KEY FINDINGS: FANNIE MAE MULTIFAMILY ENERGY AND WATER MARKET RESEARCH SURVEY

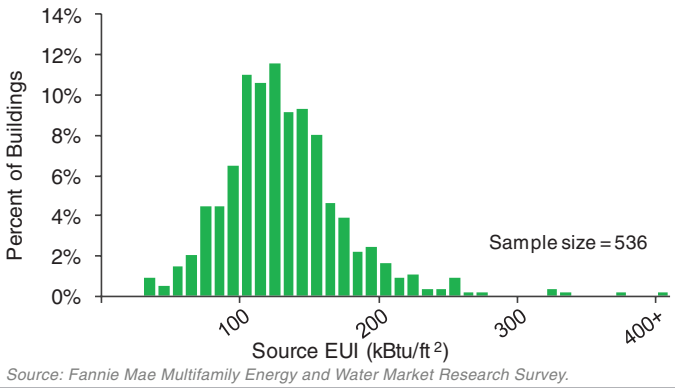
1. The **least efficient** property may end up spending $165,000 more in annual energy costs than a similar property operating the most efficiently.[8]

2. On average, a **100,000 square foot** property spends $125,000 on energy and $33,000 on water annually. If this property **saved 15%** on energy and water costs, it would **increase asset value by almost** $400,000, assuming a 6% cap rate.

3. The **least efficient** properties use over three times as much energy and six times as much water per square foot as the most efficient properties.

4. Affordable units are 29% smaller in square footage than Market Rate units, on average, and Affordable properties have a **higher density of units:** 1.29 **vs.** 0.91 **units per 1,000 square feet.** As a result, the smaller unit size results in 28% lower energy use per unit, but the higher number of units per square foot results in higher energy cost and use per square foot.

FIGURE 1: DISTRIBUTION OF WHOLE PROPERTY ENERGY USE (PER SQUARE FOOT)



Source: Fannie Mae Multifamily Energy and Water Market Research Survey.

5. **When owners paid** for all energy costs, median annual energy use was 26% higher than when tenants paid for the energy costs.

6. **Small properties** (5 to 49 units) use almost 4 times more energy per square foot in their common areas than do properties with 300+ units, because the common area is a larger percentage of the property's gross square footage.

7. **High-rise properties** use almost 10% more energy per square foot than low-rise properties. **Properties in the West** use almost 50% more water per square foot compared to properties in the Northeast.

Fannie Mae would like to thank the numerous multifamily owners, property managers, and consultants who provided data for the Survey, as well as the Commercial Real Estate Finance Council, the National Multifamily Housing Council, and the Urban Land Institute for their leadership and support of the Survey. The Survey would not have been possible without wide multifamily industry participation and support.

SURVEY OVERVIEW

Through its 2012 *Multifamily Energy and Water Market Research Survey*, Fannie Mae received 1,163 unique survey response submissions from a nationwide sample of multifamily properties, including Market Rate, Affordable, and seniors housing properties. The Survey asked the respondents to answer questions on their property's characteristics and to provide all their property's energy and water consumption and costs from January 2011 to December 2011. Further details on the Survey respondents, property characteristics reported and the observations made from the analysis can be found in the section *Who Responded to the Survey?*.

Analysis of the data from the Survey found that the total median costs for both energy and water use, including tenant and common area space, were $1.58 per square foot and $1,313 per unit. When separating energy costs from water costs, the Survey showed that the median energy cost at properties across the country was $1.25 per square foot and $1,005 per unit. The median water cost was $0.33 per square foot and $308 per unit.

These findings are generally consistent with other national surveys. For example, the 2012 NAA Survey of Operating Income & Expenses in Rental Apartment Communities found that Market Rate master-metered properties paid an average of $1.58 per square foot and $1,491 per unit in total utility costs.[9] Survey findings showed that approximately 10% of the space in a multifamily building is typically common area, and the percent of total energy costs associated with common area space was similar. Properties that provided common area energy use and cost only had a median cost of $0.14 per square foot.

TABLE 1: ANNUAL WHOLE PROPERTY ENERGY AND WATER USE AND COST

	Use/ft²	Use/Unit	Cost/ft²	Cost/Unit
Energy (Source Energy)	127 kBtu/ft²/yr	115,754 kBtu/unit/yr	$1.25	$1,005
Water (Indoor/Outdoor)	46.6 gal/ft²/yr	121 gal/unit/day	$0.33	$308
Total			$1.58	$1,313

TABLE 2: ANNUAL COMMON AREA ENERGY USE AND COST

	Use/ft²	Use/Unit	Cost/ft²	Cost/Unit
Energy (Source Energy)	12.8 kBtu/ft²/yr	13,391 kBtu/unit/yr	$0.14	$153

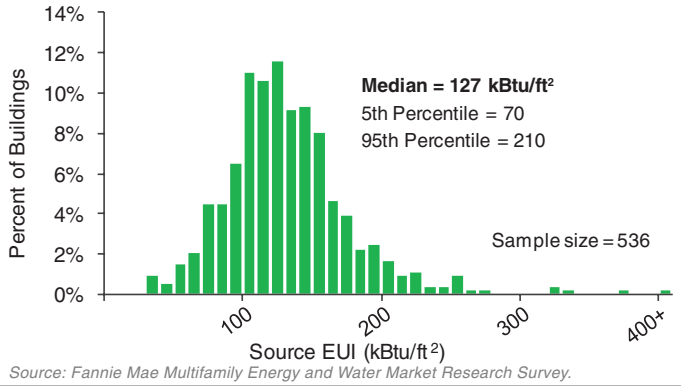
Understanding Energy Metrics: Btu, EUI, and Source Energy

Property managers and owners may be accustomed to seeing energy use on utility bills in units specific to one energy type (i.e., kWh for electricity, or therms for natural gas). In order to determine a property's total energy use, it is necessary to convert the units for each individual energy type to a single common unit, called the British Thermal Unit, or Btu. To compare properties of different sizes, Energy Use Intensity (EUI) is often used, which measures the amount of energy used per square foot. The unit for EUI is one thousand Btus per square foot, or kBtu/ft². Analysis of the data from the *Multifamily Energy and Water Market Research Survey* expresses energy use in terms of Source EUI. Source energy is a metric commonly used to provide an equitable comparison of properties that utilize different mixes of fuels. It accounts for losses from generation, transmission, and distribution of energy from the energy's source (i.e., power plant). For more information, see www.energystar.gov/sourceenergy.

Energy use results from the Survey are expressed in terms of *source energy*, since it is the most equitable metric to compare properties that use different fuel types. The national median source energy use intensity (EUI) for whole property data, including both tenant and common area space, observed in the Survey data was 127 kBtu/square foot. This is consistent with the median source EUI of 132 kBtu/square foot calculated by New York City in its study of the municipality's multifamily and commercial building energy use in 2011.[10] When expressed in terms of units used on utility bills, analysis found that the median site energy use was 7.49 kWh/square foot for electricity and 0.23 therms/square foot for natural gas. On a per unit basis, the Survey found that the national median source energy use was 115,754 kBtu/unit. The median water use observed in the Survey data was 47 gallons per square foot per year, or 121 gallons per unit per day.

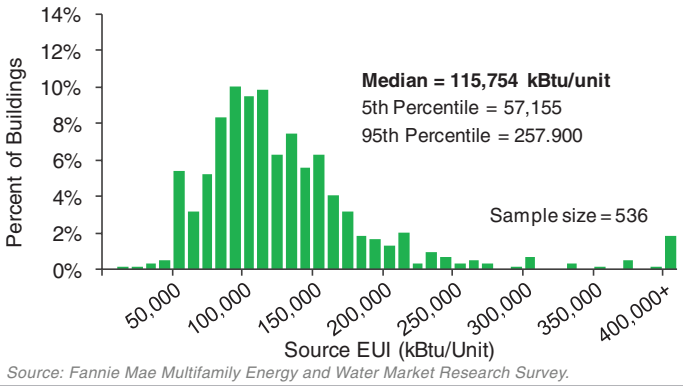
In addition to median values, it is important to understand the wide range of energy and water use in multifamily properties. The least efficient properties (those in the 95th percentile) in the Survey data use over three times as much energy per square foot and six times as much water per square foot as the most efficient properties (those in the 5th percentile). For a sample 100,000 square foot property, this translates to difference in energy cost of $165,000 annually — quite a substantial sum. Figures 2 through 5 illustrate the distribution of energy and water use per square foot and per unit across the properties in the Survey.

FIGURE 2: DISTRIBUTION OF WHOLE PROPERTY ENERGY USE (PER SQUARE FOOT)



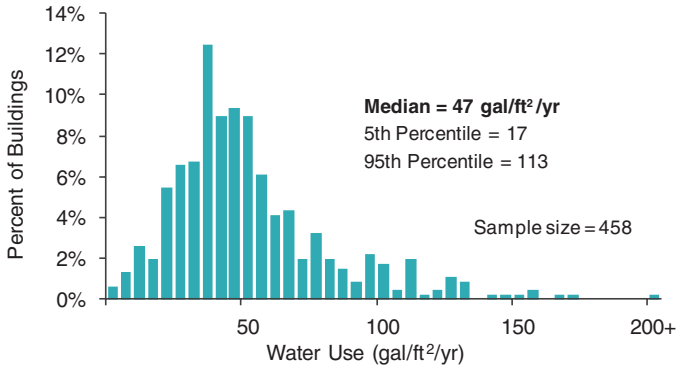
Source: Fannie Mae Multifamily Energy and Water Market Research Survey.

FIGURE 3: DISTRIBUTION OF WHOLE PROPERTY ENERGY USE (PER UNIT)



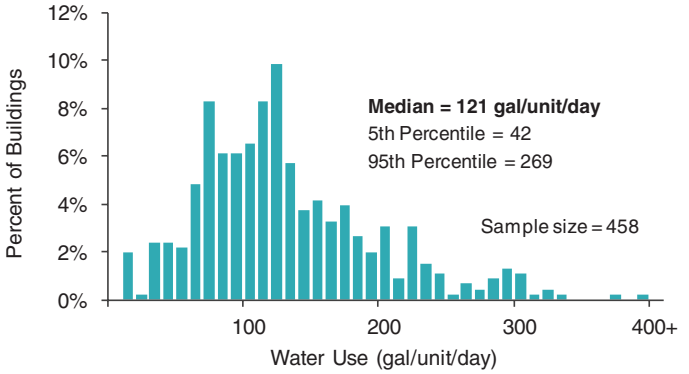
Source: Fannie Mae Multifamily Energy and Water Market Research Survey.

FIGURE 4: DISTRIBUTION OF WHOLE PROPERTY WATER USE (PER SQUARE FOOT)



Source: Fannie Mae Multifamily Energy and Water Market Research Survey.

FIGURE 5: DISTRIBUTION OF WHOLE PROPERTY WATER USE (PER UNIT)



Source: Fannie Mae Multifamily Energy and Water Market Research Survey.

One key driver of energy and water costs is energy and water rates. Absent any variations in energy and water use among multifamily properties, costs would still vary widely due to differences in local rates. However, variations in energy and water use, and subsequently costs, may also be expected based on differences in each property's characteristics, such as the location, physical condition, and operating efficiencies of the property. Based on the findings of the Survey, the following property characteristics exhibited correlations with energy and water use:

- **Location and Climate —** Energy use was lowest in the West, and higher in colder climates like the Midwest and Northeast. Water use was highest in the West.
- **Building Type —** Energy use was observed to be highest in high-rise properties (ten or more floors), while water use was highest in low-rise properties (one to four floors).
- **Occupant Density —** The number of units per square foot and bedrooms per square foot showed the strongest relationship with energy and water use.

WHO RESPONDED TO THE SURVEY?

The *Multifamily Energy and Water Market Research Survey* was launched in June 2012 and collected data through June 2013. Fannie Mae received 1,163 unique survey response submissions. Of the total responses received, 672 properties provided energy and water data, 278 properties provided energy data only, 64 properties provided water data only, and 149 properties completed only property characteristic information.

All submissions were reviewed to identify appropriate data to be used for analysis. Properties that did not provide a full twelve months of energy or water data spanning January 2011 to December 2011 were excluded. Properties that did not provide the two critical property characteristics of square footage and the number of units were also excluded. Additionally, extreme outliers for energy and water use and cost values were filtered out of the data set. Because some properties provided energy-only or water-only data, and not all properties provided cost data, it was necessary to use a number of different subsets of the data for analysis. The observations used in the analysis are summarized below:

- **Whole Property Energy Data —** 536 with use data, 317 with cost data
- **Common Area Energy Data —** 236 with use data, 228 with cost data
- **Indoor/Outdoor Water Data —** 458 with use data, 425 with cost data

Respondent Property Types, Region and Unit Range

A breakdown of the respondents is provided in Figures 6 through 8. Surveys were received from all regions of the country, with a higher representation from the Northeast, and a lower response rate from the Midwest.

There was a full distribution across property size as measured by the number of units per property. The most prevalent building type was garden apartments, followed by low-rise and high-rise. Low-rise were considered in combination with garden apartments for some energy use analysis, since both represent buildings with one to four stories.

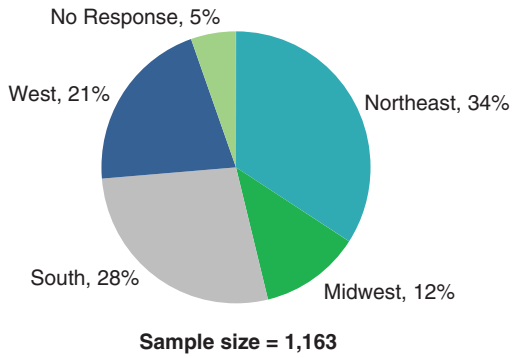
Minimal responses were received for townhouse, towngarden, and single-family homes, all of which were building types that were not targeted in the Survey.

The Survey asked respondents to provide information on typical multifamily property characteristics. Requested data points included population type, number of units, bedrooms, floors, presence of pools, the number of laundry and dishwasher hook-ups, elevators, year and type of renovation, and type of heating and cooling equipment. Though respondents were often unable to provide all desired data points, the information was valuable in providing a profile of the multifamily buildings in the final sample and was gathered with the intention of assessing the significance of energy and water use drivers.

Respondent Fuel Types and Metering Configurations

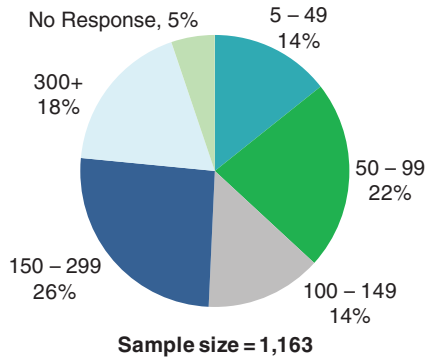
The Survey also included questions about fuel types utilized and metering configurations. Some properties depend solely on electricity as an energy source, while others consume a mix of fuels, including natural gas and fuel oil.

FIGURE 6: RESPONSES BY REGION



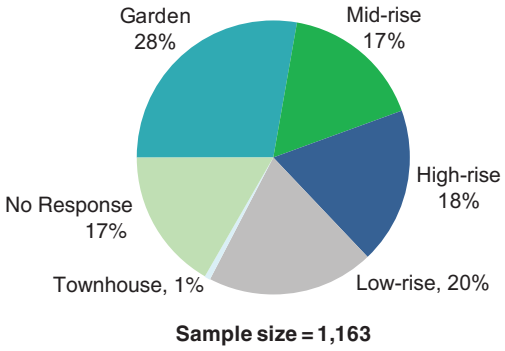
Source: Fannie Mae Multifamily Energy and Water Market Research Survey.

FIGURE 7: RESPONSES BY UNIT RANGE



Source: Fannie Mae Multifamily Energy and Water Market Research Survey.

FIGURE 8: RESPONSES BY BUILDING TYPE



Source: Fannie Mae Multifamily Energy and Water Market Research Survey.

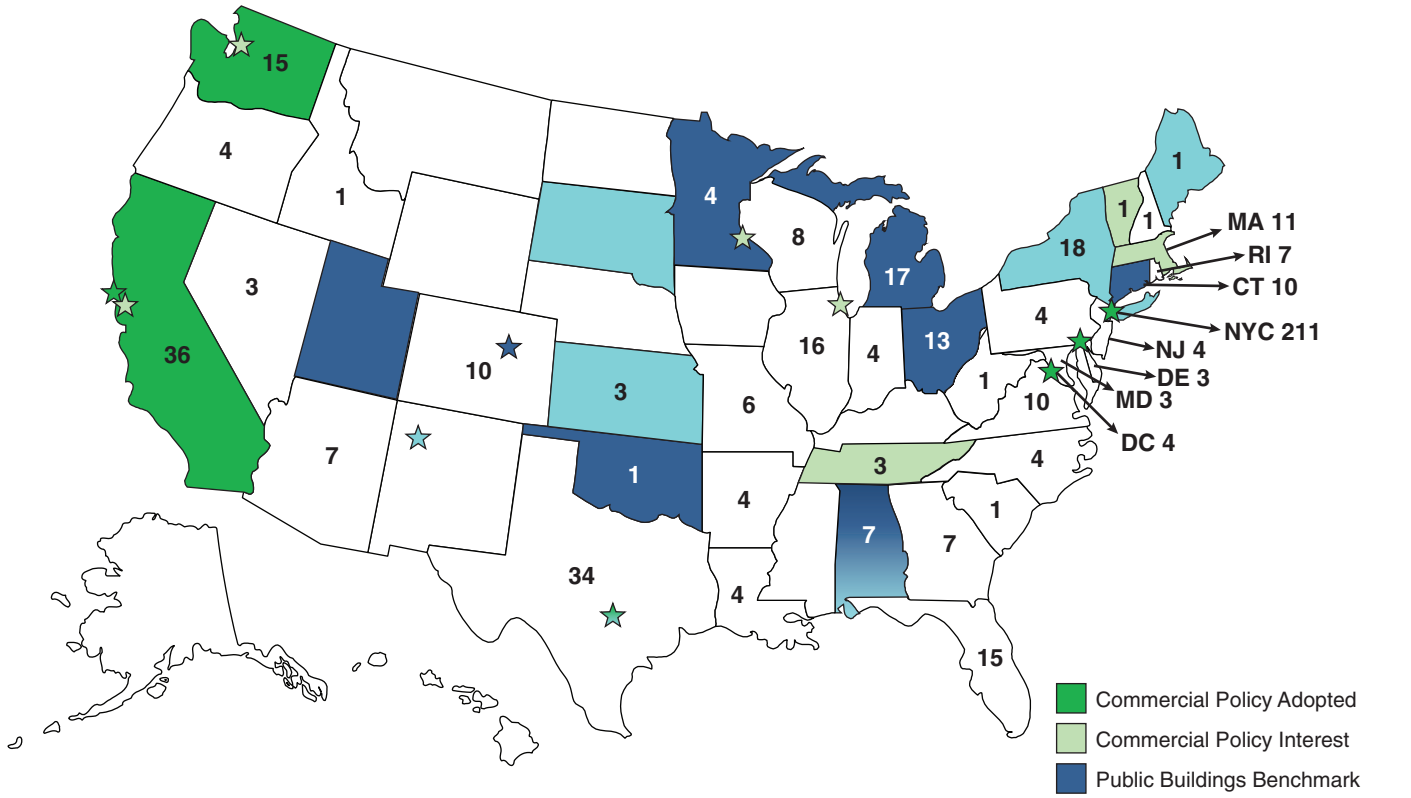
Adding another layer of complexity to data collection, the asset class displays a mix of metering configurations; some properties are entirely master-metered, some are individually-metered for all fuels, while still others have a combination of metering arrangements, such as individually-metered electricity use by apartment and master-metered natural gas for a central heating system.

Metering arrangements have significant bearing on the availability of energy and water data. Owners of master-metered properties with direct access to all energy and water bills for the property were more easily able to provide whole-property energy and water data for the Survey.

Respondents in New York City

It is important to note that 41% of properties providing whole property energy data were located in New York City. This high response rate was due to the energy benchmarking law in New York City that requires all privately owned buildings above 50,000 square feet to benchmark their energy use in the Portfolio Manager system.

FIGURE 9: SURVEY RESPONSES AND BENCHMARKING DISCLOSURE LAWS AS OF 2012 PER CITY OR STATE

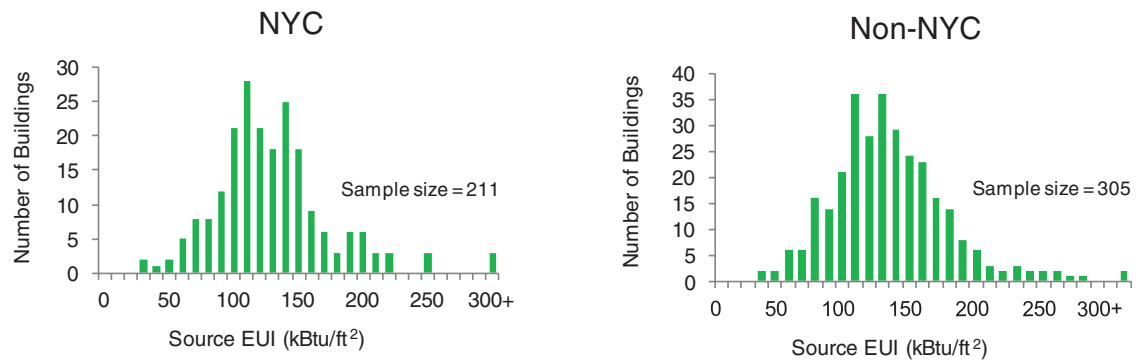


Based on benchmarking and disclosure laws in effect during the Survey in 2012. The responses count on the map includes 516 properties that provided whole property energy data and location information.

Source: Buildingrating.org and energystar.gov

To determine whether the performance of the New York City facilities was influencing the broader Survey findings, an analysis was conducted to compare properties in New York City with other properties in the database. As illustrated by Figure 10 and Table 3, the comparative analysis found that New York City properties and non-New York City properties were statistically very similar. The median source EUI, and the EUI values at the 25th and 75th percentile of the populations, were very similar. As a result, the New York City properties were not treated differently for the analysis conducted by Fannie Mae, but EPA made adjustments to the analysis process to account for regional bias.

FIGURE 10: NYC AND NON-NYC BUILDINGS IN THE SAMPLE ARE SIMILAR



Source: Fannie Mae Multifamily Energy and Water Market Research Survey.

TABLE 3: COMPARISON OF NYC vs. NON-NYC ENERGY DATA

Location of Property	Whole Building Survey Respondents	Percentage of Survey Respondents	25th percentile Source EUI (kBtu/ft^2)	Median Source EUI (kBtu/ft^2)	75th percentile Source EUI (kBtu/ft^2)
NYC	211	41%	108	128	153
Non-NYC	305	59%	104	127	153
All	516	100%	104	127	153

WHAT DRIVES MULTIFAMILY ENERGY COSTS AND USE?

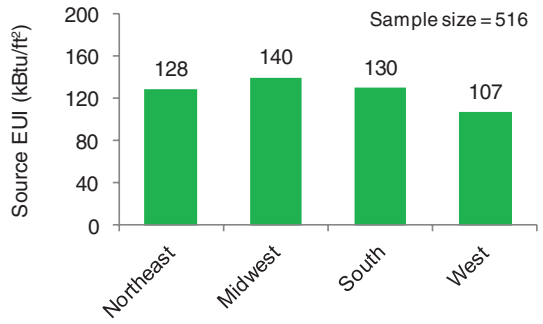
By understanding how efficiently a property uses energy, property owners and managers can make strategic decisions in developing an energy management plan and identifying opportunities for cost savings.

Energy: Impact of Location and Climate

Properties in the West had the lowest energy use, as illustrated in Figures 11 and 12. Energy use is highest in the Northeast and Midwest, depending on the energy use intensity metric used. This result is likely because parts of the West region, such as California, have milder climates with low heating and cooling loads while the Northeast and Midwest experience colder winters.

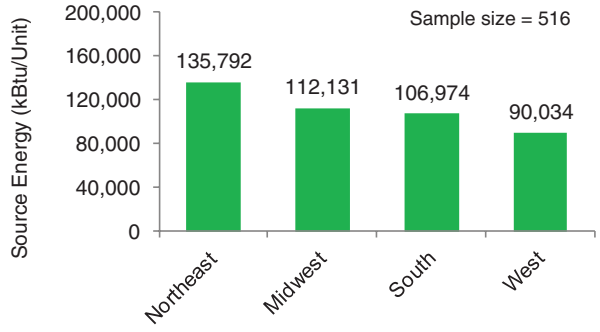
The dependence of energy use on climate can be viewed in Figure 13 showing energy use vs. heating degree days (HDD). Heating degree days are a measure of the demand for heating based on weather conditions, with higher heating degree days representing colder climates. Figure 13 shows energy use increasing slightly along with heating degree days, which is intuitive. However, consistent with analyses of energy use in other building types, the relationship between degree days and the total annual energy use for the property is present but not as strong as might be expected. This is because total energy use for a property includes many end uses that are not dependent on climate, such as appliances or even light fixtures. Additionally, some climates have higher heating loads and some have higher cooling loads; therefore, when all climate-dependent energy use is added together on an annual basis, the variation in total annual energy use based on climate is relatively limited.

FIGURE 11: WHOLE PROPERTY ENERGY USE BY REGION (PER SQUARE FOOT)



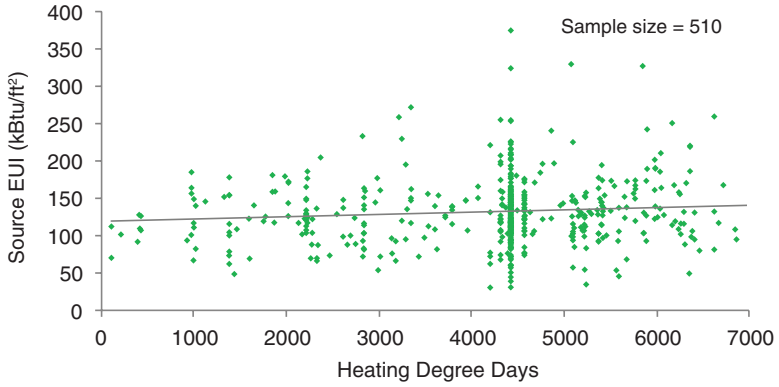
Source: Fannie Mae Multifamily Energy and Water Market Research Survey.

FIGURE 12: WHOLE PROPERTY ENERGY USE BY REGION (PER UNIT)



Source: Fannie Mae Multifamily Energy and Water Market Research Survey.

FIGURE 13: HDD CORRELATION WITH SOURCE EUI



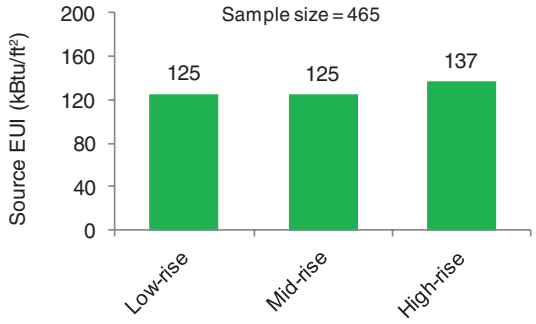
Source: Fannie Mae Multifamily Energy and Water Market Research Survey.

Energy: Impact of Building Type

High-rise properties use almost 10% more energy per square foot than low-rise properties. As shown in Figures 14 and 15, this was observed for both energy use per square foot and per unit, but was more pronounced for energy use per unit. Additionally, energy use intensity was shown to increase along with the maximum number of floors in a building, as shown in Figure 16.

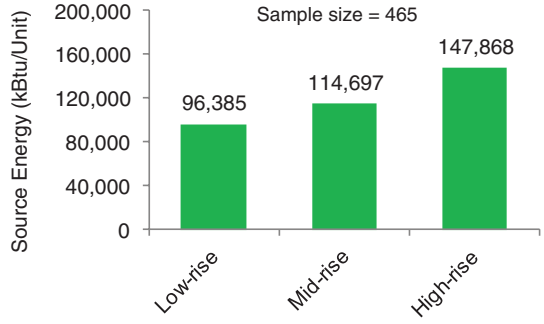
It is difficult to determine whether there is a property characteristic or operations and maintenance procedure inherent to high-rise buildings that results in higher energy use. It is unclear whether the differences are caused by the presence of more elevators or interior corridor space, or are due to correlations with other property characteristics, such as variations in occupant density or even property location. The 2012 NAA survey also found a similar result, and showed that Market Rate, master-metered mid-rise and high-rise properties paid $1.94/square foot and $1,701 per unit in total utility costs, an increase of 49 cents per square foot or $291 per unit compared to garden properties, which tend to be low-rise properties.

FIGURE 14: WHOLE PROPERTY ENERGY USE BY BUILDING TYPE (PER SQUARE FOOT)



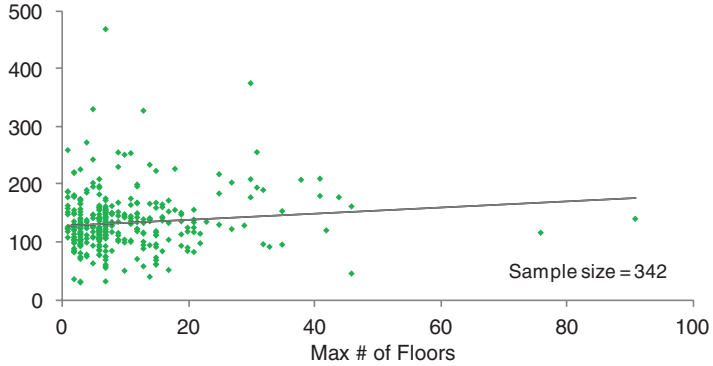
Source: Fannie Mae Multifamily Energy and Water Market Research Survey.

FIGURE 15: WHOLE PROPERTY ENERGY USE BY BUILDING TYPE (PER UNIT)



Source: Fannie Mae Multifamily Energy and Water Market Research Survey.

FIGURE 16: WHOLE PROPERTY ENERGY USE BY MAXIMUM NUMBER OF FLOORS



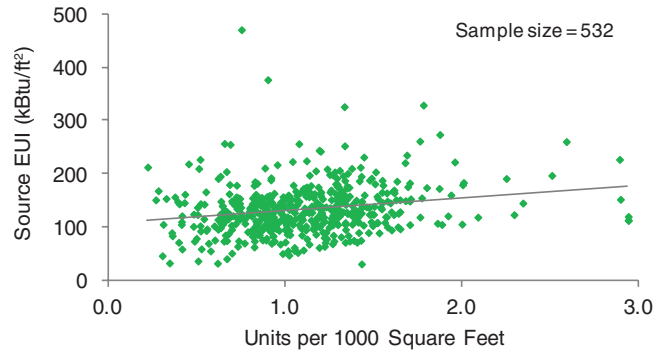
Source: Fannie Mae Multifamily Energy and Water Market Research Survey.

Energy: Impact of Occupant Density

Properties with a higher occupant density demonstrated two opposite trends: higher energy use per square foot, but lower energy use per unit. For the analysis of the Survey data, occupant density was measured in terms of units per square foot and bedrooms per square foot. The relationship of occupant density with energy use is somewhat complicated, but it was the strongest driver of energy consumption of all of the characteristics reviewed.

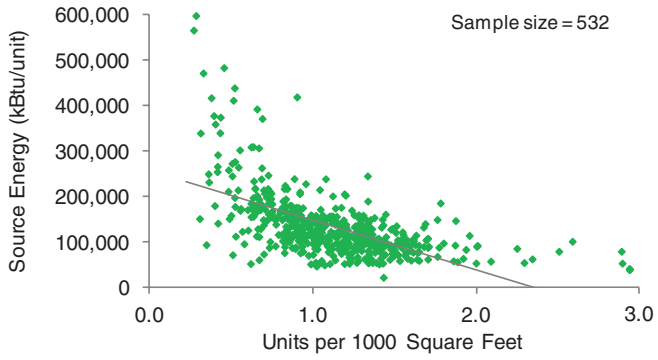
Looking at occupant density in terms of units per square foot, or unit density, Figures 17 and 18 illustrate the opposite trends observed. Energy use per square foot increases with higher unit density, because there is more occupant activity, such as cooking, doing laundry, and running appliances per square foot of space. Conversely, energy use per unit generally decreases with higher unit density, because units with high unit density are generally smaller in size, resulting in less lighting and air-conditioning being needed for each unit.

FIGURE 17: ENERGY USE PER SQUARE FOOT VS. UNITS PER SQUARE FOOT



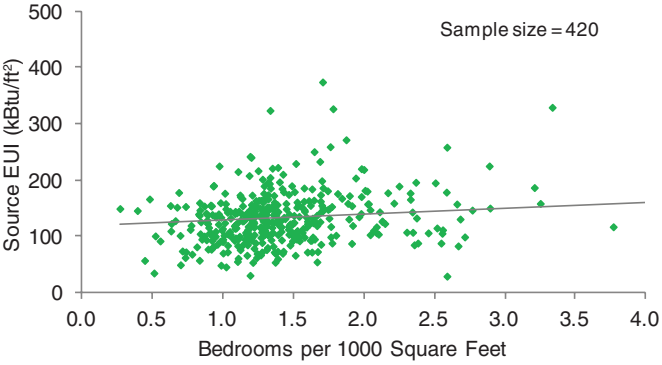
Source: Fannie Mae Multifamily Energy and Water Market Research Survey.

FIGURE 18: ENERGY USE PER UNIT VS. PER SQUARE FOOT



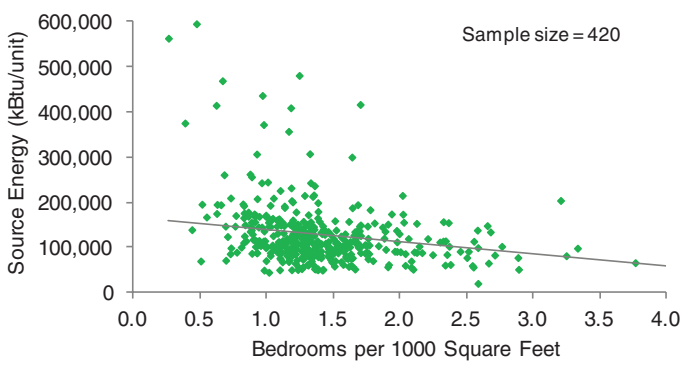
Source: Fannie Mae Multifamily Energy and Water Market Research Survey.

FIGURE 19: ENERGY USE PER SQUARE FOOT VS. BEDROOMS PER SQUARE FOOT



Source: Fannie Mae Multifamily Energy and Water Market Research Survey.

FIGURE 20: ENERGY USE PER UNIT VS. BEDROOMS PER SQUARE FOOT



Source: Fannie Mae Multifamily Energy and Water Market Research Survey.

Looking at the other end of the spectrum, a lower unit density means that the units are larger in terms of living space. If a household lives in a larger unit, that household is expected to use more total energy per unit than a household in a smaller unit. More energy is required to provide heating, cooling and lighting for a larger unit.

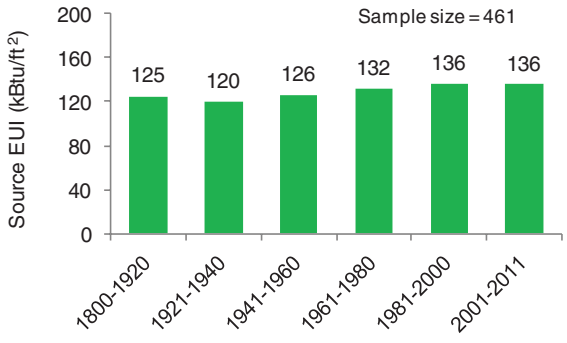
Interestingly, the energy use per square foot may actually be less for units with a lower occupant density. This is because energy use for other daily activities is spread over a larger floor area. These relationships illustrate the importance of considering occupant density when determining how efficiently a property is using energy. *A property with a high energy use per square foot may appear inefficient, when in fact the property has a high occupant density and operates more efficiently based on the energy use per unit.*

The two factors included in Figures 17 through 20, units per square foot and bedrooms per square foot, are interrelated, though not exactly the same. Generally, if a property has a high unit density, it will likely have a high bedroom density as well. However, properties can have a different mix of studios, one-bedroom units, or two- and three-bedroom units. It is possible for a property with more two- and three-bedroom units to have a high bedroom density, but not a high unit density. Therefore, it is important to consider both factors when evaluating the occupant density of a property.

Energy: Impact of Building Age

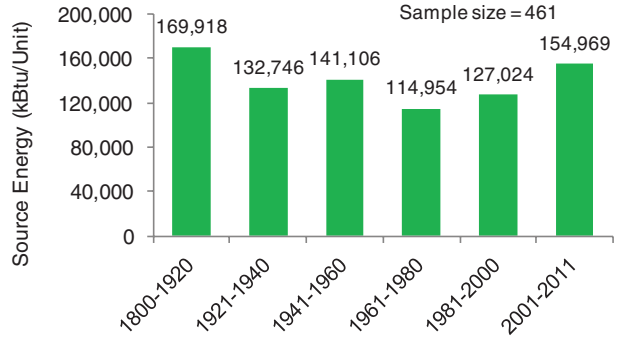
In terms of energy use, newer buildings did not perform better than older buildings in most cases. Appliances and energy using equipment have become more efficient over time, so lower energy use might be expected. However, survey results revealed that, in most cases, newer buildings showed higher energy use per square foot than older buildings, as shown in Figure 21. While this relationship is not as strong as the relationship with occupant density, it is worth noting — especially as a similar relationship with building age was observed in benchmarking data from New York City buildings. One explanation for this observation could be that older buildings tend to have superior thermal envelopes with thicker walls, fewer windows, and less ventilation. Looking at energy use per unit in Figure 22, the trend is less clear, with energy use per unit decreasing and then increasing again over time. This appears to be correlated with changes in unit size, as the average square feet per unit in the survey data follows a similar trend over these time periods.

FIGURE 21: WHOLE PROPERTY ENERGY USE BY YEAR BUILT (PER SQUARE FOOT)



Source: Fannie Mae Multifamily Energy and Water Market Research Survey.

FIGURE 22: WHOLE PROPERTY ENERGY USE BY YEAR BUILT (PER UNIT)



Source: Fannie Mae Multifamily Energy and Water Market Research Survey.

Energy: Impact of Affordability/Housing Subsidies

The *Multifamily Energy and Water Market Research Survey* collected data for both Affordable and Market Rate properties. The resident population represented by the responses included general purpose (i.e., individuals or families) or seniors; no student or military housing was included. Table 4 shows summary statistics comparing the Affordable and Market Rate properties in the Survey.

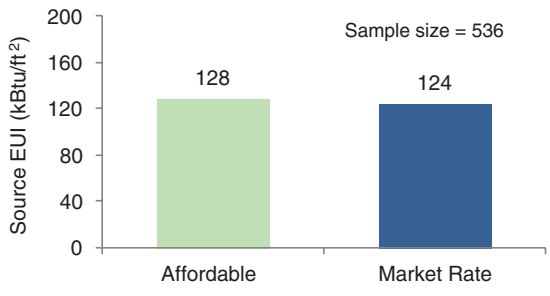
Affordable properties tended to have smaller units and higher unit density than Market Rate properties. The Market Rate properties in the Survey were older than the Affordable properties, on average. The analysis that follows compares energy use and cost for Affordable and Market Rate properties.

TABLE 4: SUMMARY STATISTICS FOR AFFORDABLE AND MARKET RATE HOUSING

	Affordable	Market Rate
Unit Density (Units/1000 ft^2)	1.29	0.91
Square Feet per Unit	778	1,099
Bedroom Density (Bedrooms/1000 ft^2)	1.40	1.16
Age	32	48
Occupancy Rate	98%	91%

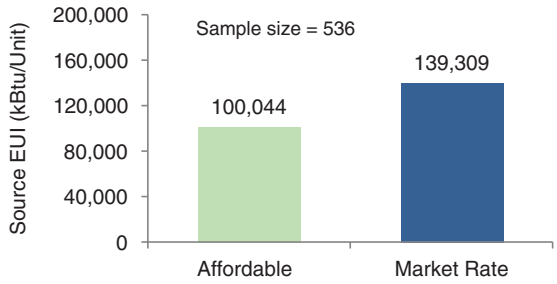
Affordable properties showed higher energy use per square foot than Market Rate housing, but lower energy use per unit. This result is illustrated in Figures 23 and 24. These findings are likely due to Affordable properties having smaller units than Market Rate properties. The energy use per square foot is higher because the occupant density is higher. Energy use per unit is lower because the Affordable units tend to be smaller.

FIGURE 23: WHOLE PROPERTY ENERGY USE BY HOUSING TYPE (PER SQUARE FOOT)



Source: Fannie Mae Multifamily Energy and Water Market Research Survey.

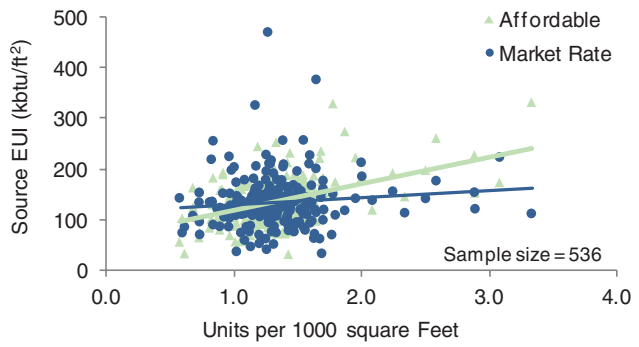
FIGURE 24: WHOLE PROPERTY ENERGY USE BY HOUSING TYPE (PER UNIT)



Source: Fannie Mae Multifamily Energy and Water Market Research Survey.

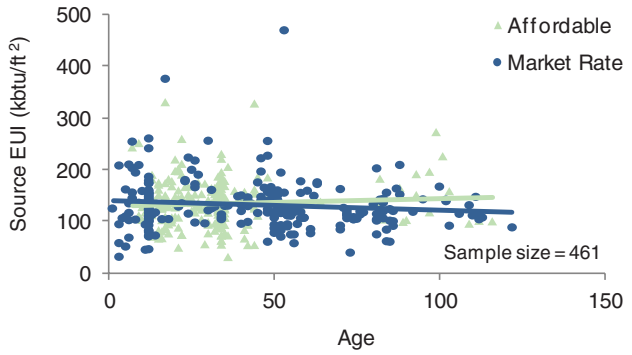
Affordable housing properties and Market Rate housing had similar key drivers of energy use. One of the key drivers of energy intensity identified by the Survey was occupant density, in terms of the number of units per square feet. Figure 25 shows that energy use increases as the number of units per square foot increases, for both Affordable and Market Rate properties. Similar trends are observed for building age, with Figure 26 showing that energy use per square foot is slightly lower for older properties, for both Affordable and Market Rate properties.

FIGURE 25: ENERGY USE PER SQUARE FOOT VS. UNITS PER SQUARE FOOT



Source: Fannie Mae Multifamily Energy and Water Market Research Survey.

FIGURE 26: ENERGY USE PER SQUARE FOOT VS. AGE

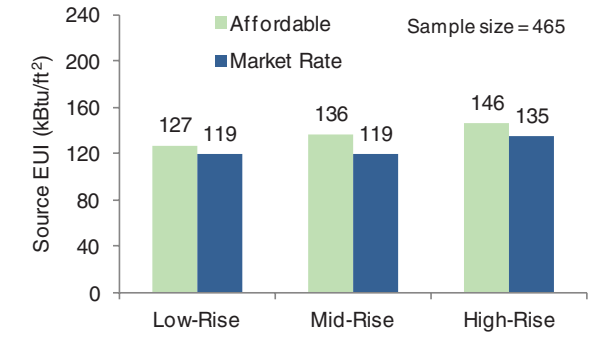


Source: Fannie Mae Multifamily Energy and Water Market Research Survey.

Another driver of energy intensity identified by the Survey was building type. For both Affordable and Market Rate properties, high-rise properties were observed to have higher energy intensity than low-rise properties, as shown in Figure 27. This difference was evident in the overall multifamily population in Figure 14. The difference is somewhat masked in the overall population, because there is a different mix of building types in the Affordable and Market Rate populations.

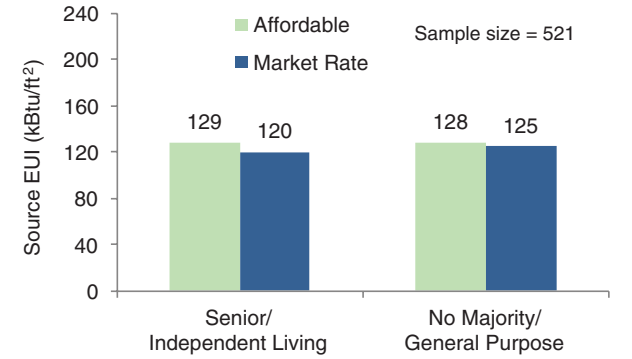
The difference between resident population types was also examined. Interestingly, the EUIs for the senior living and general purpose housing were very similar, showing that the resident population type has less influence on EUI than might be expected. This held true for both Affordable and Market Rate housing.

FIGURE 27: ENERGY USE BY BUILDING TYPE (PER SQUARE FOOT)



Source: Fannie Mae Multifamily Energy and Water Market Research Survey.

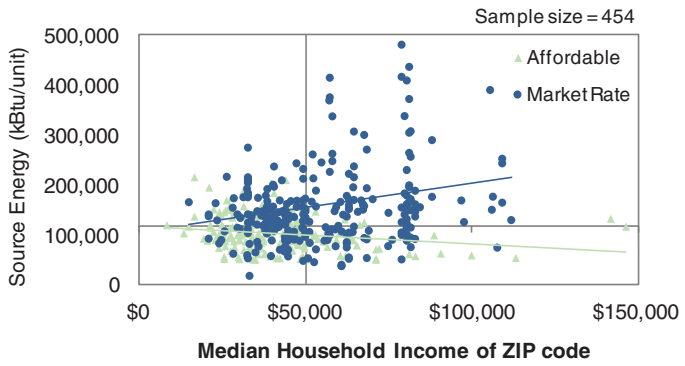
FIGURE 28: ENERGY USE BY RESIDENT POPULATION (PER SQUARE FOOT)



Source: Fannie Mae Multifamily Energy and Water Market Research Survey.

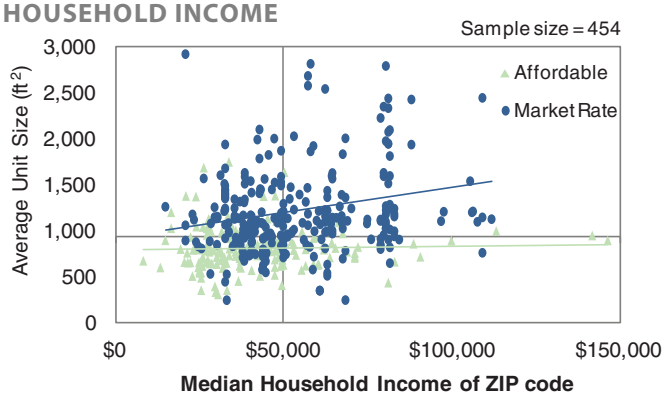
Energy use per unit in Market Rate properties increased as the median income for the ZIP code increased, while energy use for Affordable properties decreased. Energy use per unit was compared to the median household income for the ZIP code of the property. For Market Rate properties, energy use per unit increased as the median income for the ZIP code increased. For Affordable properties, energy use per unit decreased. These trends appear to be tied to the average unit size for the properties, as shown in Figure 30. Similar to energy use, unit size increases with the median income for the Market Rate properties, but remains relatively flat for Affordable properties.

FIGURE 29: WHOLE PROPERTY ENERGY USE VS. HOUSEHOLD INCOME (PER UNIT)



Source: Fannie Mae Multifamily Energy and Water Market Research Survey.

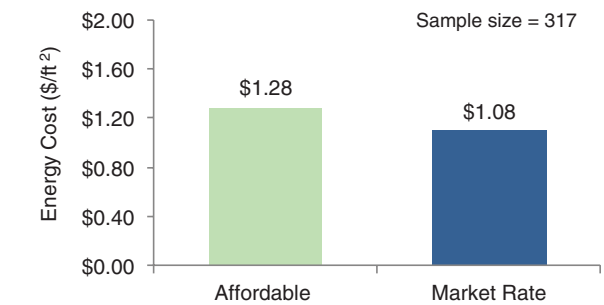
FIGURE 30: AVERAGE UNIT SIZE VS. HOUSEHOLD INCOME



Source: Fannie Mae Multifamily Energy and Water Market Research Survey.

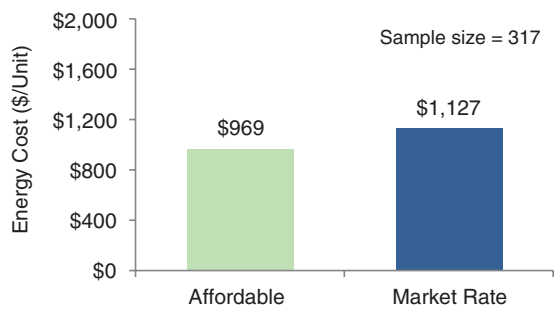
Affordable properties showed higher energy cost per square foot than Market Rate housing, but lower energy cost per unit. This result, shown in Figures 31 and 32, is the same as the findings for energy use. The higher energy cost per square foot is consistent with a 2012 NAA survey, which found that Affordable housing properties incurred total utility costs of $1.76 per square foot, compared to $1.58 for Market Rate properties.[11] As noted in Table 5, cost data was more limited than energy use data, particularly for the Market Rate properties.

FIGURE 31: WHOLE PROPERTY ENERGY COST BY AFFORDABLE HOUSING SUBSIDIES (PER SQUARE FOOT)



Source: Fannie Mae Multifamily Energy and Water Market Research Survey.

FIGURE 32: WHOLE PROPERTY ENERGY COST BY AFFORDABLE HOUSING SUBSIDIES (PER UNIT)



Source: Fannie Mae Multifamily Energy and Water Market Research Survey.

TABLE 5: ANNUAL ENERGY USE AND COST FOR AFFORDABLE AND MARKET RATE HOUSING

	# with Use Data	# with Cost Data	Source EUI (kBtu/ft²)	Source Energy (kBtu/Unit)	Energy Cost ($/ft²)	Energy Cost ($/Unit)
Affordable	238	234	128	100,044	$1.28	$969
Market Rate	298	83	124	139,309	$1.08	$1,127
All	536	317	127	115,754	$1.25	$1,005

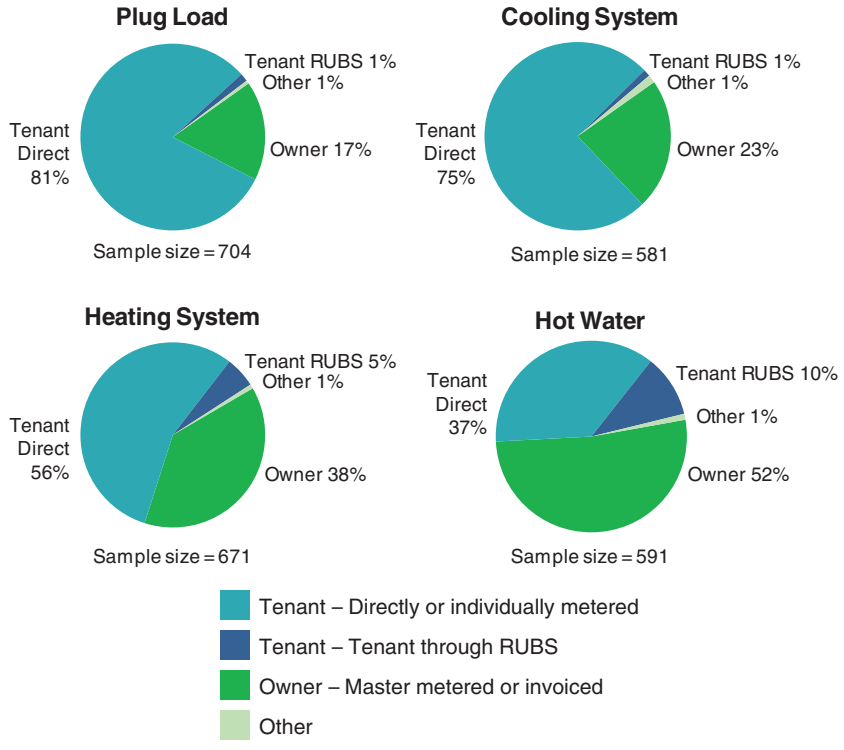
Energy: Impact of Metering Configuration and Bill Payment

Another area of interest in multifamily properties is the metering configuration. This variation is important, since it generally dictates who pays the utility bills – the owner or the tenant. This can vary based on the end uses for energy at the property, which include plug loads, cooling, heating, and hot water use.

Survey findings showed that a high percentage of tenants pay for plug load and a slightly smaller proportion for cooling systems. Hot water use was most often master-metered, meaning it is calculated for the entire building and generally paid for by the owner. The pie charts in Figure 33 shows the results for all properties that answered questions regarding metering configurations and bill payment.

Not all of the respondents were able to provide whole property energy data for common area and tenant space. Of the 704 properties that responded to the question on plug load metering configurations, only 236 of these provided whole property energy data. Of these 236 properties, 38% were

FIGURE 33: FREQUENCY OF METERING CONFIGURATIONS BY END USE



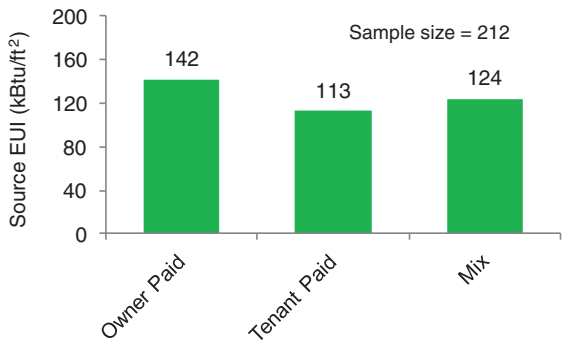
Source: Fannie Mae Multifamily Energy and Water Market Research Survey.

master-metered, as compared to 17% of the full population of 704 properties. Clearly, it is easier for master-metered properties to collect and manage whole property energy data. For properties with individual metering, the ability to gather and understand whole-property energy use represents a significant barrier to effective energy management.

Energy use was lower for properties where tenants paid the utility bills. There were 212 properties that answered all questions on metering and bill payment and also provided whole-property energy data. Of these, 83 properties had energy for all end uses paid for by the owner, 51 properties had energy for all end uses paid for by the tenant, and 78 properties had a mix of some end uses paid by the owner and some paid by the tenant.

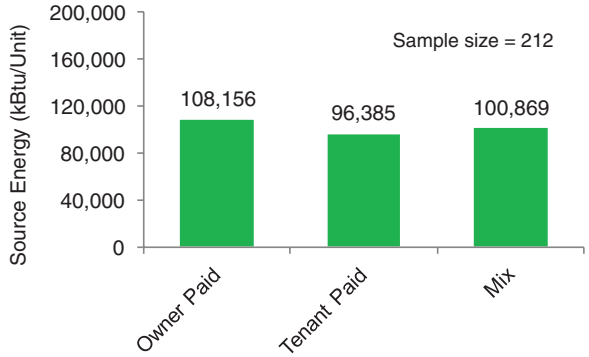
Not surprisingly, Figures 34 and 35 show that energy use was lower for the tenant-paid properties, on both a per square foot and per unit basis. This is consistent with data published by the Energy Information Administration.[12] The owner/resident management structure in multifamily properties results in competing incentives that can affect energy use. A resident paying the bill has a greater motivation to reduce energy use and costs, while an owner paying the utility bill has a greater incentive to invest in efficient technologies. For the sample of properties in this Survey, the resident incentive appeared to be more effective in reducing energy use.

FIGURE 34: WHOLE PROPERTY ENERGY USE BY METERING CONFIGURATION (PER SQUARE FOOT)



Source: Fannie Mae Multifamily Energy and Water Market Research Survey.

FIGURE 35: WHOLE PROPERTY ENERGY USE BY METERING CONFIGURATION (PER UNIT)



Source: Fannie Mae Multifamily Energy and Water Market Research Survey.

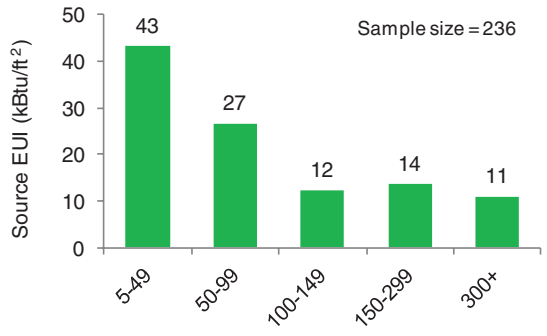
Energy: Impact of Common Area Energy Use

Regardless of a building's metering arrangement, all owners have access to common area energy bills. Common area space provides an opportunity for all properties to reduce energy use and cost. Properties that responded to the Survey typically had 10% of their gross square footage dedicated to common space. Depending on the property, common areas can consume significant amounts of energy, particularly if the common space includes interior hallways, large parking garages, or laundry facilities.

For this analysis, common area energy use was analyzed on a per square foot and per unit basis. The per square foot values were computed by taking the total energy use for the common area and dividing by the floor area of the *total property*, instead of dividing by the floor area for the common space. This approach was used for two reasons. First, property managers often look at use and cost metrics relative to the total property floor area. Second, common area energy use can include exterior lighting or amenities like swimming pools, which are not associated with floor area values. Looking at use based on the floor area of the common space, which may be a small rental office, can yield unusual results.

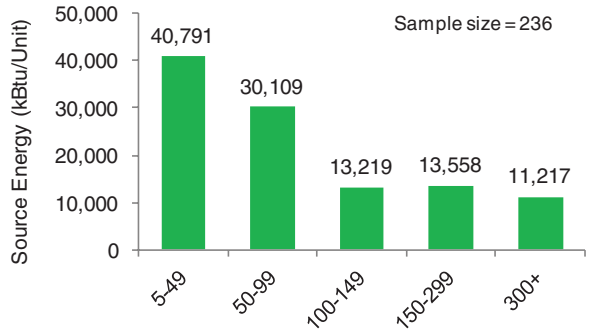
High-rise properties and properties with a low number of units use the highest amount of energy. This was observed for both energy use per square foot and number of units. Initially, this seems potentially contradictory, since high-rise properties are generally associated with a larger number of units, but the reason is quite simple. High-rise properties are likely to have higher common area energy use than low-rise properties, because there are interior corridors that require lighting and space conditioning at all times. Within a given property type, whether it is high-rise or low-rise, properties with a large number of units are able to divide the energy use associated with common area activities across a larger total floor area or number of units. As a result, these properties exhibited lower common area energy use than those with a smaller number of units.

FIGURE 36: COMMON AREA ENERGY USE BY UNIT RANGE (PER SQUARE FOOT)



Source: Fannie Mae Multifamily Energy and Water Market Research Survey.

FIGURE 37: COMMON AREA ENERGY USE BY UNIT RANGE (PER UNIT)



Source: Fannie Mae Multifamily Energy and Water Market Research Survey.

Other Factors Affecting Energy Use

A wide range of property characteristics were included in the Survey to provide a detailed profile of multifamily properties across the U.S. and determine their significance in driving energy use. The following characteristics were examined and, while likely to affect energy use, no conclusions were made due to limitations in the Survey data.

- **Amenities —** Data gathered for the number of laundry units and dishwashers was limited.
- **Energy Systems —** Few respondents provided information on the type of systems used for heating and cooling.
- **Renovations —** Few respondents provided information on whether the property had undergone any renovations to energy systems in recent years.