	4.3%	32.1%	3.9%	82.1%	3.7%	54.7%	4.3%	290
Furnace	11.7%	2.7%	12.6%	1.6%	0.0%	0.0%	11.6%	2.7%	49
Mini-split HP	2.5%	1.6%	8.5%	4.8%	0.0%	0.0%	2.6%	1.7%	13
Other Zonal Heat	18.7%	3.5%	26.9%	4.5%	12.8%	3.9%	20.4%	3.6%	105
Package Terminal Heat Pump	0.2%	0.3%	0.0%	0.0%	0.0%	0.0%	0.2%	0.3%	2
Packaged HP	2.5%	1.3%	3.9%	1.3%	0.0%	0.0%	2.7%	1.3%	14
Stove/Fireplace	3.3%	1.9%	3.8%	1.9%	2.6%	6.6%	3.2%	1.8%	14
Total	100.0%	0.0%	100.0%	0.0%	100.0%	0.0%	100.0%	0.0%	512

* Units characterized as Other Zonal Heat were counted as electric baseboard heating in RBSA I.

Table 32. DISTRIBUTION OF SECONDARY HEATING SYSTEMS BY SYSTEM AND FUEL TYPE (Compare to Table 37 in 2011 RBSA)

Secondary Heating System	Fuel Type								
	Electric		Natural Gas		None		All Types		n
	%	EB	%	EB	%	EB	%	EB	
Air Source Heat Pump	0.0%	0.3%	0.0%	0.0%	0.0%	0.0%	0.0%	13.2%	1
Electric Baseboard	0.1%▼	0.5%	0.0%	0.0%	0.0%	0.0%	0.1%	17.8%	1
Furnace	0.0%	0.0%	0.1%	0.3%	0.0%	0.0%	0.1%	7.4%	2
Other Zonal Heat	0.0%	0.3%	0.0%	0.0%	0.0%	0.0%	0.0%	13.2%	1
PTHP/DPH	0.5%	0.7%	0.0%	0.0%	0.0%	0.0%	0.5%	9.3%	3
None	0.0%	0.0%	0.0%	0.0%	99.2%▲	0.5%	99.2%▲	0.6%	515
All Systems	0.6%	0.6%	0.1%	0.3%	99.2%	0.5%	100.0%	0.0%	523

Table 33. DISTRIBUTION OF SECONDARY HEATING SYSTEM BY BUILDING SIZE (Compare to Table 38 in 2011 RBSA)

Secondary Heating System	Building Size (Stories)								
	Low-Rise (1–3)		Mid-Rise (4–6)		High-Rise (7+)		All Sizes		n
	%	EB	%	EB	%	EB	%	EB	
Air Source Heat Pump	0.0%	0.3%	0.0%	0.0%	0.0%	0.0%	0.0%	0.3%	1
Electric Baseboard	0.3%	0.9%	0.0%	0.0%	0.0%	0.0%	0.1%	0.5%	1
Furnace	0.1%	0.3%	0.0%	0.0%	0.0%	0.0%	0.1%	0.3%	2
Other Zonal Heat	0.0%	0.3%	0.0%	0.0%	0.0%	0.0%	0.0%	0.3%	1
PTHP/DPH	0.5%	0.7%	0.0%	0.0%	0.0%	0.0%	0.5%	0.7%	3
None	99.0%	0.6%	100.0%	0.0%	100.0%	0.0%	99.2%▲	0.5%	515
Total	100.0%	0.0%	100.0%	0.0%	100.0%	0.0%	100.0%	0.0%	523

Table 34. DISTRIBUTION OF COMMON AREA PRIMARY HEATING SYSTEMS BY SYSTEM AND FUEL TYPE (Compare to Table 39 in 2011 RBSA)

Secondary Heating System	Fuel Type						
	Electric		Gas		All Fuels		n
	%	EB	%	EB	%	EB	
Boiler	0.0%	0.0%	8.1%	9.2%	8.1%	37.1%	3
Electric Baseboard	54.3%	24.6%	0.0%	0.0%	54.3%	30.4%	9
Furnace	11.6%	65.1%	0.0%	0.0%	11.6%	201.9%	1
Mini-split HP	2.2%	11.3%	0.0%	0.0%	2.2%	92.8%	1
Zonal Heat	23.8%	20.6%	0.0%	0.0%	23.8%	33.8%	6
Total	91.9%	34.9%	8.1%	9.2%	100.0%	0.0%	20

Table 35. DISTRIBUTION OF UNIT COOLING SYSTEMS (Compare to Table 40 in 2011 RBSA)

Cooling System	Percentage of Units		
	%	EB	n
Air Source Heat Pump	1.7%	1.3%	9
Central AC	2.9%	1.3%	21
Evaporative Cooling	0.4%	0.4%	4
Mini-Split HP	3.1%	1.6%	15
Packaged AC	16.9%	2.7%	126
Packaged HP	2.5%	1.1%	19
No Cooling	72.4% ▲	3.3%	351
Total	100.0%	0.0%	542

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Table 36. DISTRIBUTION OF COMMON AREA COOLING SYSTEMS (Compare to Table 41 in 2011 RBSA)

Cooling System	Percentage of Common Areas		
	%	EB	n
Mini-Split HP	0.8%	1.6%	2
Packaged AC	2.1%	2.1%	4
Packaged HP	1.8%	3.8%	2
No Cooling	95.3%▲	2.8%	102
Total	100.0%	0.0%	109

Table 37. DISTRIBUTION OF DHW SERVICE TYPE BY BUILDING SIZE (Compare to Table 44 in 2011 RBSA)

DHW Service Type	Building Size (Stories)								
	Low-Rise (1–3)		Mid-Rise (4–6)		High-Rise (7+)		All Sizes		n
	%	EB	%	EB	%	EB	%	EB	
Common Area Water Heater	29.7%	4.2%	59.1%	3.9%	97.5%	1.8%	33.5%	4.2%	164
In-Unit Water Heater	70.3%	4.2%	40.9%	3.9%	2.5%	NA	66.5%	4.2%	351

Table 38. DISTRIBUTION OF CENTRAL DHW SYSTEMS BY FUEL TYPE (Compare to Table 45 in 2011 RBSA)

Common Area DHW System	Fuel Type						
	Electric		Gas		Unknown		n
	%	EB	%	EB	%	EB	
Storage Water Heater	66.2%▲	6.4%	9.2%▼	6.1%	24.7%	4.6%	38

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Table 39. DISTRIBUTION OF COMMON AREA DHW SYSTEMS BY FUEL TYPE (Compare to Table 46 in 2011 RBSA)

Common Area DHW System	Fuel Type								
	Electric		Gas		Gas/Electric		Purchased Steam		n
	%	EB	%	EB	%	EB	%	EB	
Storage Water Heater	88.0%	6.6%	12.0%	6.6%	0.0%	0.0%	0.0%	0.0%	26
All Systems	88.0%▲	6.6%	12.0%▲	6.6%	0.0%	0.0%	0.0%	0.0%	26

Table 40. AVERAGE NUMBER OF COMMON AREA LAMPS PER UNIT BY BUILDING SIZE (Compare to Table 48 in 2011 RBSA)

Building Size (Stories)	Common Area Lamps per Unit		
	Mean	EB	n
Low-Rise (1-3)	1.6▼	0.2	315

Table 41. DISTRIBUTION OF COMMON AREA LAMPS BY LAMP TYPE AND BUILDING SIZE (Compare to Table 49 in 2011 RBSA)

Building Size (Stories)	Lamp Type														
	Compact Fluorescent		Halogen		Incandescent		Incandescent / Halogen		LED		Linear Fluorescent		Other		n
	%	EB	%	EB	%	EB	%	EB	%	EB	%	EB	%	EB	
Low-Rise (1-3)	42.1%	9.5%	2.1%	3.3%	12.9%	5.4%	0.0%	1.0%	12.0%▲	7.2%	25.4%▼	6.6%	5.4%	4.6%	92

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Table 42. DISTRIBUTION OF COMMON AREA LAMPS BY COMMON AREA ROOM TYPE AND LAMP TYPE (Compare to Table 50 in 2011 RBSA)

Common Area Room Types	Lamp Type														
	Compact Fluorescent		Halogen		Incandescent		Incandescent / Halogen		LED		Linear Fluorescent		Other		n
	%	EB	%	EB	%	EB	%	EB	%	EB	%	EB	%	EB	
Hall	41.5%	10.1%	4.8%	5.7%	11.7%▲	4.9%	0.0%	0.0%	12.7%	8.8%	27.8%	5.2%	1.4%▼	4.3%	53
Kitchen	0.0%	0.0%	0.0%	0.0%	48.3%	17.6%	0.0%	0.0%	0.0%	0.0%	51.7%	38.1%	0.0%	0.0%	2
Laundry	5.0%▼	3.7%	0.0%	0.0%	1.4%▼	1.7%	0.0%	0.0%	5.9%▲	5.4%	87.5%▲	4.7%	0.1%	1.7%	51
Lobby	12.4%▼	23.7%	0.0%	0.0%	6.5%▼	9.9%	2.8%	17.3%	3.4%▲	12.6%	73.5%▲	2.9%	1.4%	12.7%	7
Mechanical	55.2%	43.0%	0.0%	0.0%	44.8%	19.9%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	2
Office	9.1%	13.4%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	90.9%	11.1%	0.0%	0.0%	6
Other	6.1%▼	7.2%	0.0%	0.0%	22.7%	4.4%	0.0%	0.0%	9.5%▲	13.0%	61.6%▲	3.4%	0.0%	0.0%	9
Outside	46.0%	9.8%	4.1%	1.8%	26.3%	9.3%	0.0%	0.0%	4.8%▲	2.6%	3.6%	3.9%	15.3%	8.6%	63
Parking	13.1%	7.0%	2.6%	5.1%	7.1%	5.3%	0.0%	0.0%	42.9%▲	8.5%	6.4%	6.0%	27.8%	10.3%	27
Recreation	3.1%▼	7.0%	2.4%	20.5%	9.0%	6.2%	0.0%	0.0%	3.8%▲	16.5%	80.4%▲	9.4%	1.3%	10.4%	7
Store	11.1%	31.1%	0.0%	0.0%	72.7%▲	11.6%	0.0%	0.0%	0.0%	0.0%	8.1%▼	17.8%	8.1%	17.8%	4
All Rooms	41.9%	9.7%	2.1%	3.4%	13.3%	5.5%	0.0%	0.9%	11.9%▲	7.4%	25.2%	6.6%	5.6%	4.7%	92

Table 43. DISTRIBUTION OF COMMON AREA LAMPS BY EISA LAMP CATEGORY (Compare to Table 51 in 2011 RBSA)

EISA Category	Percentage Common Area Lamps		
	%	EB	n
Compliant	41.3%	7.7%	74
Exempt	54.3%	8.3%	67
Noncompliant	4.5%	4.0%	25

* No statistical testing was performed. This data was only gathered for low-rise (1-3 story) buildings in RBSA II.

Table 44. AVERAGE COMMON AREA LPD (W/SQ. FT.) IN LOW-RISE BUILDINGS BY BUILDING VINTAGE (Compare to Table 52 in 2011 RBSA)

Vintage	Average Common Area LPD		
	Mean	EB	n
Pre 1955	0.25	0.06	16
1955-1970	0.44	0.08	16
1971-1980	0.65	0.15	27
1981-1990	0.81	0.04	12
1991-2000	0.11	NA	2
2001-2010	0.74	NA	2
Post 2010	0.73	NA	2
All Vintages	0.55	0.04	77

* No statistical testing was performed. This data was only gathered for low-rise (1-3 story) buildings in RBSA II.

Table 45. AVERAGE COMMON AREA LPD (W/SQ. FT.) BY BUILDING SIZE (Compare to Table 53 in 2011 RBSA)

Building Size (Stories)	Average Common Area LPD		
	Mean	EB	n
Low-Rise (1-3)	0.60	0.17	80

Table 46. AVERAGE COMMON AREA ROOM LPD (W/SQ. FT.) IN LOW-RISE BUILDINGS (Compare to Table 54 in 2011 RBSA)

Common Area Room Type	Average Common Area LPD		
	Mean	EB	n
Hall	0.43▼	0.07	38
Kitchen	0.81	NA	2
Laundry	0.71	0.12	52
Lobby	0.61▼	0.09	7
Mechanical	1.35	NA	2
Office	0.62	NA	3
Other	0.67	0.04	8
Recreation	0.54	0.01	8
Store	0.74	NA	3
All Types	0.61▼	0.04	81

Table 47. DISTRIBUTION OF COMMON AREA LIGHTING POWER (WATTS) BY CONTROL TYPE (Compare to Table 55 in 2011 RBSA)

Control Type	Percentage of Common Area Watts		
Switch Type	%	EB	n
Always On	2.6%▼	4.8%	2
Light Sensor	2.6%	11.7%	1
Manual Switch	77.4%▲	9.1%	65
Motion & Light Sensor	1.7%	15.4%	1
Motion Sensor	5.1%	3.4%	4
Timer Control	10.5%	8.2%	8
Total	100.0%	0.0%	76

Table 48. DISTRIBUTION OF EXTERIOR LIGHTING POWER (WATTS) BY LAMP TYPE AND EXTERIOR CATEGORY (Compare to Table 56 in 2011 RBSA)

Exterior Category	Lamp Type														n
	Compact Fluorescent		Halogen		Incandescent		Linear Fluorescent		LED		Other		Unknown		
	%	EB	%	EB	%	EB	%	EB	%	EB	%	EB	%	EB	
Outside	37.8%	7.3%	3.6%	2.7%	42.8%	7.0%	8.4%	4.2%	5.6%	2.7%	1.6%	1.9%	0.2%	3.4%	137
Parking	34.1%	3.8%	26.5%	3.3%	16.6%	3.9%	5.1%	2.9%	3.9%	3.0%	13.9%	4.9%	0.0%	0.0%	28
All Categories	30.1%	6.6%	14.7%	5.7%	36.8%	6.5%	8.8%	4.0%	4.5%	2.5%	5.1%	2.8%	0.1%	2.1%	155

* No statistical testing was performed. This data was only gathered for low-rise (1-3 story) buildings in RBSA II.

Table 49. DISTRIBUTION OF EXTERIOR LAMPS BY LAMP TYPE AND EXTERIOR CATEGORY (Compare to Table 57 in 2011 RBSA)

Exterior Category	Lamp Type														n
	Compact Fluorescent		Halogen		Incandescent		Linear Fluorescent		LED		Other		Unknown		
	%	EB	%	EB	%	EB	%	EB	%	EB	%	EB	%	EB	
Outside	61.5%	7.1%	0.9%	1.3%	22.2%	6.2%	4.5%	3.4%	9.9%	3.2%	0.5%	1.5%	0.5%	5.7%	137
Parking	43.7%	4.6%	25.7%	2.7%	8.9%	3.6%	7.2%	3.2%	8.6%	4.2%	5.9%	3.7%	0.0%	0.0%	28
All Categories	59.7%	7.3%	2.3%	3.0%	21.2%	6.1%	5.4%	3.2%	9.5%	3.2%	1.5%	1.5%	0.4%	5.5%	155

* No statistical testing was performed. This data was only gathered for low-rise (1-3 story) buildings in RBSA II.

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Table 50. AVERAGE EXTERIOR LIGHTING POWER (WATTS) BY EXTERIOR CATEGORY AND BUILDING SIZE (Compare to Table 58 in 2011 RBSA)

Exterior Category	Building Size (Stories)		
	Low-Rise (1–3)		
	Mean	EB	n
Outside	210.2	49.1	137
Parking	507.6	24.6	28
All Categories	341.4▼	29.3	155

Table 51. DISTRIBUTION OF EXTERIOR LIGHTING POWER (WATTS) BY CONTROL TYPE AND EXTERIOR CATEGORY (Compare to Table 59 in 2011 RBSA)

Exterior Category	Lighting Control Type																
	24 Hour Operation		Manual Switch		Motion Sensor		Photo Sensor		Photo and Motion Sensor		Timer Control		Other		Unknown		n
	%	EB	%	EB	%	EB	%	EB	%	EB	%	EB	%	EB	%	EB	
Outside	0.1%	0.7%	30.9%	7.0%	0.1%	0.8%	7.3%	4.0%	0.0%	0.5%	7.1%	3.8%	0.0%	0.0%	54.5%	7.0%	137
Parking	0.0%	0.0%	1.3%	2.1%	3.1%	5.1%	26.3%	4.0%	3.2%	3.6%	8.6%	3.6%	0.0%	0.0%	57.6%	4.1%	28
All Types	0.1%	0.6%	28.2%	6.9%	0.3%	0.7%	8.2%	4.7%	0.4%	1.0%	7.5%	3.8%	0.0%	0.0%	55.3%	7.2%	155

* No statistical testing was performed. This data was only gathered for low-rise (1-3 story) buildings in RBSA II.

Table 52. DISTRIBUTION OF BUILDING LAUNDRY TYPE BY BUILDING VINTAGE (Compare to Table 60 in 2011 RBSA)

Vintage	Laundry Type								
	Common Only		In-Unit Only		In-Unit and Common		None		n
	%	EB	%	EB	%	EB	%	EB	
Pre 1955	8.4%▼	4.0%	12.0%	5.5%	11.7%▲	7.0%	67.9%	6.1%	59
1955-1970	17.2%▼	4.1%	12.6%▼	3.0%	0.0%	0.0%	70.3%▲	4.5%	144
1971-1980	9.5%▼	2.7%	14.7%▼	3.1%	0.0%	0.0%	75.8%▲	3.6%	209
1981-1990	11.3%▼	3.6%	24.0%▼	4.3%	0.0%	0.0%	64.7%▲	4.9%	103
1991-2000	3.3%▼	3.7%	35.7%▼	4.9%	0.0%	0.0%	60.9%▲	4.9%	115
2001-2010	3.2%▼	3.0%	30.4%▼	4.4%	0.0%	0.0%	66.4%	4.7%	118
Post 2010	2.3%	5.2%	46.2%	6.1%	0.0%	0.0%	51.5%	6.1%	48
All Vintages	8.6%▼	3.0%	22.1%▼	3.8%	0.5%▼	1.4%	68.8%▲	4.5%	889

Table 53. DISTRIBUTION OF COMMON AREA CLOTHES WASHER TYPE BY WASHER VINTAGE (Compare to Table 61 in 2011 RBSA)

Clothes Washer Type	Clothes Washer Vintage																
	1980 - 1989		1990 - 1994		1995 - 1999		2000 - 2004		2005 - 2009		2010 - 2014		Post 2014		All Vintage		n
	%	EB	%	EB	%	EB	%	EB	%	EB	%	EB	%	EB	%	EB	
Horizontal Axis	0.0%	0.0%	0.0%	0.0%	19.3%▲	3.8%	66.4%	8.1%	59.5%▲	15.2%	8.3%▲	3.8%	20.1%	4.8%	26.1%	10.9%	21
Vertical Axis (with agitator)	0.0%	0.0%	100.0%	0.0%	65.7%▲	20.9%	33.6%	7.6%	40.5%▲	15.5%	79.6%▲	5.2%	57.6%	3.8%	69.7%	11.1%	44
Vertical Axis (without agitator)	0.0%	0.0%	0.0%	0.0%	15.0%	66.9%	0.0%	0.0%	0.0%	0.0%	12.1%	5.9%	22.3%	0.0%	4.2%	6.6%	4
All Types	0.0%	0.0%	0.9%▼	2.1%	11.4%	9.3%	14.3%▼	7.1%	21.8%	10.8%	43.1%▲	12.9%	8.6%	4.9%	100.0%	0.0%	69

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Table 54. AVERAGE NUMBER OF CLOTHES WASHER LOADS PER WEEK BY LAUNDRY TYPE (Compare to Table 62 in 2011 RBSA)

Laundry Type	Average Loads per Week		
	Mean	EB	n
In Unit	3.6	0.3	387
In Unit and Common	3.0	0.0	2
None	2.3▼	0.2	67
All Types	3.0▼	0.2	456

Table 55. DISTRIBUTION OF COMMON AREA DRYERS BY DRYER VINTAGE (Compare to Table 63 in 2011 RBSA)

Dryer Vintage	Clothes Dryers		
	%	EB	n
Pre 1980	1.1%	5.9%	1
1980-1989	2.4%▼	13.8%	1
1990-1994	0.0%	NA	0
1995-1999	26.1%	24.5%	4
2000-2004	19.4%	23.4%	5
2005-2009	3.0%▼	5.5%	2
2010-2014	30.2%▲	15.3%	5
Post 2014	17.9%	16.5%	4
Total	100.0%	0.0%	20

Table 56. PERCENTAGE OF BUILDINGS WITH ELEVATORS BY BUILDING SIZE (Compare to Table 64 in 2011 RBSA)

Building Size (Stories)	Percentage with Elevators		
	%	EB	n
Low-Rise (1-3)	9.5%	2.8%	398
Mid-Rise (4-6)	78.9%▲	4.0%	69
High-Rise (7+)	100.0%	0.0%	16
All Sizes	18.9%▲	2.9%	483

Table 57. AVERAGE NUMBER OF ELEVATORS (IN BUILDINGS WITH ELEVATORS) BY BUILDING SIZE (Compare to Table 65 in 2011 RBSA)

Building Size (Stories)	Number of Elevators		
	Mean	EB	n
Low-Rise (1-3)	1.3▲	0.1	40
Mid-Rise (4-6)	1.5▲	0.1	54
High-Rise (7+)	1.8	0.1	16
All Sizes	1.4▲	0.0	110

Table 58. PERCENTAGE OF BUILDINGS WITH POOLS BY POOL TYPE AND BUILDING SIZE (Compare to Table 66 in 2011 RBSA)

Building Size (Stories)	Pool Type						n
	Exterior Pools		Interior Pools		All Pools		
	%	EB	%	EB	%	EB	
Low-Rise (1-3)	9.4%▼	0.03	0.9%▼	0.01	8.8%▼	0.02	436
Mid-Rise (4-6)	4.8%▼	0.02	0.0%	0.00	0.6%▼	0.00	71
High-Rise (7+)	2.4%▼	NA	4.8%	0.09	0.3%▼	0.00	16
All Sizes	9.0%▼	0.03	0.7%▼	0.01	9.7%	0.00	523

Table 59. AVERAGE NUMBER OF KITCHEN FACILITIES BY BUILDING SIZE (Compare to Table 68 in 2011 RBSA)

Building Size (Stories)	Number of Kitchens		
	Mean	EB	n
Low-Rise (1-3)	0.012▼	0.011	436

Table 60. AVERAGE NUMBER OF COMMON AREA REFRIGERATORS BY BUILDING SIZE (Compare to Table 69 in 2011 RBSA)

Building Size (Stories)	Number of Refrigerators		
	Mean	EB	n
Low-Rise (1-3)	0.050	0.031	109

Table 61. AVERAGE NUMBER OF COMPUTERS IN COMMON AREAS BY BUILDING OWNERSHIP TYPE (Compare to Table 70 in 2011 RBSA)

Ownership Type	Number of Computers		
	Mean	EB	n
Condo association	0.00	0.00	12
Cooperative	0.00	0.00	4
Corporation/REIT	0.01▼	0.01	44
Individual	0.00	0.00	44
Mixed	0.00	NA	1
Private non-profit	0.03	0.00	7
Public agency	0.30	0.00	9
All Types	0.04▼	0.00	121

Table 62. DISTRIBUTION OF PRIMARY IN-UNIT HEATING SYSTEMS BY SYSTEM AND FUEL TYPE (Compare to Table 71 in 2011 RBSA)

Primary Heating System	Fuel Type								
	Electric		Gas		Wood		All Types		n
	%	EB	%	EB	%	EB	%	EB	
Air Source Heat Pump	1.8%	1.3%	0.0%	0.0%	0.0%	0.0%	1.8%	1.3%	9
Boiler	0.0%	0.0%	0.5%	0.6%	0.0%	0.0%	0.5%	0.6%	5
Electric Baseboard and Wall Heaters	56.2%	4.2%	0.2%	1.4%	0.0%	0.0%	56.4%	4.2%	302
Furnace	2.6%	1.2%	5.9%	2.0%	0.0%	0.0%	8.4%	2.2%	43
Mini-Split HP	3.0%	1.7%	0.0%	0.0%	0.0%	0.0%	3.0%	1.7%	13
Packaged HP	0.2% ▼	0.3%	0.1%	0.8%	0.0%	0.0%	0.3%	0.4%	3
Stove/Fireplace	0.4%	0.9%	2.0%	1.5%	1.0%	1.2%	3.4%	1.8%	13
Plug In Heaters	7.0%	2.4%	0.0%	0.0%	0.0%	0.0%	7.0%	2.4%	34
Other Zonal Heat	19.0%	3.3%	0.2%	1.4%	0.0%	0.0%	19.2%	3.4%	102
All Systems	90.1%	2.6%	8.9%	2.5%	1.0%	1.2%	100.0%	0.0%	498

* Units characterized as Other Zonal Heat were counted as electric baseboard heating in RBSA I.

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Table 63. DISTRIBUTION OF SECONDARY IN-UNIT HEATING SYSTEMS BY SYSTEM AND FUEL TYPE (Compare to Table 72 in 2011 RBSA)

Secondary Heating System	Fuel Type												n
	Electric		Gas		Wood		Propane		None		All Types		
	%	EB	%	EB	%	EB	%	EB	%	EB	%	EB	
Electric Baseboard and Wall Heaters	19.5%▲	3.3%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	19.5%	6.1%	115
Furnace	0.0%	0.0%	0.2%	1.3%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.2%	27.9%	1
Mini-Split HP	0.1%	0.5%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.1%	17.8%	1
Stove/Fireplace	1.1%	1.1%	3.0%	1.3%	8.2%▲	2.2%	0.1%	0.4%	0.0%	0.0%	12.4%	6.5%	71
Other Zonal Heat	5.0%▲	1.5%	0.0%	0.0%	0.2%	1.2%	0.2%	1.2%	0.0%	0.0%	5.4%	5.7%	44
Plug-in Heaters	7.2%	2.2%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	7.2%	6.9%	40
None	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	55.3%	3.9%	55.3%▼	4.6%	318
All Systems	32.9%▲	4.3%	3.2%	1.4%	8.4%▲	2.2%	0.2%	0.6%	55.3%▼	3.9%	100.0%▼	0.0%	542

Table 64. PERCENTAGE OF UNITS WITH IN-UNIT COOLING SYSTEMS BY BUILDING SIZE (Compare to Table 73 in 2011 RBSA)

Building Size	Units with In-Unit Cooling Systems		
	%	EB	n
Low-Rise (1-3)	26.0%	3.3%	453
Mid-Rise (4-6)	20.0%	3.4%	73
High-Rise (7+)	4.4%▼	3.2%	16
All Types	20.9%▼	2.1%	542

Table 65. DISTRIBUTION OF IN-UNIT COOLING SYSTEMS BY SYSTEM TYPE AND BUILDING SIZE (Compare to Table 74 in 2011 RBSA)

Cooling Systems	Building Size								
	Low-Rise (1–3)		Mid-Rise (4–6)		High-Rise (7+)		All Sizes		n
	%	EB	%	EB	%	EB	%	EB	
Air Source Heat Pump	4.3%	4.7%	0.0%	0.0%	0.0%	0.0%	4.3%	18.3%	5
Central AC	9.9%	5.6%	0.0%	0.0%	0.0%	0.0%	9.9%	11.2%	21
Evaporative Cooling	0.2%	1.0%	0.0%	0.0%	0.0%	0.0%	0.2%	25.4%	1
Mini-split HP	9.3% ▲	5.5%	4.2%	5.5%	0.0%	0.0%	13.5%	15.5%	15
Packaged AC	52.2%	7.5%	14.4%	6.9%	1.2%	7.5%	67.8%	7.0%	121
Packaged HP	3.5%	3.4%	0.6%	0.8%	0.0%	0.0%	4.1%	11.4%	10
Packaged Unit	0.2%	1.2%	0.0%	0.0%	0.0%	0.0%	0.2%	29.3%	1
All Systems	79.6% ▼	11.6%	19.1%	7.8%	1.2%	7.5%	100.0%	0.0%	174

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Table 66. DISTRIBUTION OF THERMOSTATS BY TYPE

Thermostat Type	Thermostats		
	%	EB	n
Manual thermostat - Analog	83.2%	3.3%	400
Manual thermostat - Digital	8.0%	2.4%	58
Programmable thermostat	8.6%	2.6%	48
Wi-Fi enabled thermostat	0.1%	0.4%	1
Unknown	0.1%	0.4%	1
Total	100.0%	0.0%	487

Table 67. IN-UNIT THERMOSTAT SETTINGS AND BEHAVIOR (Compare to Table 75 in 2011 RBSA)

Category	Thermostat Characteristics		
	Mean	EB	n
Heating Setpoint	68.0	0.4	498
Percent Heating Setback	41.3%	4.8%	363
Average Heating Setback	2.8▼	0.4	363
Cooling Setpoint	70.0	0.7	216
Percent Cooling Setup	9.8%▼	5.1%	132

Table 68. DISTRIBUTION OF UNIT WATER HEATERS BY TYPE (Compare to Table 77 in 2011 RBSA)

Heater Type	Water Heaters		
	%	EB	n
Instantaneous Water Heater	0.5%	3.2%	1
Storage Water Heater	99.5%	0.8%	366

Table 69. DISTRIBUTION OF IN-UNIT WATER HEATERS BY DETAILED TYPE

Detailed Type	In-Unit Water Heaters		
	%	EB	n
Instantaneous-Fossil Fuel Non-Condensing	0.5%	3.2%	1
Storage-Electric Resistance	88.5%	3.5%	330
Storage-Fossil Fuel Condensing	1.7%	1.7%	7
Storage-Fossil Fuel Non-Condensing	9.3%	3.3%	25
Total	100.0%	0.0%	363

Table 70. DISTRIBUTION OF IN-UNIT WATER HEATER TANKS BY SIZE AND FUEL TYPE (Compare to Table 78 in 2011 RBSA)

Water Heater Fuel Type	Tank Size						
	0–55 Gallons		>55 Gallons		All Sizes		n
	%	EB	%	EB	%	EB	
Electric	86.5%	3.8%	1.5%	2.0%	88.0%	4.1%	309
Natural Gas	11.9% ▲	3.7%	0.1%	0.1%	12.0%	3.6%	33
All Types	98.4%	0.0%	1.6%	0.0%	100.0%	0.0%	342

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Table 71. DISTRIBUTION OF IN-UNIT WATER HEATERS BY VINTAGE (Compare to Table 79 in 2011 RBSA)

Vintage	Water Heaters		
	%	EB	n
Pre-1990	3.8%	2.3%	14
1990-1999	17.1% ▼	4.4%	48
2000-2004	15.0% ▼	4.3%	49
2005-2009	25.6%	5.3%	68
Post-2009	38.4% ▲	5.9%	110
All Vintages	100.0%	0.0%	289

Table 72. DISTRIBUTION OF SHOWERHEAD FLOW RATE
(Compare to Table 80 in 2011 RBSA)

Flow Rate (GPM)	Showerheads			
	%	EB	Count	n
≤ 1.5	23.6%	7.5%	85	81
1.6 - 2.0	31.5%	7.4%	102	97
2.1 - 2.5	35.9%	6.2%	150	136
2.6 - 3.5	8.1%	8.0%	40	39
≥ 3.6	0.9%	20.0%	4	4
Total	100.0%	0.0%	381	331

* No statistical testing performed because results include all showerheads. RBSA I only included primary.
* Count represents the total number of fixtures. Percentages are based on the number of fixtures in each bin.
* n represents the total number of homes.
* GPM data have been calibrated to adjust for systematic bias in the data collection approach.
* GPM error bounds incorporate both sampling and measurement uncertainty. Measurement uncertainty adjusts for systematic bias in the data collection approach

Table 73. DISTRIBUTION OF BATHROOM FAUCET FLOW RATE

Flow Rate (GPM)	Bathroom Faucet Flow Rate			
	%	EB	Count	n
≤ 1.5	46.4%	5.2%	251	214
1.5 - 2.2	39.7%	5.2%	218	178
≥ 2.3	13.9%	4.4%	67	58
Total	100.0%	0.0%	536	402

* Count represents the total number of fixtures. Percentages are based on the number of fixtures in each bin.
* n represents the total number of homes.
* GPM data have been calibrated to adjust for systematic bias in the data collection approach.
* GPM error bounds incorporate both sampling and measurement uncertainty. Measurement uncertainty adjusts for systematic bias in the data collection approach

Table 74. DISTRIBUTION OF KITCHEN FAUCET FLOW RATE

Flow Rate (GPM)	Kitchen Faucet Flow Rate			
	%	EB	Count	n
≤ 1.5	40.8%	5.1%	144	142
1.5 - 2.2	46.0%	5.1%	203	202
≥ 2.3	13.1%	4.2%	53	53
Total	100.0%	0.0%	400	396

* Count represents the total number of fixtures. Percentages are based on the number of fixtures in each bin.
* n represents the total number of homes.
* GPM data have been calibrated to adjust for systematic bias in the data collection approach.
* GPM error bounds incorporate both sampling and measurement uncertainty. Measurement uncertainty adjusts for systematic bias in the data collection approach

Table 75. AVERAGE NUMBER OF SHOWERHEADS AND FAUCETS PER HOME

Fixture Type	Showerheads and Faucets per Home			
	Mean	EB	Count	n
Bathroom Faucet	1.3	0.1	712	541
Kitchen Faucet	1.0	0.0	517	541
Shower	0.3	0.0	129	541
Shower / Bathtub combo with diverter valve	0.9	0.0	485	541
Shower / Bathtub combo with separate valve	0.0	0.0	6	541

* Count represents the total number of fixtures. Means are based on the number of fixtures in each bin.
* n represents the total number of homes.

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Table 76. DISTRIBUTION OF LAMPS BY EISA CATEGORY (Compare to Table 81 in 2011 RBSA)

EISA Category	Percentage of Lamps		
	%	EB	n
Compliant	47.6%▲	4.1%	529
Exempt	32.4%▲	3.9%	456
Noncompliant	19.9%▼	3.3%	399

Table 77. LIGHTING CHARACTERISTICS
(Compare to Table 82 in 2011 RBSA)

Category	Lighting Characteristics		
	Mean	EB	n
Total Unit Fixtures	13.1	0.6	542
Total Unit Lamps	20.2▼	0.9	542
Compact Fluorescent	6.1	0.4	542
Halogen	1.2	0.3	542
Incandescent	7.4▼	0.7	542
Light Emitting Diode	3.2▲	0.5	542
Linear Fluorescent	1.4▼	0.2	542
Other	0.9▲	0.1	542

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Table 78. DISTRIBUTION OF LAMPS BY TYPE
(Compare to Table 83 in 2011 RBSA)

Lamp Type	Percentage of Lamps		
	%	EB	n
Compact Fluorescent	30.0%	3.8%	477
Halogen	6.6%▲	2.0%	190
Incandescent	37.4%▼	4.0%	480
Incandescent / Halogen	0.3%	0.5%	16
Light Emitting Diode	15.8%▲	3.0%	295
Linear Fluorescent	6.2%	2.0%	268
Other	1.9%	1.1%	121
Unknown	1.8%	1.1%	90

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Table 79. DISTRIBUTION OF LAMPS BY TYPE AND ROOM (Compare to Table 84 in 2011 RBSA)

Room Type	Lamp Type														n
	Compact Fluorescent		Halogen		Incandescent		Incandescent/Halogen		LED		Linear Fluorescent		Other		
	%	EB	%	EB	%	EB	%	EB	%	EB	%	EB	%	EB	
Bathroom	24.4%	3.5%	4.9%▲	1.9%	48.1%▼	4.1%	0.3%	0.5%	13.7%▲	2.9%	4.0%	1.7%	4.5%▲	1.7%	533
Bedroom	37.4%▲	4.0%	5.1%	1.7%	38.1%▼	4.0%	0.5%	0.8%	15.4%▲	2.9%	2.1%	1.2%	1.5%	0.9%	514
Closet	27.4%	3.6%	2.9%	1.3%	42.5%▼	3.7%	1.4%	3.1%	15.2%	3.3%	9.9%▲	2.8%	0.8%	0.7%	107
Dining Room	23.3%▼	3.4%	5.1%▲	1.6%	46.8%▼	3.8%	0.0%	0.0%	21.5%▲	3.2%	2.0%	2.1%	1.2%	1.3%	111
Family Room	29.4%	4.0%	11.6%	2.4%	42.7%▼	4.0%	0.0%	0.0%	9.5%	2.2%	2.6%	1.7%	4.2%	1.9%	60
Garage	14.3%▲	2.9%	0.0%	0.0%	69.7%▼	2.1%	0.0%	0.0%	0.0%	0.0%	16.0%▼	2.6%	0.0%	0.0%	12
Hall	43.4%▲	4.1%	5.7%▲	1.8%	32.7%▼	3.8%	0.3%	0.4%	15.3%▲	3.0%	1.5%	1.0%	1.1%	0.9%	397
Kitchen	22.7%	3.3%	10.3%	2.4%	23.6%▼	3.6%	0.0%	0.1%	13.1%▲	2.6%	28.7%	3.7%	1.6%	0.9%	514
Laundry	26.1%▲	3.4%	4.6%▲	1.2%	39.9%▼	3.6%	0.8%	1.5%	27.3%▲	3.3%	1.3%▼	0.9%	0.0%	0.0%	67
Living Room	37.1%▲	4.0%	5.8%	1.7%	30.9%▼	3.8%	0.4%	1.2%	22.7%▲	3.5%	1.6%▼	1.1%	1.5%	1.0%	459
Office	40.8%	4.6%	6.6%	2.1%	26.7%▼	2.9%	0.0%	0.0%	22.9%▲	4.2%	3.1%	1.6%	0.0%	0.0%	27
Other	31.7%▲	5.2%	8.4%	0.0%	48.1%▼	5.0%	0.0%	0.0%	2.5%	1.8%	1.6%▼	3.8%	7.7%	13.6%	22
Outside	56.8%▲	3.8%	0.0%	0.0%	26.1%	3.5%	0.0%	0.0%	15.6%▲	2.6%	0.0%	0.0%	1.5%▲	2.9%	65
All Room Types	31.0%	3.8%	6.3%▲	1.9%	36.9%▼	4.0%	0.3%	0.5%	15.9%▲	3.0%	7.3%	2.2%	2.3%	1.2%	542

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Table 80. AVERAGE LIGHTING POWER DENSITY (LPD) BY ROOM TYPE AND OVERALL (Compare to Table 85 in 2011 RBSA)

Room Type	LPD (W/Sq. Ft.)		
	Mean	EB	n
Basement	0.5	NA	2
Bathroom	3.6▼	0.3	507
Bedroom	0.5▼	0.0	502
Closet	1.7	0.1	94
Dining Room	1.3	0.2	108
Family Room	0.7▼	0.1	58
Garage	0.5▲	0.0	5
Grow Room	9.9	NA	2
Hall	1.3	0.1	370
Kitchen	1.2▼	0.1	485
Laundry	2.0	0.2	60
Living Room	0.5▼	0.0	441
Mechanical	3.2	0.5	8
Office	0.7▼	0.0	24
Other	1.1▼	0.1	6
Unit LPD	0.9▼	0.0	541

Table 81. AVERAGE IN UNIT WATTS PER BULB

Building Size (Stories)	Average Watts		
	Mean	EB	n
Low-Rise (1-3)	41.7	1.7	453
Mid-Rise (4-6)	42.7	2.1	72
High-Rise (7+)	33.1	2.6	16
All Types	41.0	1.2	541

Table 82. AVERAGE NUMBER OF STORAGE BULBS BY BULB TYPE AND BUILDING SIZE

Lamp Type	Lamp Type								
	Low-Rise (1–3)		Mid-Rise (4–6)		High-Rise (7+)		All Sizes		n
	%	EB	%	EB	%	EB	%	EB	
Compact Fluorescent	26.3%	3.5%	48.0%	4.4%	39.1%	7.2%	28.1%	3.5%	542
Halogen	9.5%	2.4%	3.8%	1.8%	22.3%	6.0%	9.6%	2.4%	542
Incandescent	49.0%	4.1%	24.5%	4.0%	21.2%	6.3%	45.0%	4.0%	542
Incandescent / Halogen	0.1%	0.1%	0.0%	0.0%	0.0%	0.0%	0.1%	0.1%	542
Light Emitting Diode	14.9%	2.8%	23.3%	3.9%	17.4%	6.0%	16.9%	3.0%	542
Linear Fluorescent	0.2%	0.3%	0.4%	0.6%	0.0%	0.0%	0.3%	0.4%	542
Other	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	542
Unknown	0.1%	0.1%	0.0%	0.0%	0.0%	0.0%	0.1%	0.1%	542
All Categories	100.0%	0.0%	100.0%	0.0%	100.0%	0.0%	100.0%	0.0%	542

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Table 83. DISTRIBUTION OF STORAGE BULBS BY BULB TYPE AND BUILDING SIZE

Lamp Type	Lamp Type								
	Low-Rise (1–3)		Mid-Rise (4–6)		High-Rise (7+)		All Sizes		n
	Mean	EB	Mean	EB	Mean	EB	Mean	EB	
Compact Fluorescent	1.0	0.2	1.4	0.3	1.9	0.5	1.3	0.2	542
Halogen	0.4	0.2	0.2	0.1	1.0	0.1	0.4	0.1	542
Incandescent	1.9	0.5	0.8	0.2	1.0	0.3	1.3	0.2	542
Incandescent / Halogen	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	542
Light Emitting Diode	0.5	0.1	0.6	0.2	0.8	0.2	0.6	0.1	542
Linear Fluorescent	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	542
Other	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	542
Unknown	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	542
All Categories	3.8	0.6	3.0	0.4	4.7	0.6	3.6	0.3	542

Table 84. PERCENT OF HOMES WITH CFLS BY BUILDING SIZE

Building Size (Stories)	Percent of Units		
	%	EB	n
Low-Rise (1-3)	87.7%	2.8%	453
Mid-Rise (4-6)	89.6%	2.3%	73
High-Rise (7+)	100.0%	0.0%	16
All Types	90.0%	1.6%	542

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Table 85. PERCENT OF HOMES WITH LEDS BY BUILDING SIZE

Building Size (Stories)	Percent of Units		
	%	EB	n
Low-Rise (1-3)	51.9%	4.1%	453
Mid-Rise (4-6)	64.3%	4.1%	73
High-Rise (7+)	86.9%	5.1%	16
All Types	61.1%	2.6%	542

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Table 86. PERCENT OF UNITS WITH CONNECTED LIGHTING

Building Size (Stories)	Percent of Units		
	%	EB	n
Low-Rise (1-3)	1.1%	0.8%	453
Mid-Rise (4-6)	1.0%	0.8%	73
High-Rise (7+)	0.0%	0.0%	16
All Types	0.9%	0.5%	542

Table 87. AVERAGE NUMBER OF APPLIANCES PER UNIT BY TYPE (Compare to Table 86 in 2011 RBSA)

Appliance	Number of Appliances per Unit		
	Mean	EB	n
Dishwasher	0.68 ▼	0.04	542
Dryer	0.45	0.04	542
Freezer	0.05	0.02	542
Refrigerator	1.04	0.02	542
Washer	0.46	0.04	542
Water Heater	0.64 ▼	0.04	542

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Table 88. DISTRIBUTION OF REFRIGERATOR/FREEZERS BY VINTAGE (Compare to Table 87 in 2011 RBSA)

Vintage	Refrigerators/Freezers		
	%	EB	n
1980-1989	0.6%▼	1.6%	2
1990-1994	10.3%	4.0%	27
1995-1999	12.7%▼	4.4%	32
2000-2004	14.6%▼	4.3%	47
2005-2009	23.7%▼	5.2%	77
2010-2014	26.7%▲	5.1%	102
Post 2014	11.4%	3.4%	50
Total	100.0%	0.0%	326

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Table 89. DISTRIBUTION OF IN-UNIT REFRIGERATORS BY TYPE (Compare to Table 88 in 2011 RBSA)

Refrigerator Type	Refrigerators		
	%	EB	n
Mini Refrigerator	2.2%	1.2%	12
Refrigerated Beer Cooler	0.3%	1.6%	1
Refrigerated Wine Cooler	0.2%	1.4%	1
Refrigerator with Bottom Freezer	3.9%	1.7%	18
Refrigerator with Side-by-Side Freezer	4.6%	1.8%	26
Refrigerator with Top Freezer	85.3%▼	2.8%	464
Side-by-Side Refrigerator with Bottom Freezer	0.8%	0.8%	4
Unknown	2.7%	1.0%	30
Total	100.0%	0.0%	542

Table 90. AVERAGE IN-UNIT REFRIGERATOR VOLUME BY TYPE (Compare to Table 89 in 2011 RBSA)

Refrigerator Type	Volume (Cu. Ft.)		
	Mean	EB	n
Mini Refrigerator	6.2	1.1	7
Refrigerated Wine Cooler	4.8	NA	1
Refrigerator with Bottom Freezer	20.2▲	0.3	12
Refrigerator with Side-by-Side Freezer	22.6	0.5	21
Refrigerator with Top Freezer	17.6▲	0.4	341
Side-by-Side Refrigerator with Bottom Freezer	18.9	5.9	3
All Refrigerator Types	17.9▲	0.2	380

Table 91. DISTRIBUTION OF IN-UNIT CLOTHES WASHERS BY TYPE AND VINTAGE (Compare to Table 90 in 2011 RBSA)

Vintage	Clothes Washer Type												n
	Combined Washer Dryer, One Drum		Horizontal Axis Washer		Stacked Washer Dryer		Vertical Axis with Agitator		Vertical Axis without Agitator		All Types		
	%	EB	%	EB	%	EB	%	EB	%	EB	%	EB	
1980-1989	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.4%	2.3%	0.0%	0.0%	0.4%	10.2%	1
1990-1994	0.0%	0.0%	0.0%	0.0%	0.5%	3.3%	4.5%	4.1%	0.0%	0.0%	5.1%	14.7%	6
1995-1999	0.0%	0.0%	1.1%	2.1%	0.0%	0.0%	5.5%▼	2.2%	0.3%	2.0%	6.9%	10.8%	15
2000-2004	0.0%	0.0%	1.0%	1.3%	1.8%	2.9%	11.0%	4.4%	0.0%	0.0%	13.8%	10.7%	28
2005-2009	0.0%	0.0%	6.4%	3.8%	3.4%▼	2.5%	15.0%	5.5%	0.3%	1.4%	25.0%	11.1%	41
2010-2014	0.0%	0.0%	7.4%▲	3.2%	4.0%	3.4%	18.7%▲	4.8%	3.5%	2.8%	33.5%▲	10.2%	58
Post 2014	0.0%	0.0%	4.2%	2.8%	2.5%	2.7%	6.8%	3.9%	1.7%	2.3%	15.3%	11.2%	28
All Vintages	0.0%	0.0%	20.0%▲	5.6%	12.2%▼	4.9%	62.0%	9.9%	5.8%	3.2%	100.0%	0.0%	177

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Table 92. DISTRIBUTION OF IN-UNIT CLOTHES DRYERS BY VINTAGE (Compare to Table 91 in 2011 RBSA)

Vintage	Clothes Dryers		
	%	EB	n
1980-1989	1.1%▼	6.1%	1
1990-1994	2.9%▼	3.3%	3
1995-1999	6.7%▼	4.6%	8
2000-2004	15.1%	8.2%	17
2005-2009	29.1%	11.3%	21
2010-2014	29.9%▲	10.6%	20
Post 2014	15.2%	9.4%	12
Total	100.0%	0.0%	82

Table 93. IN-UNIT LAUNDRY CHARACTERISTICS (Compare to Table 92 in 2011 RBSA)

Category	Laundry Characteristics		
	Mean	EB	n
Clothes Washer Loads per Week	3.2▼	0.3	278
Dryer Loads per Washer Load	89.8%	2.5%	278

Table 94. AVERAGE SIZE OF IN UNIT CLOTHES WASHERS BY BUILDING SIZE

Building Size (Stories)	Clothes Washer Size (Cu. Ft.)		
	Mean	EB	n
Low-Rise (1-3)	3.3	0.2	187
Mid-Rise (4-6)	3.0	0.1	30
High-Rise (7+)	3.3	0.5	8
All Types	3.2	0.2	225

Table 95. DISTRIBUTION OF IN UNIT DRYERS BY FUEL TYPE AND SIZE

Building Size (Stories)	Dryer Fuel Type										
	Electric		Gas		Propane		Unknown		All Types		n
	%	EB	%	EB	%	EB	%	EB	%	EB	
Low-Rise (1-3)	97.1%	2.4%	2.1%	3.3%	0.0%	0.0%	0.8%	1.0%	100.0%	0.0%	186
Mid-Rise (4-6)	100.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	100.0%	0.0%	24
High-Rise (7+)	100.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	100.0%	0.0%	8

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Table 96. PERCENT OF UNITS WITH VENTED DRYERS BY SIZE

Building Size (Stories)	Percent of Units		
	%	EB	n
Low-Rise (1-3)	95.7%	3.1%	174
Mid-Rise (4-6)	100.0%	0.0%	24
High-Rise (7+)	87.5%	13.1%	8
Total	96.2%	2.2%	206

Table 97. DISTRIBUTION OF IN-UNIT DISHWASHERS BY VINTAGE (Compare to Table 93 in 2011 RBSA)

Vintage	Dishwashers		
	%	EB	n
Pre 1980	0.0%	0.0%	NA
1980-1989	1.7%▼	1.3%	7
1990-1994	3.7%	2.0%	12
1995-1999	6.7%▼	2.5%	24
2000-2004	8.8%▼	2.3%	44
2005-2009	15.2%▼	3.0%	73
2010-2014	24.5%▲	3.9%	93
Post 2014	11.4%	3.0%	44
None	19.4%	3.2%	183
Unknown	8.6%▼	2.5%	43
Total	100.0%	0.0%	523

Table 98. IN-UNIT KITCHEN APPLIANCE CHARACTERISTICS (Compare to Table 94 in 2011 RBSA)

Category	Kitchen Appliance Characteristics		
	Mean	EB	n
Dishwasher Loads per Week	2.6▲	0.2	335
Cooktop Fuel: Electric	96.1%	1.6%	510
Cooktop Fuel: Gas	3.9%	1.7%	20
Oven Fuel: Electric	96.7%	1.5%	512
Oven Fuel: Gas	3.3%	1.6%	18

Table 99. PERCENT OF UNITS WITH SMART POWER STRIPS

Building Size (Stories)	Homes with Smart Power Strips		
	%	EB	n
Low-Rise (1-3)	3.1%	1.4%	453
Mid-Rise (4-6)	0.5%	0.6%	73
High-Rise (7+)	0.0%	0.0%	16
All Types	1.7%	0.7%	542

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Table 100. IN-UNIT POWER STRIP CHARACTERISTICS

End Use	Power Strip Use Type								
	Low-Rise (1-3)		Mid-Rise (4-6)		High-Rise (7+)		All Types		n
	%	EB	%	EB	%	EB	%	EB	
Entertainment Center	60.5%	6.6%	78.9%	5.3%	20.5%	13.7%	60.3%	6.6%	169
Home Office	22.5%	5.6%	6.9%	4.0%	56.3%	13.8%	23.2%	5.6%	78
Other	17.0%	5.2%	14.1%	5.2%	23.2%	14.7%	16.5%	5.1%	56
Total	100.0%	0.0%	100.0%	0.0%	100.0%	0.0%	100.0%	0.0%	221

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Table 101. PERCENT OF APPLIANCES THAT ARE WI-FI ENABLED

Type	Percent of Appliances		
	%	EB	n
Dryer	0.0%	0.0%	215
Freezer	0.0%	0.0%	33
Refrigerator	0.0%	0.0%	532
Stove/Oven	0.2%	0.4%	530
Washer	0.0%	0.0%	230

Table 102. PERCENT OF UNITS REPORTING HAVING SMART DEVICES

Building Size (Stories)	Percent of Units		
	%	EB	n
Low-Rise (1-3)	1.7%	0.9%	453
Mid-Rise (4-6)	1.5%	1.0%	73
High-Rise (7+)	0.0%	0.0%	16
All Types	1.4%	0.6%	542

Table 103. AVERAGE AGE OF EQUIPMENT APPLIANCES BY TYPE

Type	Average Age of Equipment		
	Mean	EB	n
Dishwasher	2008	0.7	299
Dryer	2008	0.5	82
Freezer	2000	0.5	14
Refrigerator	2006	0.6	325
Washer	2009	0.5	177

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Table 104. PERCENT OF APPLIANCES ABOVE MEASURE LIFE BY TYPE

Type	Percent of Appliances		
	%	EB	n
Dishwasher	27.0%	3.8%	299
Dryer	21.4%	3.0%	82
Freezer	9.3%	2.1%	14
Refrigerator	28.6%	4.0%	325
Washer	16.7%	3.2%	177

Table 105. IN-UNIT ELECTRONICS CHARACTERISTICS (Compare to Table 95 in 2011 RBSA)

Category	Electronics Characteristics		
	Mean	EB	n
Televisions Per Unit	1.4▼	0.1	542
Primary Television On-Time Hours Per Day Per Unit	6.0▼	0.4	504
Set-Top Boxes per Unit	0.6▼	0.1	542
Units with Set-Top Boxes	45.4%▼	4.1%	542
Set-Top Boxes with DVR Capability	5.3%▼	2.7%	243
Units with Gaming Systems	27.8%▲	3.7%	542
Gaming Systems Per Unit with Gaming Systems	0.3▼	0.0	542
Computers Per Unit	0.6	0.1	542
Units with Computers	54.9%	4.0%	542
Audio Systems Per Unit	0.4▼	0.0	542
Total Subwoofers Per Unit	0.1▼	0.0	542
Passive Subwoofers Per Unit	0.1	0.0	542
Powered Subwoofers Per Unit	0.0▼	0.0	542

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Table 106. AVERAGE IN-UNIT TELEVISION POWER BY VINTAGE (Compare to Table 96 in 2011 RBSA)

Vintage	Television Power (W)		
	Mean	EB	n
Pre 1990	48.5	NA	2
1990-1999	68.6▼	3.3	12
2000-2004	70.8▼	4.4	24
2005-2009	118.2	7.0	78
2010-2014	77.1▼	4.3	135
Post 2014	61.0	4.2	67
Unknown Vintage	75.6	4.7	147
All Vintages	78.7▼	1.9	388

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Table 107. DISTRIBUTION OF IN-UNIT TELEVISION SCREENS BY TYPE AND VINTAGE (Compare to Table 97 in 2011 RBSA)

Vintage	Television Screens												
	CRT		LED		LCD		LED+LCD		Plasma		Other		n
	%	EB	%	EB	%	EB	%	EB	%	EB	%	EB	
Pre 1990	3.8%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	96.2%	0.0%	2
1990-1999	100.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	18
2000-2004	95.1%	2.7%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	4.9%	9.9%	30
2005-2009	18.2% ▼	3.9%	0.1%	0.3%	71.0%	4.3%	0.0%	0.0%	7.4%	2.6%	3.2%	3.7%	100
2010-2014	0.2%	0.8%	38.3%	4.6%	51.8%	4.7%	0.7%	0.9%	9.0%	2.8%	0.0%	0.0%	186
Post 2014	0.0%	0.0%	86.2%	3.5%	13.3%	3.8%	0.0%	0.0%	0.0%	0.0%	0.5%	1.4%	89
All Vintages	16.2% ▼	3.8%	31.7%	4.6%	44.0%	4.8%	0.4%	0.7%	5.9%	2.2%	1.7%	1.8%	366

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Table 108. DISTRIBUTION OF IN-UNIT TELEVISIONS BY ROOM TYPE
(Compare to Table 98 in 2011 RBSA)

Room	Televisions		
	%	EB	n
Bathroom	0.3%	0.8%	2
Bedroom	34.6%▲	4.1%	224
Dining Room	0.2%	0.5%	2
Family Room	6.5%▲	2.1%	50
Hall	0.1%	0.9%	1
Kitchen	1.6%	1.0%	12
Living Room	56.4%	4.2%	413
Office	0.3%	0.8%	2
Total	100.0%	0.0%	502

Table 109. PERCENT OF UNITS REPORTING HAVING COMPLETED AN ENERGY AUDIT IN THE LAST TWO YEARS

Building Size (Stories)	Percent of Units		
	%	EB	n
Low-Rise (1-3)	3.3%	1.6%	353
Mid-Rise (4-6)	4.3%	1.5%	57
High-Rise (7+)	0.0%	0.0%	14
Total	3.3%	1.0%	424

Table 110. AVERAGE ANNUAL UNIT ELECTRIC CONSUMPTION BY BUILDING SIZE
(Compare to Table 99 in 2011 RBSA)

Building Size (Stories)	Electric kWh per Unit		
	Mean	EB	n
Low-Rise (1-3)	7,744.5▼	261.6	288
Mid-Rise (4-6)	5,685.3▼	202.3	60
High-Rise (7+)	4,739.7	457.2	13
All Types	7,456.0▼	227.5	361

Table 111. AVERAGE ANNUAL UNIT ELECTRIC CONSUMPTION BY UNIT SIZE AND BUILDING SIZE
(Compare to Table 100 in 2011 RBSA)

Building Size (Stories)	Unit kWh per Sq. Ft.		
	Mean	EB	n
Low-Rise (1-3)	9.7	0.5	288
Mid-Rise (4-6)	8.1▲	0.4	60
High-Rise (7+)	5.9	0.3	13
All Types	9.5	0.4	361

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Table 112. AVERAGE ANNUAL PER UNIT COMMON AREA ELECTRIC CONSUMPTION BY BUILDING SIZE (Compare to Table 101 in 2011 RBSA)

Building Size (Stories)	Common Area kWh per Unit		
	Mean	EB	n
Low-Rise (1-3)	1,390.9▼	294.0	120
Mid-Rise (4-6)	2,988.1▲	458.4	18
High-Rise (7+)	336.3	NA	1
All Types	1,602.5▼	258.8	139

Table 113. AVERAGE ANNUAL PER SQUARE FOOT COMMON AREA ELECTRIC CONSUMPTION BY BUILDING SIZE (Compare to Table 102 in 2011 RBSA)

Building Size (Stories)	Common Area kWh per Sq. Ft.		
	Mean	EB	n
Low-Rise (1-3)	27.2	5.7	42
Mid-Rise (4-6)	39.4▲	14.8	14
High-Rise (7+)	2.3	NA	1
All Types	30.7▲	5.5	57

Table 114. AVERAGE ANNUAL TOTAL RESIDENTIAL GAS THERMS PER RESIDENTIAL UNIT BY BUILDING SIZE FOR BUILDINGS WITH GAS SERVICE
(Compare to Table 103 in 2011 RBSA)

Building Size (Stories)	Gas Therms per Unit		
	Mean	EB	n
Low-Rise (1-3)	274.1▲	37.8	47
Mid-Rise (4-6)	355.8▲	107.0	10
High-Rise (7+)	320.8	133.1	3
All Types	296.3▲	34.7	60

Table 115. AVERAGE ANNUAL RESIDENTIAL GAS THERMS PER SQ. FT. BY BUILDING SIZE FOR BUILDINGS WITH GAS SERVICE
(Compare to Table 104 in 2011 RBSA)

Building Size (Stories)	Gas Therms per Sq. Ft.		
	Mean	EB	n
Low-Rise (1-3)	0.31▲	0.05	47
Mid-Rise (4-6)	0.29▲	0.05	10
High-Rise (7+)	0.29	0.06	3
All Types	0.30▲	0.03	60

Table 116. AVERAGE ANNUAL TOTAL ELECTRIC CONSUMPTION BY BUILDING SIZE (Compare to Table 105 in 2011 RBSA)

Building Size (Stories)	Electric kWh per Unit		
	Mean	EB	n
Low-Rise (1-3)	8,091.4▼	327.8	175
Mid-Rise (4-6)	7,562.5▼	180.0	19
High-Rise (7+)	4,370.5▼	316.7	2
All Types	8,025.0▼	294.0	196

Table 117. AVERAGE ANNUAL TOTAL ELECTRIC CONSUMPTION PER UNIT SQUARE FOOT BY BUILDING SIZE (Compare to Table 106 in 2011 RBSA)

Building Size (Stories)	Electric kWh per Unit		
	Mean	EB	n
Low-Rise (1-3)	10.2	0.5	120
Mid-Rise (4-6)	11.2▲	1.1	18
High-Rise (7+)	4.1	NA	1
All Types	10.3	0.4	139

Table 118. SUMMARY STATISTICS BY EUI QUARTILES

Quartile and EUI Range	Summary Statistics by EUI Quartile										
	Conditioned Area		Electric Heat		Efficient Lighting		Air Conditioning		Electric Hot Water		n
	Mean	EB	%	EB	%	EB	%	EB	%	EB	
1 (< 7.15)	991.3	22.6	72.2%	4.1%	50.3%	4.9%	26.6%	3.4%	31.6%	4.0%	90
2 (7.15 - 9.17)	871.2	18.3	86.4%	3.2%	44.6%	5.2%	26.2%	3.2%	54.9%	4.2%	90
3 (9.17 - 11.58)	801.9	22.1	89.1%	1.6%	46.4%	4.8%	30.8%	3.9%	67.1%	4.4%	91
4 (> 11.58)	676.4	20.8	98.3%	0.9%	46.9%	5.3%	29.5%	4.4%	65.4%	4.2%	90

BACK TO REPORT

Addendum: Report Updates

Cadmus made the following updates to the RBSA II report and Appendix A tables.

RBSA II Updated GPM Flow Rate Calibration

Cadmus used two different techniques to measure fixture flow rates for the RBSA II study: a flow bag and a flow microweir. Technicians did not record which method was used at the time of data collection. The study results for water flow rate were higher than those recorded in the RBSA I study, raising understandable concerns about market trends and data reliability. To address these concerns and appropriately calibrate RBSA II results, Cadmus took these actions:

- Tested the accuracy of the two measurement methods (flow bag and microweir) and developed calibration factors for each method
- Contacted the field technicians who collected the RBSA II data to determine faucets and showerheads for which Cadmus could identify the measurement method with a high level of certainty

Our testing found that the measurements from both flow bags and microweirs were consistently higher than the actual flow rate of the faucets and showerheads. Based on this testing, applying a calibration factor for each method produced results that more accurately represent RBSA II average flow rates. Therefore, we developed calibration factors for the two measurement methods, based on our testing, and applied it to flow rates where we were confident in the measurement method used by the field technician.

The results of this calibration are presented in the showerhead and faucet aerator GPM flow rate tables of this report and Appendix A.

RBSA II UA and Total Heat Loss Methodology

Based on stakeholder feedback, Cadmus updated its method for calculating UA values and total heat-loss estimates for the RBSA II. These updated methods add several elements for consistency with RBSA I and incorporate Regional Technical Forum standard practices, NREL Efficiency Measure Database and Super Good Cents load calculations, including heat loss through building assembly layers and components.

The results of this update are presented in the insulation and UA chapters and tables of this report and Appendix A.

Other Updates and Corrections

As part of this update, Cadmus also addressed identified inconsistencies and oversights in several tables. These updates did not produce any significant change to the report or its key findings.

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