

# Results Report



# Shopping Center Energy Intensity Benchmarking Study

Prepared for:

The International Council of Shopping Centers

12221 Avenue of the Americas

New York, NY 10020



# TABLE OF CONTENTS

- Executive Summary ..... 1
  - Background ..... 1
  - Data ..... 1
  - Data Processing ..... 1
  - Benchmarking Analysis ..... 1
  - Benchmarking Findings ..... 2
- Introduction..... 4
  - Data Collection Methodology..... 4
  - Data Processing and Quality Assurance ..... 5
    - Exclusion Factors and Outlier Identification Process ..... 5
    - Sub-Group Characterization Process ..... 6
- Benchmarking Findings..... 7
  - Aggregate and Regional Analysis ..... 7
  - Sub-Group Analysis by Property Type and Meter Configuration ..... 7
  - Comparison to External Benchmarks ..... 8
    - Commercial Buildings Energy Consumption Survey (CBECS) ..... 8
    - ENERGY STAR ..... 9
    - Global Real Estate Sustainability Benchmark (GRESB) ..... 9
- Uncovered Improvement Opportunities ..... 11
  - Variation..... 11
  - Comparison to Mean Performance ..... 12
  - State Electricity ..... 13
- Appendix ..... 15
  - Climate Zone Mapping ..... 15
  - Additional Sub-Group Analysis by Climate Zone, Property Type and Meter Configuration..... 16
  - Risk and Uncertainty ..... 28
  - Additional Sub-Group Definitions and Details ..... 29

# EXECUTIVE SUMMARY

## Background

In July of 2015 the ICSC Scorecard committee began to expand the data collection process for energy benchmarking purposes and to improve the benchmarking analysis methodology, overall to create a highly in-depth benchmarking report for retail shopping centers. The energy use trends and findings from this enhanced process is discussed in this report. The report is designed to allow all ICSC members to view the energy conservation performance of the industry as a whole, compare performance and explore opportunities for improvement.

## Data

For this analysis, the original data set consisted of data submitted from 2,298 properties. 1,163 properties were removed, leaving 1,135 properties in the report and analysis. Reasons for exclusion are discussed in detail in later sections. The included data set has the following key characteristics:

- 96% of respondent properties are located in the US, including Puerto Rico
- Non-US properties include Canada (43), Italy (5), Greece (2) and Spain (1)
- All 1,135 included properties reported electricity data, whereas only 229 included reported natural gas, 84 chilled water, 37 propane, 36 fuel oil and 35 reported steam

## Data Processing

Energy and property information was collected from all respondents and then processed to add additional layers of analysis and insight into the sector's energy usage performance. This information was processed to remove outliers (properties with atypical or incomplete information). This resulted in a smaller data set, which was then analyzed to create an industry benchmark and exploit trends, and potential opportunities.

## Benchmarking Analysis

The key benchmarking metric is the Energy Use Intensity (EUI), which is calculated for each property included in the data analysis as the total energy use for 2014 (kWh) divided by the Gross Leasable Area (sq ft). Total energy use for 2013 (kWh) was also collected, but the benchmarking results in this report reflect the most up-to-date data 2014 data<sup>1</sup>.

Aggregate mean and median EUI was calculated, and the properties were also broken into four overarching sub-groups for analysis. These sub-groups account for meter configuration (whether tenant energy use was included or excluded) and property type (whether a property is classified as an Enclosed center – those for which common area exists – or an Open Air center, which are all other properties for which no common area exists). Within these groups, the mean and median 2014 EUIs were determined and compared to each other as well as external benchmarks.

Additional analysis expressed the variance in mean EUI for each property sub-group, which were broken down into quartiles to clearly illustrate improvement opportunities. While there are a number of factors that can influence EUI (e.g., weather, building design, and the data response rate of the tenants in any

---

<sup>1</sup> Though analyses reflect 2014 data, a year-over-year comparison was performed for aggregate EUI and it was determined 2013 and 2014 mean EUIs are analogous (3.87 kWh / sq ft for 2013 and 3.83 kWh / sq ft for 2014)

one center, etc.) throughout this report a property's variation from the mean EUI of similar properties is taken to indicate their overall performance regardless of other factors. Opportunities to save energy, cost and emissions were highlighted by calculating the hypothetical shift of an average third-quartile property to the mean EUI of its respective sub-group. And to illustrate relative return on investment of energy investments, US specific properties were broken down by state to compare EUI to the cost of electricity in each state.

The appendix then further breaks down the data set into 28 property sub-groups to provide an additional layer of analysis, incorporating climate zone mapping and groupings, as well as property and meter types.

## Benchmarking Findings

The overall mean EUI of shopping center properties included in the data set was found to be 3.83 kWh / sq ft, analogous to the calculated 2013 mean EUI of 3.87 kWh / sq ft. However, both retail property type and meter configuration have a significant influence on the mean EUI. Taking into account these additional property qualities, data was analyzed based on four sub-groups and provides a clearer picture into respondent performance:

1. Enclosed, Tenant Data Included
  - Average GLA: 549,755 sq ft
2. Enclosed, Tenant Data Excluded
3. Open Air, Tenant Data Included
4. Open Air, Tenant Data Excluded

As shown in Figure 1 below, Enclosed sites with tenant energy usage data included have the highest mean EUI (25.4 kWh / sq ft), while Open Air centers with tenant usage excluded have the lowest mean EUI (1.4 kWh / sq ft).

		Property Type	
		Enclosed	Open Air
Meter Configuration	Included	<b>Mean: 25.4</b> <b>Median: 21.8</b> <b>Count: 70</b>	<b>Mean: 8.0</b> <b>Median: 2.6</b> <b>Count: 56</b>
	Excluded	<b>Mean: 6.3</b> <b>Median: 5.3</b> <b>Count: 56</b>	<b>Mean: 1.9</b> <b>Median: 1.4</b> <b>Count: 953</b>

Figure 1 – Results by Group (kWh / sq ft)

When compared to external benchmarks (CBECS and ENERGY STAR), the aggregate mean EUI for all data is quite low. However, this is due to the high population (89%) of Open Air centers in the survey, which experience significantly lower consumptions and EUIs than Enclosed centers. When solely considering Enclosed sites with included tenant loads, which align more closely with the external reports, the mean EUI jumps to 29.9 kWh / sq ft, actually slightly higher than external benchmarks.

Further analysis shows wide variation across all property sub-groups – particularly within the Enclosed, tenant data included sub-group – indicating improvement opportunities across groups. Energy, cost and carbon emission savings were also calculated by shifting an average, bottom-quartile performing

electricity EUI property to the mean, and thus quantifying the difference from the bottom-quartile to mean. For example, for a 565,000 square foot Enclosed center with tenant energy data included, increasing from bottom quartile to average EUI performance would represent an expected energy savings of 2.8 million kWh, a cost savings of \$304,000, and a carbon savings of 1,591 tons annually. Table 1 expresses these results across the four analyzed groups. This analysis further highlights that properties have the opportunity to find both financial and environmental improvement through improving energy usage performance.

Annual Opportunity	Enclosed Properties		Open Air Properties	
	Included	Excluded	Included	Excluded
<b>Average GLA (sq ft)</b>	565,240	532,840	230,260	171,000
<b>Average Energy Savings (kWh)</b>	2,786,410	868,480	1,184,610	33,940
<b>Average Savings (\$/year)</b>	\$ 303,720	\$ 94,660	\$ 129,120	\$ 3,700
<b>Average CO2e Savings (Tons/year)</b>	1,591	496	676	19

*Table 1 – Average Property Performance Improvement Opportunities*

## INTRODUCTION

A special project was launched by the ICSC Scorecard Committee in July of 2015 to expand the data collection process for energy benchmarking purposes, to improve the benchmarking analysis methodology, and to provide participating companies with a robust industry energy intensity report. Energy usage data was collected from ICSC member centers with the intention of creating the most robust dataset ever collected for the retail shopping center sector.

The energy use trends and findings from this enhanced process are discussed in this report, which focuses on highlighting an energy use intensity (“EUI”) benchmark, calculated using energy kilowatts (“kWh”) for shopping centers as the numerator and gross leasing area (“GLA”) as the denominator. This key indicator and the following analysis will allow property owners, investors, and other key stakeholders to compare performance and uncover opportunities for improvement.

### Data Collection Methodology

Based on feedback from the ICSC Scorecard committee, a data collection spreadsheet was designed to elicit the most responses from ICSC member properties. The collection spreadsheet was generated to be straightforward and facilitate submission of member property and energy use data.

Unlike other benchmarking efforts that are either initiated because of mandatory compliance or to analyze a single portfolio, the incentive for ICSC members to provide property information is to create an industry benchmark from the strongest dataset collected in the retail shopping center sector.

The data collection spreadsheet asked for the following information, which was then utilized to create the EUI benchmark:

- Location
- Retail Property Type:
  - Open Air
  - Enclosed
- Meter Configuration Type:
  - Common Area Loads Only (Tenants Excluded)
  - Common Area Loads and Tenant Loads (Tenants Included)
- Gross Leasable Area
- Total Number of Parking Spaces
- Interior Common Area
- Annual Energy Consumption for 2013 and 2014:
  - Electricity
  - Natural Gas
  - Propane
  - Fuel Oil
  - Steam
  - Chilled Water

The data collection spreadsheet also included two questions to determine other means of collecting energy data from the retail shopping center industry and whether respondents have utilized or attempted to utilize ENERGY STAR’s Portfolio Manager as a benchmarking tool:

- Is energy consumption data available in ENERGY STAR’s Portfolio Manager?
- Is energy consumption data available in a GRESB Report?

On July 20th, 2015, ICSC CEO, Michael P. Kercheval, sent an email to approximately 10,000 ICSC members, requesting they participate in the benchmarking effort. This email included two spreadsheets: a form for determining intent to contribute energy data for the benchmark study (used to estimate the level of participation and also for follow-up purposes), and the energy data collection spreadsheet.

Energy data collection spreadsheets were collected from July 21st, 2015 to October 5th, 2015. Approximately 50 property management companies participated in this data collection effort, collectively submitting over 2,000 properties in under a three month time period.

## Data Processing and Quality Assurance

Survey respondents' data was processed and examined for quality assurance purposes to ensure the analysis within this report accurately represents the shopping center sector's energy usage. All property data was collected from ICSC members.

Of 2,298 total respondents, 1,163 properties were removed from the analyzed data set. Properties were excluded from the analysis supplied in this report if they submitted data that was either (a) incomplete or (b) highly irregular. More information about the inclusion / exclusion process is provided below. The result was a data set from which the conclusions within this report are drawn.

### EXCLUSION FACTORS AND OUTLIER IDENTIFICATION PROCESS

In order to accurately analyze the responses received, a number of respondents' data were excluded from the report due to incomplete or unrecognizable data. Error checks were performed to identify these properties. Of the 2,298 respondent, 368 properties were eliminated due to the following factors:

- Zip code, property type, or meter type were not provided (43 properties excluded)
- Gross Leasable Area (GLA) not provided (98 properties excluded)
- Utility data provided included a period of renovations and/or included energy use from other mixed-use buildings, such as office space (32 properties excluded)
- ASHRAE climate zone not able to be mapped with provided information (described in further detail in the Appendix) (195 properties excluded)

To further ensure the accuracy of data, the variation in each property's total energy use data from 2013 to 2014 was evaluated. Enclosed centers, which possess an indoor common area, generally have a greater variation in energy use year-over-year than Open Air centers, which are all other properties (including lifestyle centers and outlet centers, etc.) and experience less frequent changes and shifts in energy use due to building structure, footprint and use. Following, a 30% threshold in year-over-year total energy usage was utilized for Enclosed centers, with those centers exhibiting less than 30% change year-over-year included in the data set, and those centers with greater than or equal to 30% change excluded from the data set. For Open Air properties, the same method was utilized only with a 10% year-over-year threshold<sup>2</sup>. This process is summarized below, and along with the other following factors, were used to exclude abnormal data:

- Significantly (>30%) different total energy use from 2013 to 2014 for Enclosed centers (10 properties excluded)
- Significantly (>10%) different total energy use from 2013 to 2014 for Open Air centers (744 properties excluded)
- Electricity data from either 2013 or 2014 not provided (27 properties excluded)

---

<sup>2</sup> The year-over-year changes were calculated by dividing the change in energy (kWh) from 2013 to 2014 by the average energy usage (kWh) in 2013 and 2014. Any changes greater than 30% (Enclosed) or 10% (Open Air) were eliminated from the data set due to high variability and likely errors in data

- Locations where GLA was abnormally and inexplicably large<sup>3</sup> (14 properties excluded)

#### **SUB-GROUP CHARACTERIZATION PROCESS**

Additional analysis was necessary to account for both the type of retail property space the centers occupy, as well as the type of meter configuration they utilize, two characteristics which all properties in the analyzed data set had provided and are truly defining qualities of properties included in the data set:

- Retail Property Type: Properties are classified as either Open Air shopping centers or Enclosed shopping centers<sup>4</sup>
- Meter Configuration: Individual property data either includes or excludes tenant energy data

Note: For sake of clarity, the following terms “Common Area Loads Only” and “Common Area Loads and Tenant Loads” used in the data collection forms have been replaced as follows in this report:

- Common Area Loads Only = Tenant Energy Use Excluded
- Common Area Loads and Tenant Loads = Tenant Energy Use Included

Taking into account these additional property qualities, this additional layer of analysis splits the properties into four sub-groups, and provides a clearer picture into respondent performance:

1. Enclosed, Tenant Data Included
  - 70 properties
  - Average GLA: 549,755 sq ft
2. Enclosed, Tenant Data Excluded
  - 56 properties
  - Average GLA: 532,837 sq ft
3. Open Air, Tenant Data Included
  - 56 properties
  - Average GLA: 230,256 sq ft
4. Open Air, Tenant Data Excluded
  - 953 properties
  - Average GLA: 171,001 sq ft

While data was analyzed and is presented in this report through a number of methods, the four aforementioned sub-groups represent the main focus of the analysis.

---

<sup>3</sup> 14 locations in the Philippines were listed with a GLA in the billions of square feet and were removed from the analysis

<sup>4</sup> Properties for which interior common area exists are defined as Enclosed; all other properties, including lifestyle and outlet centers, are defined as Open Air

# BENCHMARKING FINDINGS

## Aggregate and Regional Analysis

The mean and median of the energy use intensities are utilized to benchmark the landscape of shopping centers worldwide. As Table 2 demonstrates, the mean EUI for all respondents is 3.8 kWh / sq ft and the median for all respondents is 1.6 kWh / sq ft. Mean EUI is also nearly identical in 2014 to 2013 data (3.87 kWh / sq ft).

Group Description	Mean EUI (kWh / sq ft)	Median EUI (kWh / sq ft)	# Properties
<b>Overall</b>	<b>3.8</b>	<b>1.6</b>	<b>1,135</b>
US	3.2	1.5	1,084
Canada	20.1	17.5	43
Other International <sup>5</sup>	9.4	8.9	8

Table 2 - Total Mean EUI, and By Region

The mean EUI of properties located in the United States is 3.2 kWh / sq ft, compared to a higher value of 9.4 kWh / sq ft for Other International properties, and an even higher value of 20.1 for properties located in Canada. Two main factors are at play in causing the range of figures. First, the vast majority of responses included in the data set (96%) are from properties located in the US. Thus, the variation in the global mean is much more sensitive to individual responses, and also less indicative of the actual mean for all global locations. Secondly, non-US properties are dominated by Canadian properties, which are located in very cold climates. The majority of these properties belong to climate zones 6 and 7, and buildings located in such areas may thus exhibit a higher EUI due to the added natural gas requirements for heating. In addition, 26 out of 43 total Canadian properties are classified as enclosed centers with tenant energy data included.

## Sub-Group Analysis by Property Type and Meter Configuration

To better understand the mean EUI, the dataset was split into the four aforementioned sub-groups:

1. Enclosed Included
  - o 70 properties
  - o Average GLA: 549,755 sq ft
2. Enclosed Excluded
  - o 56 properties
  - o Average GLA: 532,837 sq ft
3. Open Air Included
  - o 56 properties
  - o Average GLA: 230,256 sq ft
4. Open Air Excluded
  - o 953 properties
  - o Average GLA: 171,001 sq ft

Both property and meter types have a significant effect on the EUI of a shopping center. As Figure 2 shows, in general, inclusion of tenant energy data raises the EUI, while exclusion of tenant energy data lowers the mean EUI. And Open Air centers exhibit a lower mean EUI compared to Enclosed properties.

<sup>5</sup> 'Other International' includes Italy (5 properties), Greece (2 properties), and Spain (1 property)

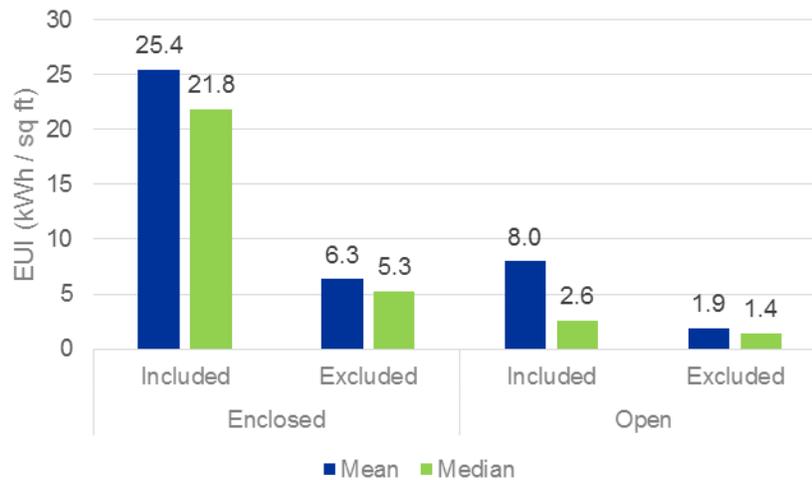


Figure 2 – EUI by Property and Meter Type

Specifically, 89% of the data set is classified as Open Air centers, and though both property and meter type impact EUI, the property type has the most substantial impact. Mean EUI for Enclosed centers is 17.0 kWh / sq ft whereas mean EUI for Open Air centers is significantly lower, or 2.2 kWh / sq ft. Of these four sub-groupings, the highest mean EUI is 25.4 kWh / sq ft, for Enclosed centers that include tenant data. The lowest mean EUI is 1.4 kWh / sq ft, for Open Air centers that exclude tenant data.

## Comparison to External Benchmarks

### COMMERCIAL BUILDINGS ENERGY CONSUMPTION SURVEY (CBECS)

CBECS, sponsored by the U.S. Department of Energy's Energy Information Administration, provides information on the stock of US commercial buildings, including energy-related building characteristics and energy usage data.<sup>6</sup> In addition to total energy EUI, CBECS also provides electricity intensity data, which provides a good proxy for performance as electricity represents the vast majority of energy data submitted by respondents to the ICSC survey. The 2003 CBECS survey, the most recent for which data is publicly available, reported data for enclosed and strip mall properties in the United States constituting more than 6.8 billion square feet. These buildings collectively utilized 153 billion kWh of electricity, with lighting representing the largest category (58 billion kWh) followed by cooling (25 billion kWh).

	ICSC		CBECS	ICSC		CBECS
<b>EUI (kWh / sq ft)</b>	<b>3.8</b>	<b>25.4</b>	<b>29.9</b>	<b>3.6</b>	<b>23.0</b>	<b>22.3<sup>1,2</sup></b>
<b>Property Type</b>	All (Enclosed & Open Air)	Enclosed, Incl. Tenant Usage	Enclosed & Strip Malls	All (Enclosed & Open Air)	Enclosed, Incl. Tenant Usage	Enclosed & Strip Malls
<b>Energy Type</b>	<i>Total energy<sup>3</sup></i>			<i>Electricity only</i>		
<b>Region</b>	Global (96% US)		US	Global (96% US)		US

<sup>6</sup> "Commercial buildings include all buildings in which at least half of the floor space is used for a purpose that is not residential, industrial, or agricultural. By this definition, CBECS includes building types that might not traditionally be considered commercial, such as schools, hospitals, correctional institutions, and buildings used for religious worship, in addition to traditional commercial buildings such as stores, restaurants, warehouses, and office buildings."

Table 3 - Mean EUI: Benchmarking to CBECS

As shown in Table 3, ICSC survey respondents reported a significantly lower mean EUI than CBECS reports when accounting for total energy (3.8 kWh / sq ft to 29.9 kWh / sq ft). However, removing Open Air respondents and focusing on Enclosed properties including tenant energy data, mean EUI jumps to 25.4 kWh / sq ft, or 17.0 kWh / sq ft when accounting for all enclosed properties both including and excluding tenant energy data.

ICSC survey respondents' electricity data parallels the conclusions arrived when comparing total energy EUI to the CBECS total energy benchmark. According to CBECS, electricity consumption intensity for enclosed and strip malls was 22.3 kWh / sq ft in 2003, approximately 50% larger than the 2003 average for all commercial buildings (14.9 kWh / sq ft). This is also 56% larger than the 2003 average for retail (other than mall) property types (14.3 kWh / sq ft), indicating shopping centers use more energy and are presumably less efficient than other retail, non-mall properties such as retail stores, liquor stores, rental centers, automobile dealerships, or studios / galleries.<sup>78</sup>

### ENERGY STAR

Median EUI can also be utilized to compare performance as it reflects the mid-point of energy use, and similar results to the mean analysis are demonstrated when comparing median ICSC respondent performance to median ENERGY STAR benchmarking.<sup>9</sup> In Table 4, ICSC respondents indicate a noticeably lower median EUI (1.6) compared to ENERGY STAR benchmarks (27.5 - 27.6 for various mall types) for retail mall property types. Removing Open Air properties and those excluding tenant energy data – thus incorporating partial data which may influence the final statistic – from the analysis results in a higher median EUI of 21.8.

	ICSC		ENERGY STAR	
<b>EUI (kWh / sq ft)</b>	<b>1.6</b>	<b>21.8</b>	<b>27.5</b>	<b>27.6</b>
<b>Property Type</b>	All (Enclosed & Open Air)	Enclosed, Included Tenant Usage	Enclosed Mall	Lifestyle, Strip and Other Malls
<b>Energy Type</b>	Total energy			
<b>Region</b>	Global (96% US)		US	

Table 4 - Median EUI: Benchmarking to ENERGY STAR

### GLOBAL REAL ESTATE SUSTAINABILITY BENCHMARK (GRESB)

As introduced above, the data collection spreadsheet included one particular question (“is energy consumption data available in a GRESB report?”) to determine other means of collecting energy data from the retail shopping center industry. Approximately 25% of all survey respondents (i.e., no exclusions) responded positively that they reported energy consumption data in a GRESB report, which provides information regarding the broader sustainability practices and progress of the global real estate market.<sup>10,11</sup> The 2015 GRESB Report, with 707 global GRESB participants representing \$2.3 trillion in property value and 61,000 assets (excluding single-family residential assets), illustrates that the real

<sup>7</sup> Source: Energy Information Administration, Office of Energy Markets and End Use, Form EIA-871A, C, and E of the 2003 Commercial Buildings Energy Consumption Survey, “2003 CBECS survey data, Consumption and Expenditures Table E6A,” data released September 2008, <http://www.eia.gov/consumption/commercial/data/2003/index.cfm?view=consumption#e1a>

<sup>8</sup> CBECS Principal Building Activity: Mercantile, Enclosed and Strip Malls

<sup>9</sup> Source: ENERGYSTAR, “DataTrends: Energy Use Benchmarking” Oct, 2012, <http://www.energystar.gov/buildings/facility-owners-and-managers/existing-buildings/use-portfolio-manager/understand-metrics/what-energy>

<sup>10</sup> “GRESB is widely recognized as the global standard for portfolio-level sustainability reporting in the real estate sector. In total, GRESB covers almost 1,000 listed property companies and private equity funds. More than 150 institutional investors, listed property companies and fund managers are subscribers to GRESB data.”

<sup>11</sup> GRESB, “2015 GRESB Report,” 2015, <https://gresb-public.s3.amazonaws.com/content/2015-GRESB-Report.pdf>.

estate industry has improved its sustainability performance, particularly in regards to energy consumption.<sup>12</sup>

100% of GRESB respondents maintain environmental policies including energy consumption / management. Energy reduction initiatives are largely focused on the demand side, as the use of energy efficiency measures increased from 78% in 2014 to 85% in 2015. In 2014, most participants focused on lighting upgrades and replacements as well as HVAC upgrades; however, respondents have widened their approach in 2015, with methods including:

- Installation of high-efficiency equipment: 57%
- Building energy management: 36%
- Systems commissioning: 35%
- Wall/roof insulation: 23%
- Building automation system upgrades / replacements: 22%
- Other: 12%

Though less widely utilized than energy efficiency, from an energy supply perspective, GRESB respondents generating or consuming renewable energy, in any form, increased from 27% to 33%.

From an energy management system standpoint, 61% (up from 46% in 2014) of GRESB respondents utilize an Environmental Management System (EMS) to bolster their sustainability and energy management, and 78% (same as 2014) use data management systems to collect and enable analysis of performance data. Nearly all (99%) of the utilized data management systems cover energy consumption data and 88% include greenhouse gas (GHG) emissions data.

More specifically related to this report's shopping center respondents, both the 2014 and 2015 GRESB reports indicated a 3% average reduction in energy consumption year-over-year for the Retail Shopping Centers sector. Alternatively, respondents to the ICSC survey indicated a slightly lower, 0.05% average reduction in global energy consumption.<sup>13</sup>

---

<sup>12</sup> The 2015 GRESB Report includes aggregated data from 707 respondents, including 155 real estate companies and investment funds centered in North America, 380 in Europe, 104 in Asia, 47 in Australia/NZ, 10 in South Africa, 4 in Africa and seven globally diversified

<sup>13</sup> Electricity consumption data only, 2013 to 2014

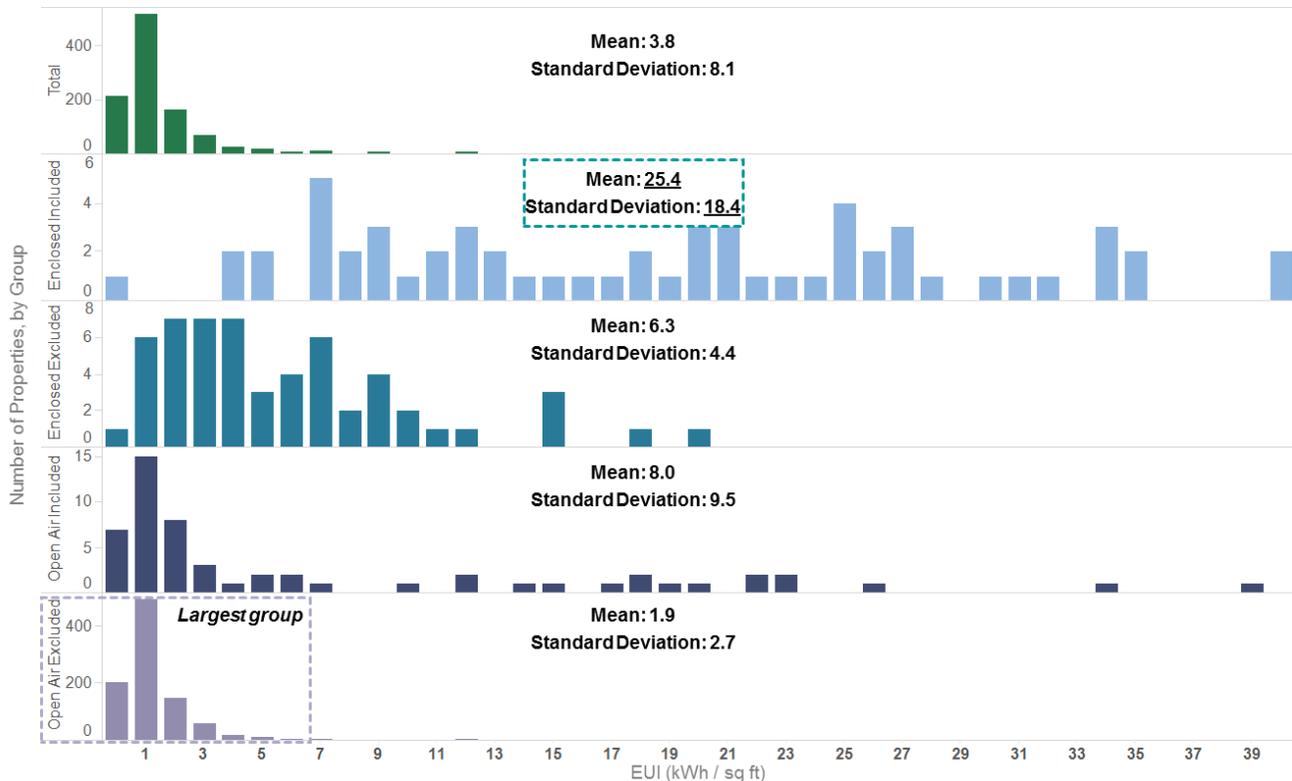
# UNCOVERED IMPROVEMENT OPPORTUNITIES

## Variation

While a number of properties have displayed below average mean EUIs, the large variances of the four property sub-groups point the potential for improvement. The standard deviation and variance of each of the four sub-groups were determined and examined to determine the uncertainty of mean EUIs. Factors that contribute to a more or less precise estimate include the number of properties submitted in each property group and how similar the energy data was for properties in the same group. Where energy use was very similar, a more precise estimate was able to be provided.

The standard deviation is also an indicator of the spread of the data, which can be interpreted as the opportunity for improvement of various properties. If the standard deviation is large, the mean EUIs of individual properties vary significantly. This indicates that properties with similar characteristics are achieving different levels of energy conservation. Similarly, there is a likely opportunity for below-average properties (i.e., those with higher EUIs than the average) to save money, electricity and carbon emissions because similarly categorized sites, which are performing at a higher level, provide examples of the potential for properties in that category to improve performance.

Figure 2 contains histograms of the respondents broken down by the four property and meter type groups, displaying the variation inherent in each (each bar represents a group of facilities at a particular mean EUI). These represent more or less energy intensity, compared to the majority of properties in these sub-groupings of property characteristics. As observed, Enclosed Included properties have the highest standard deviation (18.4), presenting the greatest likelihood for improvement across the sub-group.



Similarly, with a standard deviation of 9.5, the long, right-sided tail of the Open Air Included histogram indicates a number of below-average performing properties. While these two types of properties exhibit

Figure 3 – Histograms of respondents EUIs by property and meter type group

the largest variance, and smaller group sizes and / or inaccurate data could influence these high level observations, all sub-groups show the likely opportunity for improvement. Even with the smallest standard deviation (2.7), the Open Air Excluded property sub-group still has a significant number of properties to the right of the mean.

## Comparison to Mean Performance

The potential for improvement of a below-average property (i.e., those with higher EUIs than the average), to the mean or better, results in real savings both from a financial and environmental perspective. To demonstrate this potential, a conservative improvement opportunity was examined for an average property in the bottom quartile (Q3) of electricity EUIs.<sup>14</sup> The opportunity for savings was determined by simulating an improvement in EUI from the third quartile to the mean EUI, for any one average property across each of the four property and meter type groups.<sup>15</sup> Figure 4 displays the spread of the quartiles for each group to help visualize the potential improvement from below-average properties on the right to higher performing properties on the left.

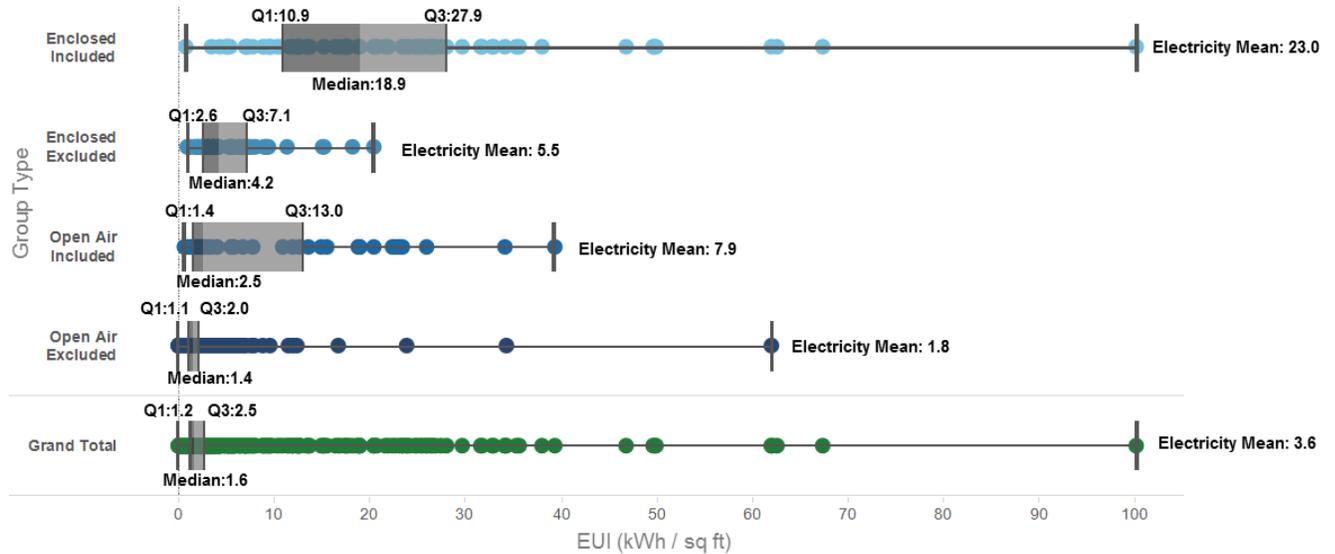


Figure 4 – Box and whiskers plot displaying quartiles and means of each property and meter type group

<sup>14</sup> In this section all EUIs are for electricity data only to allow for cost and emission savings calculations. The EUI is calculated as electricity usage (kWh) divided by GLA (sq ft)

<sup>15</sup> For the analysis of this report a hypothetical improvement is examine from the third-quartile (Q3) to the mean

An improvement in Q3 EUI to mean EUI for each group equates to the opportunity for significant savings when considering the average size of the respondent shopping centers. Table 4 displays the average GLA for each of the four sub-groups, as well as the average savings per property in terms of electricity (kWh), operating cost (\$) and emissions (CO<sub>2</sub> equivalent, tons) for a site improving from the bottom quartile of performers to the mean. The average electricity usage savings was calculated by determining the difference in the third-quartile and mean performers (kWh / sq ft) and multiplying it by the average GLA for each group. The average cost savings was determined by multiplying the electricity savings by the average cost of electricity in the U.S.<sup>16</sup> Lastly, the average carbon emissions savings was calculated by multiplying the electricity savings (kWh) by the average emissions factor (lbs / kWh) for electricity in the U.S.<sup>17</sup>

Due to its large variance, an Enclosed site with tenant data included performing in the bottom quartile of properties has the ability to save over \$300,000 in cost and 1,500 tons of CO<sub>2</sub>e per year by improving its performance to the mean EUI for its respective sub-group. The improvement opportunity is evident across all groups, particularly for Open Air Included and Enclosed Excluded properties. Furthermore, if properties are able to improve their energy efficiency and renewable energy (energy demand and supply) policies and practices to reach to top quartile of performers compared to the bottom quartile, the potential savings would be more than 3x the savings expressed in Table 5.

Annual Opportunity	Enclosed Properties		Open Air Properties	
	Included	Excluded	Included	Excluded
Average GLA (sq ft)	565,240	532,840	230,260	171,000
Average Energy Savings (kWh)	2,786,410	868,480	1,184,610	33,940
Average Savings (\$/year)	\$ 303,720	\$ 94,660	\$ 129,120	\$ 3,700
Average CO <sub>2</sub> e Savings (Tons/year)	1,591	496	676	19

Table 5 – Savings in energy, dollars and CO<sub>2</sub>e due to improvement from Q3 to mean

## State Electricity

The return on an investment is often a key consideration and metric when considering a new energy strategy or investment. To demonstrate how the performance of various properties may vary across the United States, electricity EUI was compared to the average cost of electricity of each state. As illustrated in Figure 5 below, in states with a higher cost of electricity, there is a greater likelihood for a positive return on investment and thus, a greater incentive to reduce a property's electricity EUI. And for this analysis, the electricity EUI was utilized rather than the overall EUI of the sites as the vast majority of survey data was reported as electricity usage with minimal other fuels reported. Furthermore, average electricity costs are on a state-by-state basis are readily available.

<sup>16</sup> Average cost of electricity in the U.S. is 10.9 cents ([http://www.eia.gov/electricity/monthly/epm\\_table\\_grapher.cfm?t=epmt\\_5\\_6\\_a](http://www.eia.gov/electricity/monthly/epm_table_grapher.cfm?t=epmt_5_6_a))

<sup>17</sup> The average emissions factor for electricity in the U.S. is 1.14 lbs / kWh ([http://oaspub.epa.gov/powpro/ept\\_pack.charts](http://oaspub.epa.gov/powpro/ept_pack.charts))

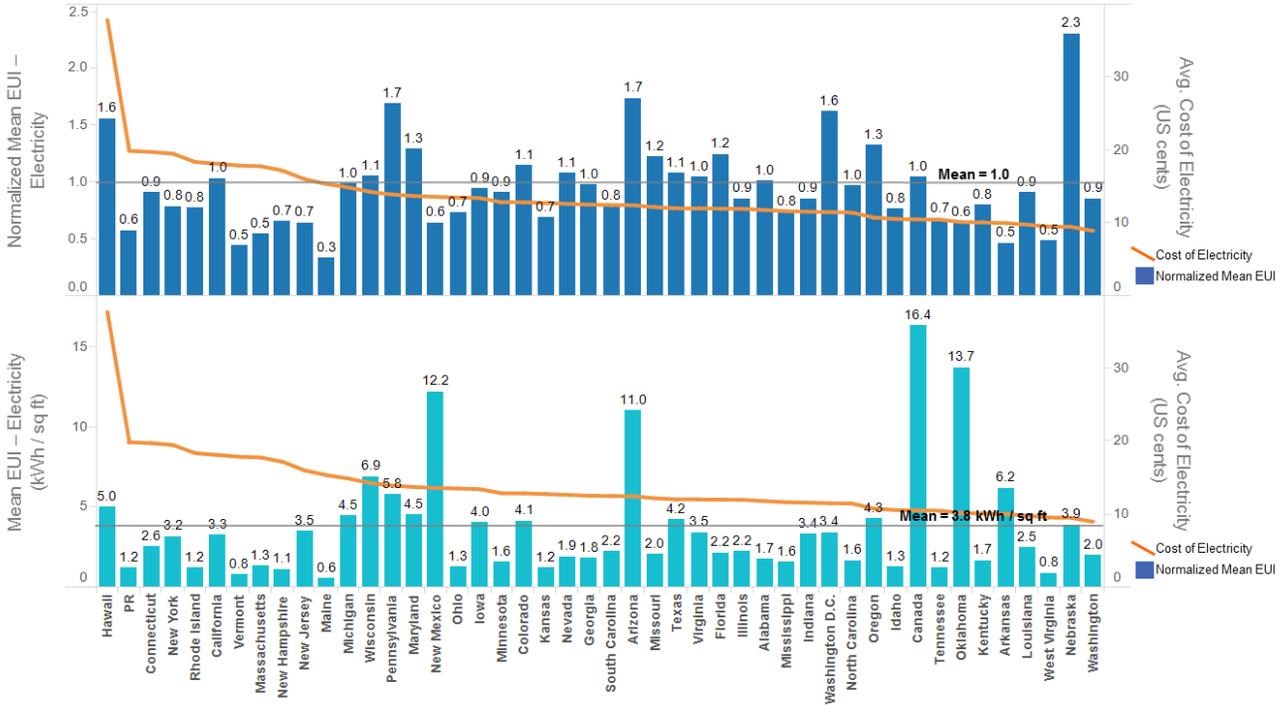


Figure 5 - EUI (Electricity) Compared to State Average Electricity Cost

In addition, each site's electricity EUI was normalized to compare the performance on a state-by-state basis without bias in regards to site property and meter type. Each property's electricity EUI (kWh) was divided by the mean electricity EUI (kWh) of its property and meter type sub-group to create a unit-less measurement of its performance (represented by the top chart in Figure 4). This unit-less measurement indicates a site's performance compared to similar sites. With an average performance of 1 for all properties, values greater than 1 indicate a less-than-average performing state and values below 1 indicate a better-than-average performing state. Figure 4 displays the normalized electricity EUIs on the same plot as the average cost of electricity by state. The bottom half of Figure 4 is the same plot, however, here the light blue bars represent the average electricity EUI (kWh / sq ft) for each state. In general, the normalized electricity EUI is lower in states with higher average electricity costs, (e.g., Vermont and Maine) indicating better performing states and a likelihood of a greater return on investment on energy conservation investments compared to states with cheaper electricity costs. Taking this simplified comparison approach, it thus appears that there is greater potential for savings in states with high electricity costs, and below-average performing properties in these regions can reviews the various energy supply and demand investments at their disposal to reduce their energy use and intensity.

# APPENDIX

## CLIMATE ZONE MAPPING

Climate is another factor influencing energy use in retail shopping centers. To further breakdown and analyze the respondent properties, each property was mapped to an ASHRAE climate zone using each property's zip code and location.<sup>18</sup> Properties that did not report zip codes or reported incorrect zip codes were excluded. Similarly, international properties that could not be mapped to a climate zone were not included in the analysis.<sup>19</sup>

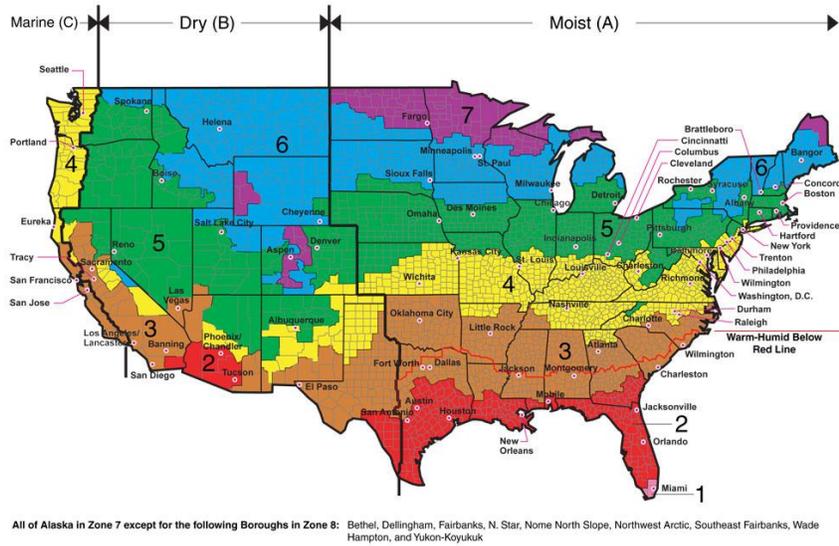


Figure 6 – ASHRAE Climate Zones

ASHRAE's climate zones range from one to eight, although survey respondents only mapped to the first 7 zones. Lower climate zones indicate warmer climates, whereas higher climate zones indicate cooler climates. Figure 6 shows the location of ASHRAE climate zones across the United States, which encapsulates the overarching majority of properties included in this analysis. International properties matching an ASHRAE supplied climate zone were also included in the analysis.

Through climate zones, property space type and meter type, 28 new property sub-groups were distinguished and individually analyzed. Figure 7 shows the mean EUI for each of these 28 groups, distinguishing their property and meter type group by color. Further detail into the characteristics of each of these 28 sub-groups (e.g., Group 1: ASHRAE Climate Zone 1, Tenants Included, Enclosed) is provided at the end of this report in Table 9.



Figure 7 - Mean EUI by Property Group

Figure 6 highlights that Group 25 in climate zone 7 (very cold) reported the highest mean EUI (33.7) likely due to large heating and lighting needs, while Group 3 in climate zone 1 (hot) and Group 24 in climate

<sup>18</sup> American Society of Heating, Refrigerating and Air-Conditioning Engineers

<sup>19</sup> ASHRAE only lists international climate zones for particular cities ([https://www.ashrae.org/File%20Library/docLib/Public/20081111\\_CZTables.pdf](https://www.ashrae.org/File%20Library/docLib/Public/20081111_CZTables.pdf))

zone 6 (cold, humid/dry) reported the lowest mean EUI (1.2). Examining the climate zones, zone 1 (very hot, humid/dry) centers reported the lowest mean EUIs for any climate zone, likely due to the majority being Open Air, as Open Air shopping centers exhibit a much lower mean EUI (2.2) than Enclosed centers (17.0). Similarly, properties that excluded tenant loads reported a lower mean EUI (2.1) compared to centers that included tenant energy use (17.7).

### Additional Sub-Group Analysis by Climate Zone, Property Type and Meter Configuration

The following provides a description and analysis for each of the 28 property sub-groups, which benchmarks the EUI for any property within that category. The analysis includes a chart under each group, which allows property stakeholders to visually compare their square footage and energy usage to other properties in that property group. A table of property group definitions, as well as the number of included and excluded properties, can be found at the end of this appendix (Figure 8 on page 28).

#### Group 1, ASHRAE Climate Zone 1, Tenants Included, Enclosed (0 properties)

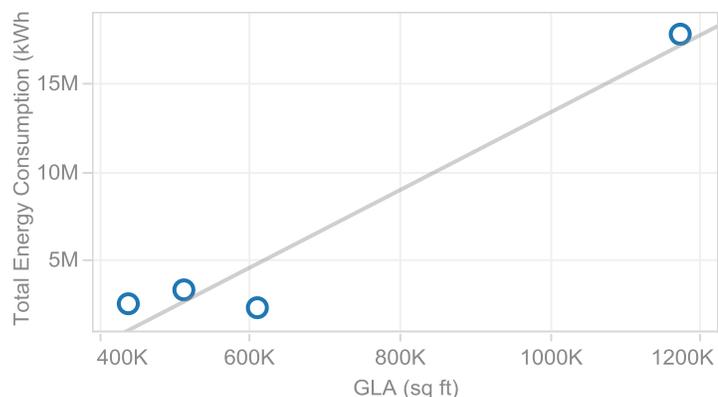
One property responded to the survey, but it was excluded due to incomplete data. No conclusions were drawn about this property type.

#### Group 2, ASHRAE Climate Zone 1, Tenants Excluded, Enclosed (4 properties)

**Mean EUI – 7.7 kWh / sq ft**

##### PROPERTY GROUP DESCRIPTION / ANALYSIS

Properties in this property group are located in ASHRAE Climate Zone 1, which indicates a very hot climate dominated by cooling loads nearly year round. Since properties in this group are enclosed and have excluded tenant energy use, the majority of the energy consumption is likely related to cooling the common areas in the shopping center.



The average EUI of an enclosed shopping center, excluding tenant energy usage, in this hot climate zone is 7.7 kWh / sq ft. While the large number of cooling days required for the enclosed space increases the mean EUI, the exclusion of the tenants' consumptions dramatically reduces the energy usage compared to similar property groups. Four properties were included in the final data set for this group.

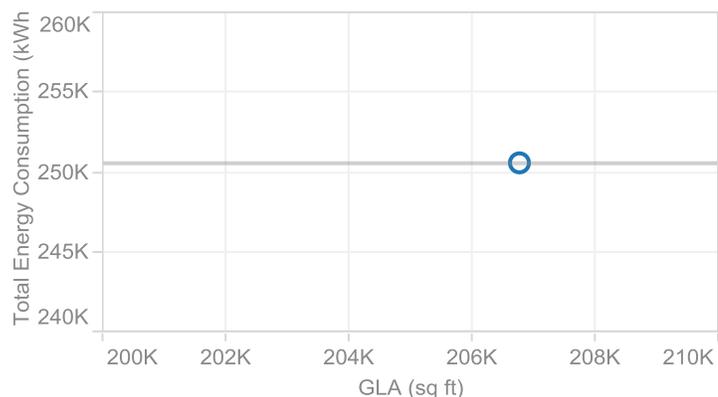
##### CERTAINTY

The 95% confidence interval is from 2.6 kWh / sq ft to 12.8 kWh / sq ft.

#### Group 3, ASHRAE Climate Zone 1, Tenants Included, Open Air (1 property)

**Mean EUI – 1.2 kWh / sq ft**

##### PROPERTY GROUP DESCRIPTION / ANALYSIS



Properties in this property group are located in ASHRAE Climate Zone 1, which indicates a very hot climate dominated by cooling loads nearly year round. Since properties in this group are open air and have included tenant energy use, the majority of the energy consumption is likely related to cooling the tenants in the shopping center.

The average EUI of an open air shopping center in an extremely hot climate, including tenant energy usage is 1.2 kWh / sq ft. The property group has a surprisingly low EUI for including tenant data; however, open air centers do often have low EUIs. One property was included in this group.

**CERTAINTY**

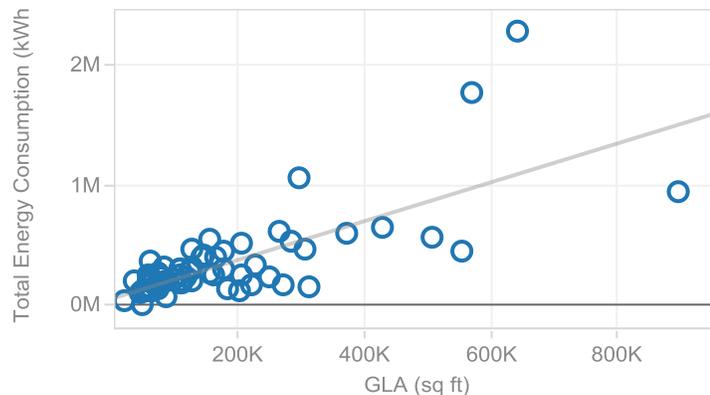
Only one property was submitted in this property group, therefore strong conclusions cannot be drawn and no confidence interval can be determined.

**Group 4, ASHRAE Climate Zone 1, Tenants Excluded, Open Air (63 properties)**

**Mean EUI – 2.2 kWh / sq ft**

**PROPERTY GROUP DESCRIPTION / ANALYSIS**

Properties in this property group are located in ASHRAE Climate Zone 1, which indicates a very hot climate dominated by cooling loads nearly year round. Since properties in this group are open air and have excluded tenant energy use, the majority of the energy consumption is likely related to lighting the external common areas.



The average EUI of an open air shopping center in an extremely hot climate, excluding tenant energy usage is 2.2 kWh / sq ft. The property group has a very low EUI as it likely requires minimal cooling and no heating loads. 63 properties were included in this group.

**CERTAINTY**

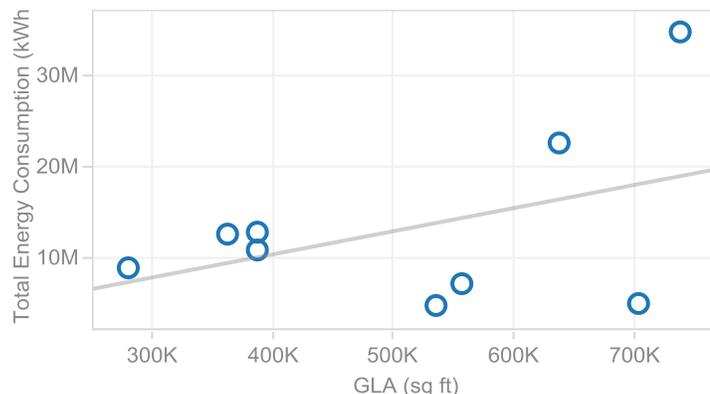
The 95% confidence interval is from 1.9 kWh / sq ft to 2.4 kWh / sq ft.

**Group 5, ASHRAE Climate Zone 2, Tenants Included, Enclosed (9 properties)**

**Mean EUI – 26.5 kWh/ sq ft**

**PROPERTY GROUP DESCRIPTION / ANALYSIS**

Properties in this property group are located in ASHRAE Climate Zone 2, which indicates a hot climate dominated by cooling loads nearly year round. Since properties in this group are enclosed and have included tenant energy use, the energy consumption is likely high due to cooling the common areas and tenants in the shopping center.



The average EUI of an enclosed shopping center in a hot climate, including tenant energy usage is 26.5 kWh / sq ft. The large number of cooling days required for the enclosed space, and the inclusion of the

tenants' consumptions dramatically increases the energy usage compared to similar property groups. Nine properties were included in this group.

#### CERTAINTY

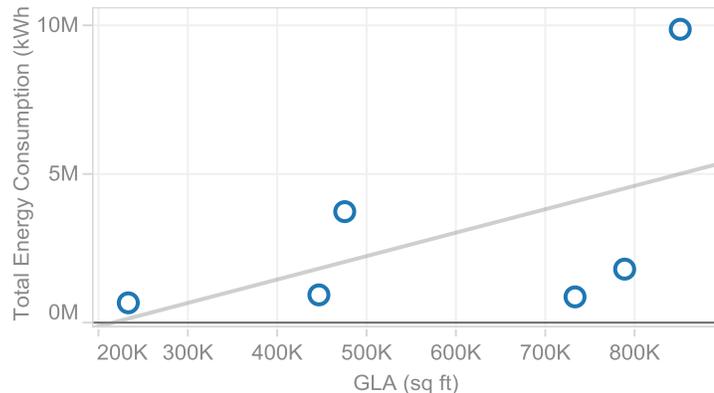
The 95% confidence interval is from 17.3 kWh / sq ft to 35.6 kWh / sq ft.

### Group 6, ASHRAE Climate Zone 2, Tenants Excluded, Enclosed (6 properties)

**Mean EUI – 4.6 kWh / sq ft**

#### PROPERTY GROUP DESCRIPTION / ANALYSIS

Properties in this property group are located in ASHRAE Climate Zone 2, which indicates a hot climate dominated by cooling loads nearly year round. Since properties in this group are enclosed and have excluded tenant energy use, the majority of the energy consumption is likely related to cooling the common areas in the shopping center.



The average EUI of an enclosed shopping center in a hot climate, excluding tenant energy usage is 4.6 kWh / sq ft. While the large number of cooling days required for the enclosed space increase the overall EUI, the exclusion of the tenants' consumptions dramatically reduces the energy usage compared to similar property groups. Six properties were included in this group.

#### CERTAINTY

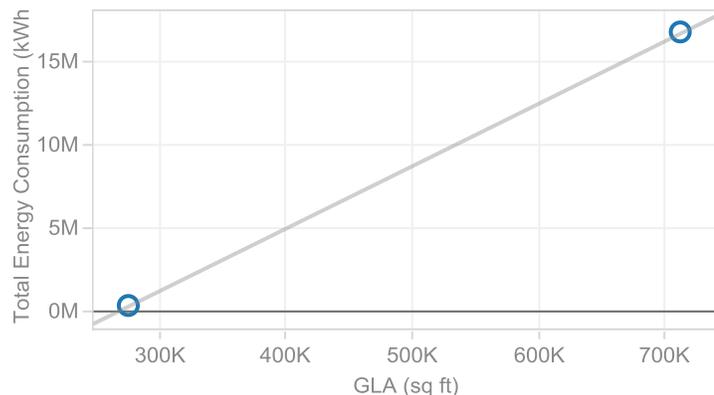
The 95% confidence interval is from 1.2 kWh / sq ft to 7.9 kWh / sq ft.

### Group 7, ASHRAE Climate Zone 2, Tenants Included, Open Air (2 properties)

**Mean EUI – 12.2 kWh / sq ft**

#### PROPERTY GROUP DESCRIPTION / ANALYSIS

Properties in this property group are located in ASHRAE Climate Zone 2, which indicates a hot climate dominated by cooling loads nearly year round. Since properties in this group are open air and have included tenant energy use, the majority of the energy consumption is likely related to cooling the tenants in the shopping center.



The average EUI of an open air shopping center in a hot climate, including tenant energy usage is 12.2 kWh / sq ft. While the property is open air, the inclusion of tenant's energy use dramatically increases the EUI. Two properties were included in this group.

#### CERTAINTY

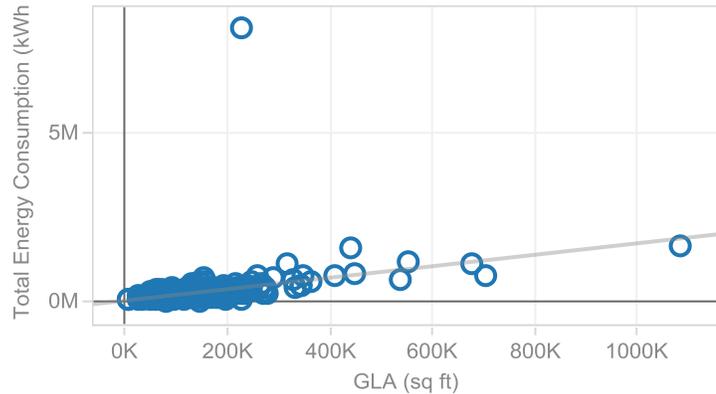
Only two properties were submitted in this property group, therefore strong conclusions cannot be drawn. The 95% confidence interval is from -10.1 kWh / sq ft to 34.6 kWh / sq ft.

**Group 8, ASHRAE Climate Zone 2, Tenants Excluded, Open Air (209 properties)**

**Mean EUI – 2.0 kWh / sq ft**

**PROPERTY GROUP DESCRIPTION / ANALYSIS**

Properties in this property group are located in ASHRAE Climate Zone 2, which indicates a hot climate dominated by cooling loads nearly year round. Since properties in this group are open air and have excluded tenant energy use, the majority of the energy consumption is likely related to lighting the external common areas.



The average EUI of an open air shopping center in a hot climate, excluding tenant energy usage is 2.0 kWh / sq ft. The property group has a very low EUI as it likely requires minimal cooling and no heating loads. 209 properties were included in this group.

**CERTAINTY**

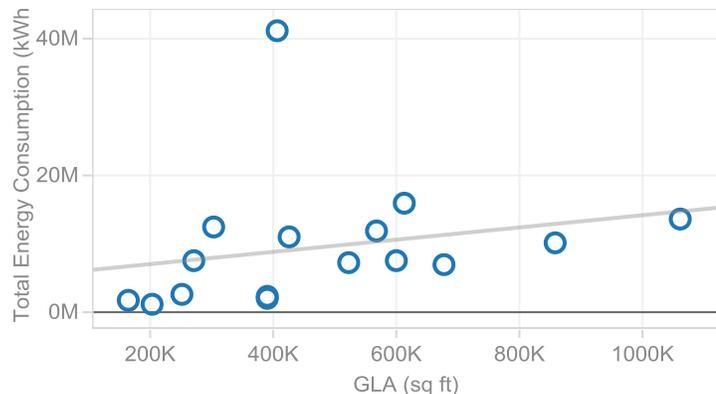
The 95% confidence interval is from 1.7 kWh / sq ft to 2.4 kWh / sq ft.

**Group 9, ASHRAE Climate Zone 3, Tenants Included, Enclosed (16 properties)**

**Mean EUI – 20.8 kWh / sq ft**

**PROPERTY GROUP DESCRIPTION / ANALYSIS**

Properties in this property group are located in ASHRAE Climate Zone 3, which indicates a warm climate dominated by cooling loads part of the year. Since properties in this group are enclosed and have included tenant energy use, the energy consumption is likely due to cooling the common areas and tenants in the shopping center.



The average EUI of an enclosed shopping center in a warm climate, including tenant energy usage is 20.8 kWh / sq ft. The large number of cooling days required for the enclosed space, and the inclusion of the tenants' consumptions dramatically increases the energy usage compared to similar property groups. 16 properties were included in this group.

**CERTAINTY**

The 95% confidence interval is from 9.1 kWh / sq ft to 32.5 kWh / sq ft.

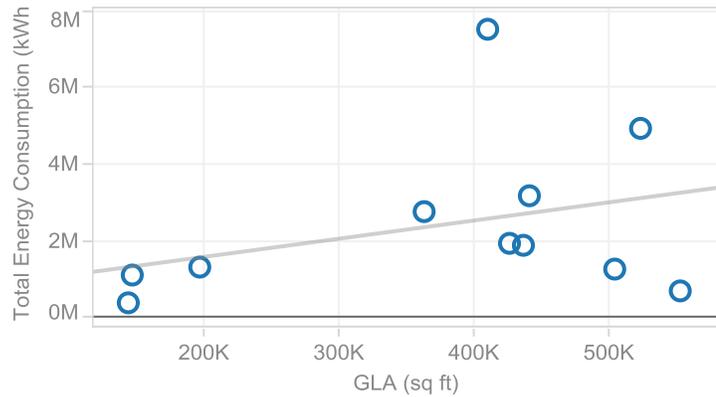
**Group 10, ASHRAE Climate Zone 3, Tenants Excluded, Enclosed (11 properties)**

**Mean EUI – 6.4 kWh / sq ft**

**PROPERTY GROUP DESCRIPTION / ANALYSIS**

Properties in this property group are located in ASHRAE Climate Zone 3, which indicates a warm climate dominated by cooling loads part of the year. Since properties in this group are enclosed and have excluded tenant energy use, the majority of the energy consumption is likely related to cooling the common areas in the shopping center.

The average EUI of an enclosed shopping center in a warm climate, excluding tenant energy usage is 6.4 kWh / sq ft. While the large number of cooling days required for the enclosed space increase the overall EUI, the exclusion of the tenants' consumptions dramatically reduces the energy usage compared to similar property groups. 11 properties were included in this group.



**CERTAINTY**

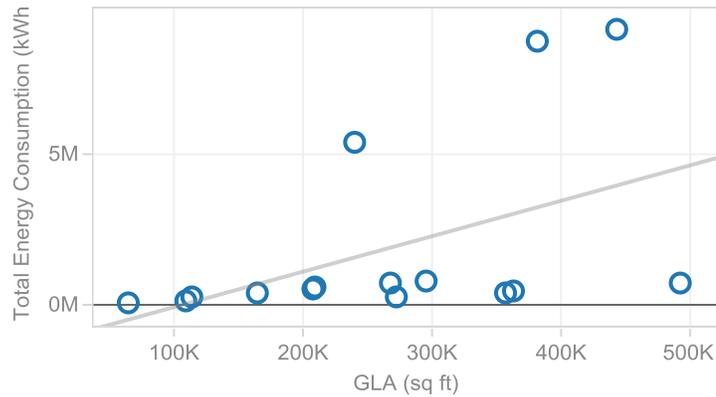
The 95% confidence interval is from 3.6 kWh / sq ft to 9.3 kWh / sq ft.

**Group 11, ASHRAE Climate Zone 3, Tenants Included, Open Air (15 properties)**

**Mean EUI – 5.7 kWh / sq ft**

**PROPERTY GROUP DESCRIPTION / ANALYSIS**

Properties in this property group are located in ASHRAE Climate Zone 3, which indicates a warm climate dominated by cooling loads part of the year. Since properties in this group are open air and have included tenant energy use, the majority of the energy consumption is likely related to cooling the tenants in the shopping center.



The average EUI of an open air shopping center in a warm climate, including tenant energy usage is 5.7 kWh / sq ft. While the property is open air, the inclusion of tenant's energy use dramatically increases the EUI. 15 properties were included in this group.

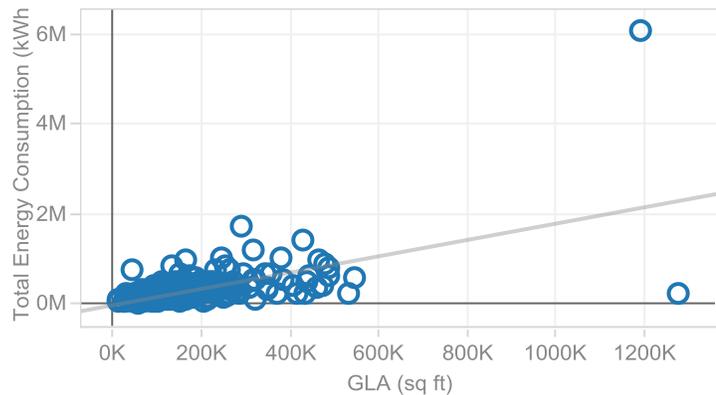
**CERTAINTY**

The 95% confidence interval is from 1.4 kWh / sq ft to 10.0 kWh / sq ft.

**Group 12, ASHRAE Climate Zone 3, Tenants Excluded, Open Air (246 properties)**

**Mean EUI – 1.8 kWh / sq ft**

**PROPERTY GROUP DESCRIPTION / ANALYSIS**



Properties in this property group are located in ASHRAE Climate Zone 3, which indicates a warm climate dominated by cooling loads part of the year. Since properties in this group are open air and have excluded tenant energy use, the majority of the energy consumption is likely related to lighting the external common areas.

The average EUI of an open air shopping center in a warm climate, excluding tenant energy usage is 1.8 kWh / sq ft. The property group has a very low EUI as it likely requires minimal cooling and no heating loads. 246 properties were included in this group.

**CERTAINTY**

The 95% confidence interval is from 1.6 kWh / sq ft to 1.9 kWh / sq ft.

**Group 13, ASHRAE Climate Zone 4, Tenants Included, Enclosed (13 properties)**

**Mean EUI – 25.4 kWh / sq ft**

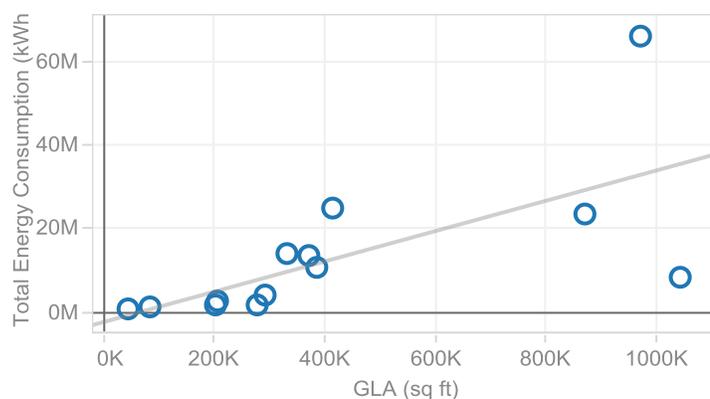
**PROPERTY GROUP DESCRIPTION / ANALYSIS**

Properties in this property group are located in ASHRAE Climate Zone 4, which indicates a mixed (both warm and cool) climate. Since properties in this group are enclosed and have included tenant energy use, the energy consumption is likely due to moderating temperatures in the common areas and tenants in the shopping center.

The average EUI of an enclosed shopping center in a mixed climate, including tenant energy usage is 25.4 kWh / sq ft. The required energy to moderate temperatures in the enclosed space, and the inclusion of the tenants’ consumptions dramatically increases the energy usage compared to similar property groups. 13 properties were included in this group.

**CERTAINTY**

The 95% confidence interval is from 14.2 kWh / sq ft to 36.7 kWh / sq ft.

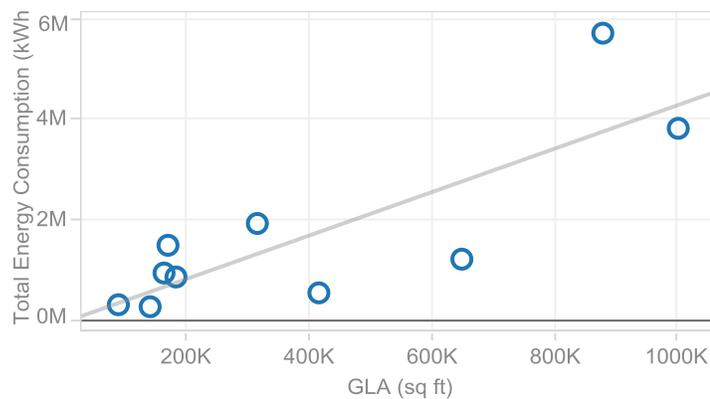


**Group 14, ASHRAE Climate Zone 4, Tenants Excluded, Enclosed (10 properties)**

**Mean EUI – 4.3 kWh / sq ft**

**PROPERTY GROUP DESCRIPTION / ANALYSIS**

Properties in this property group are located in ASHRAE Climate Zone 4, which indicates a mixed (both warm and cool) climate. Since properties in this group are enclosed and have excluded tenant energy use, the energy consumption is likely due to moderating temperatures in the common areas in the shopping center.



The average EUI of an enclosed shopping center in a mixed climate, excluding tenant energy usage is 4.3 kWh / sq ft. While the required energy to moderate temperatures for the enclosed space increases the overall EUI, the exclusion of the tenants' consumptions dramatically reduces the energy usage compared to similar property groups. Ten properties were included in this group.

**CERTAINTY**

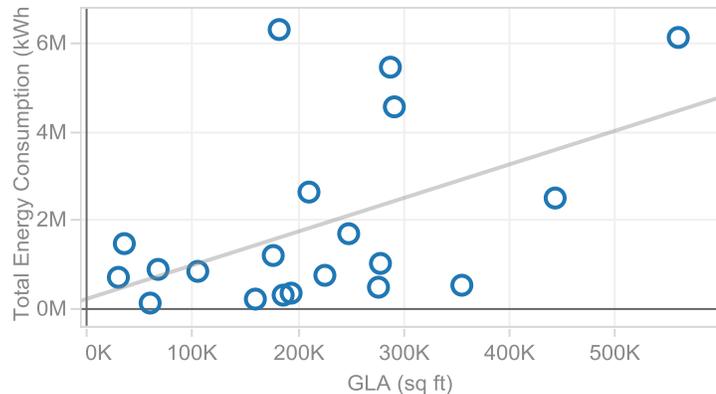
The 95% confidence interval is from 2.8 kWh / sq ft to 5.8 kWh / sq ft.

**Group 15, ASHRAE Climate Zone 4, Tenants Included, Open Air (20 properties)**

**Mean EUI – 10.5 kWh / sq ft**

**PROPERTY GROUP DESCRIPTION / ANALYSIS**

Properties in this property group are located in ASHRAE Climate Zone 4, which indicates a mixed (both warm and cool) climate. Since properties in this group are open air and have included tenant energy use, the energy consumption is likely due to moderating temperatures in the tenants in the shopping center.



The average EUI of an open air shopping center in a mixed climate, including tenant energy usage is 10.5 kWh / sq ft. While the space is open air, which reduces the overall EUI, the inclusion of tenant loads increases the EUI compared to similar property groups. 20 properties were included in this group.

**CERTAINTY**

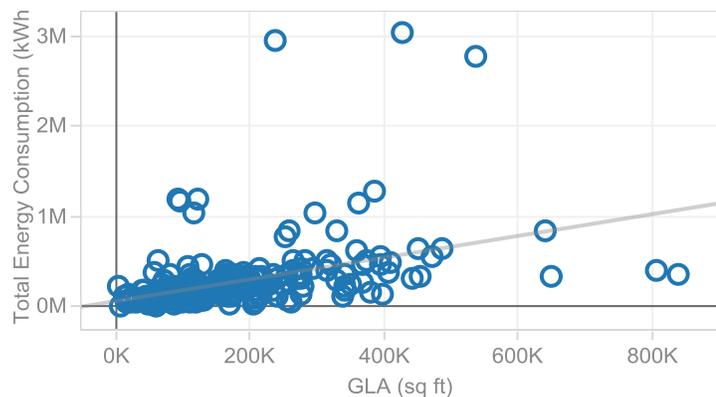
The 95% confidence interval is from 5.6 kWh / sq ft to 15.4 kWh / sq ft.

**Group 16, ASHRAE Climate Zone 4, Tenants Excluded, Open Air (239 properties)**

**Mean EUI – 2.0 kWh / sq ft**

**PROPERTY GROUP DESCRIPTION / ANALYSIS**

Properties in this property group are located in ASHRAE Climate Zone 4, which indicates a mixed (both warm and cool) climate. Since properties in this group are open air and have excluded tenant energy use, the energy consumption is likely due to lighting the exterior common areas.



The average EUI of an open air shopping center in a mixed climate, excluding tenant energy usage is 2.0 kWh / sq ft. The space is open air and does not include tenant. Thus, the resulting EUI is very low compared to similar property groups. 239 properties were included in this group.

**CERTAINTY**

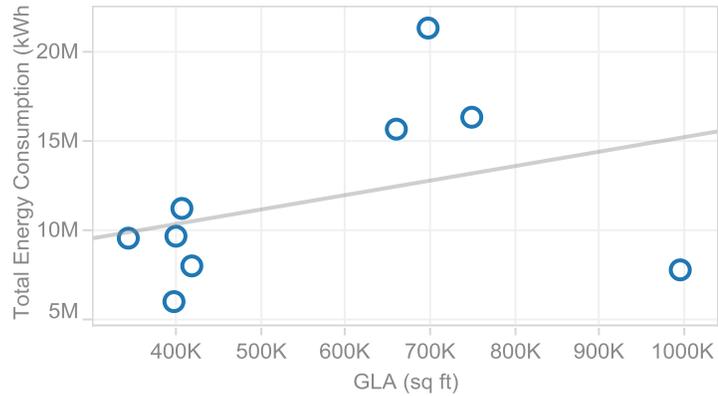
The 95% confidence interval is from 1.5 kWh / sq ft to 2.6 kWh / sq ft.

**Group 17, ASHRAE Climate Zone 5, Tenants Included, Enclosed (9 properties)**

**Mean EUI – 21.9 kWh / sq ft**

**PROPERTY GROUP DESCRIPTION / ANALYSIS**

Properties in this property group are located in ASHRAE Climate Zone 5, which indicates a cool climate dominated by heating loads part of the year. Since properties in this group are enclosed and have included tenant energy use, the energy consumption is likely due to heating the common areas and tenants in the shopping center.



The average EUI of an enclosed shopping center in a cool climate, including tenant energy usage is 21.9 kWh / sq ft. The large number of heating days required for the enclosed space, and the inclusion of the tenants' consumptions dramatically increases the energy usage compared to similar property groups. Nine properties were included in this group.

**CERTAINTY**

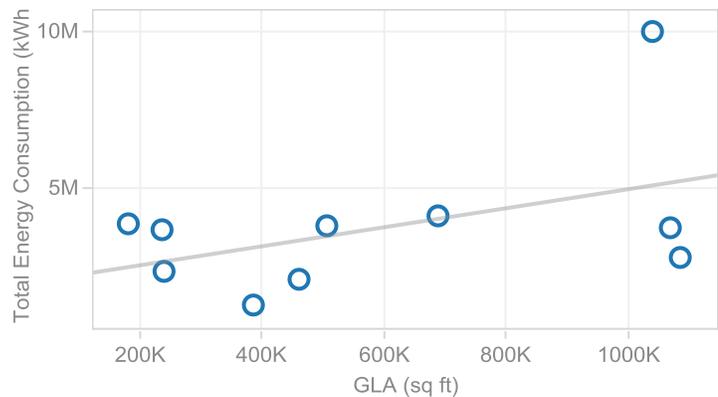
The 95% confidence interval is from 17.2 kWh / sq ft to 26.6 kWh / sq ft.

**Group 18, ASHRAE Climate Zone 5, Tenants Excluded, Enclosed (10 properties)**

**Mean EUI – 8.2 kWh / sq ft**

**PROPERTY GROUP DESCRIPTION / ANALYSIS**

Properties in this property group are located in ASHRAE Climate Zone 5, which indicates a cool climate dominated by heating loads part of the year. Since properties in this group are enclosed and have excluded tenant energy use, the majority of the energy consumption is likely related to heating the common areas in the shopping center.



The average EUI of an enclosed shopping center in a warm climate, excluding tenant energy usage is 8.2 kWh / sq ft. While the large number of heating days required for the enclosed space increase the overall EUI, the exclusion of the tenants' consumptions dramatically reduces the energy usage compared to similar property groups. Ten properties were included in this group.

**CERTAINTY**

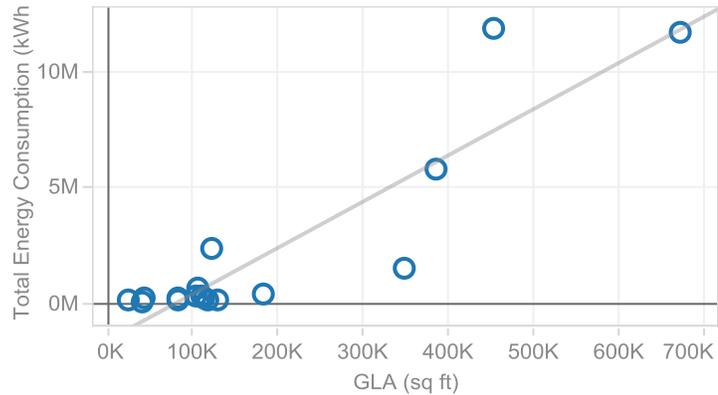
The 95% confidence interval is from 4.5 kWh / sq ft to 11.9 kWh / sq ft.

**Group 19, ASHRAE Climate Zone 5, Tenants Included, Open Air (17 properties)**

**Mean EUI – 6.2 kWh / sq ft**

**PROPERTY GROUP DESCRIPTION / ANALYSIS**

Properties in this property group are located in ASHRAE Climate Zone 5, which indicates a cool climate dominated by heating loads part of the year. Since properties in this group are open air and have included tenant energy use, the majority of the energy consumption is likely related to heating the tenants in the shopping center.



The average EUI of an open air shopping center in a cool climate, including tenant energy usage is 6.2 kWh / sq ft. While the property is open air, the inclusion of tenant's energy use dramatically increases the EUI. 17 properties were included in this group.

**CERTAINTY**

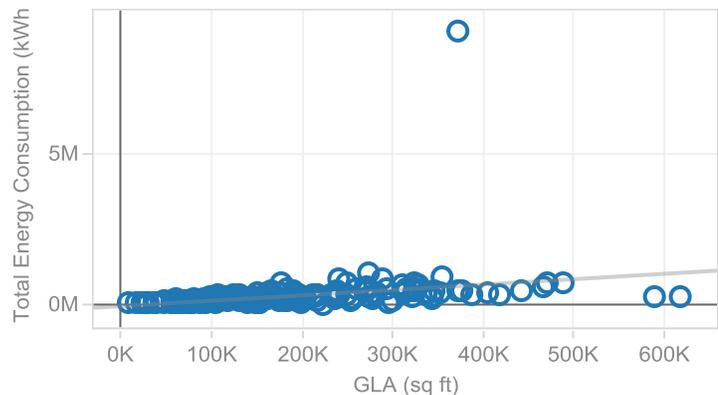
The 95% confidence interval is from 2.4 kWh / sq ft to 10.0 kWh / sq ft.

**Group 20, ASHRAE Climate Zone 5, Tenants Excluded, Open Air (179 properties)**

**Mean EUI – 1.5 kWh / sq ft**

**PROPERTY GROUP DESCRIPTION / ANALYSIS**

Properties in this property group are located in ASHRAE Climate Zone 5, which indicates a cool climate dominated by heating loads part of the year. Since properties in this group are open air and have excluded tenant energy use, the majority of the energy consumption is likely related to lighting the external common areas.



The average EUI of an open air shopping center in a cool climate, excluding tenant energy usage is 1.5 kWh / sq ft. The property group has a very low EUI as it does not requiring any heating or cooling loads. 179 properties were included in this group.

**CERTAINTY**

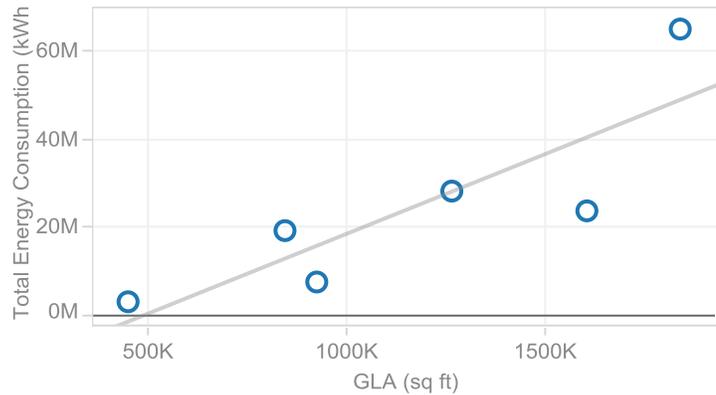
The 95% confidence interval is from 1.2 kWh / sq ft to 1.8 kWh / sq ft.

**Group 21, ASHRAE Climate Zone 6, Tenants Included, Enclosed (6 properties)**

**Mean EUI – 18.2 kWh / sq ft**

**PROPERTY GROUP DESCRIPTION / ANALYSIS**

Properties in this property group are located in ASHRAE Climate Zone 6, which indicates a cold climate dominated by heating loads nearly year round. Since properties in this group are enclosed and have included tenant energy use, the energy consumption is likely due to heating the common areas and tenants in the shopping center.



The average EUI of an enclosed shopping center in a cold climate, including tenant energy usage is 18.2 kWh / sq ft. The large number of heating days required for the enclosed space, and the inclusion of the tenants' consumptions dramatically increases the energy usage compared to similar property groups. Six properties were included in this group.

**CERTAINTY**

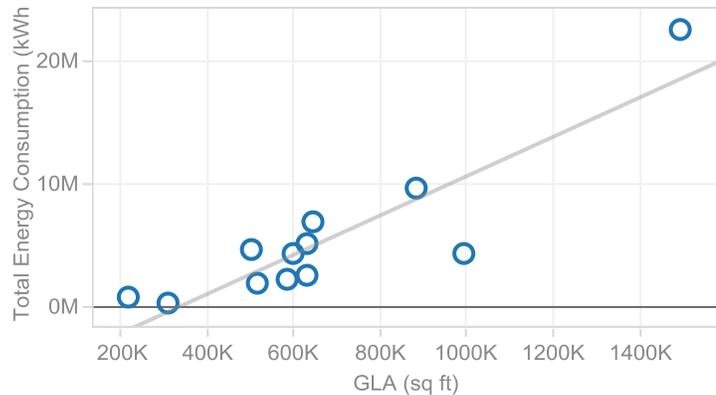
The 95% confidence interval is from 9.6 kWh / sq ft to 26.8 kWh / sq ft.

**Group 22, ASHRAE Climate Zone 6, Tenants Excluded, Enclosed (12 properties)**

**Mean EUI – 6.7 kWh / sq ft**

**PROPERTY GROUP DESCRIPTION / ANALYSIS**

Properties in this property group are located in ASHRAE Climate Zone 6, which indicates a cold climate dominated by heating loads nearly year round. Since properties in this group are enclosed and have excluded tenant energy use, the majority of the energy consumption is likely related to heating the common areas in the shopping center.



The average EUI of an enclosed shopping center in a cold climate, excluding tenant energy usage is 6.7 kWh / sq ft. While the large number of heating days required for the enclosed space increase the overall EUI, the exclusion of the tenants' consumptions dramatically reduces the energy usage compared to similar property groups. 12 properties were included in this group.

**CERTAINTY**

The 95% confidence interval is from 4.3 kWh / sq ft to 9.1 kWh / sq ft.

### Group 23, ASHRAE Climate Zone 6, Tenants Included, Open Air (1 property)

**Mean EUI – 19.0 kWh / sq ft**

#### PROPERTY GROUP DESCRIPTION / ANALYSIS

Properties in this property group are located in ASHRAE Climate Zone 6, which indicates a cold climate dominated by heating load nearly year round. Since properties in this group are open air and have included tenant energy use, the majority of the energy consumption is likely related to heating the tenants in the shopping center.

The average EUI of an open air shopping center in a cold climate, including tenant energy usage is 19.0 kWh / sq ft. One site was included in this group.

#### CERTAINTY

Only one property was submitted in this property group, therefore strong conclusions cannot be drawn and no confidence interval can be determined.

### Group 24, ASHRAE Climate Zone 6, Tenants Excluded, Open Air (16 properties)

**Mean EUI – 1.2 kWh / sq ft**

#### PROPERTY GROUP DESCRIPTION / ANALYSIS

Properties in this property group are located in ASHRAE Climate Zone 6, which indicates a cold climate dominated by heating loads nearly year round. Since properties in this group are open air and have excluded tenant energy use, the majority of the energy consumption is likely related to lighting the external common areas.

The average EUI of an open air shopping center in a cold climate, excluding tenant energy usage is 1.2 kWh / sq ft. The property group has a very low EUI as it does not requiring any heating or cooling loads. 16 properties were included in this group.

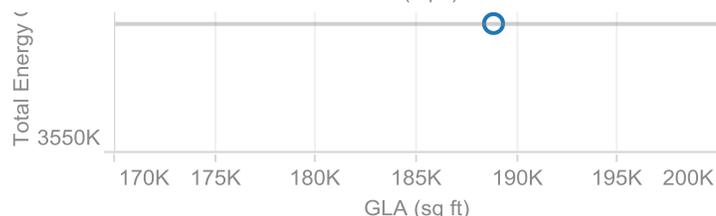
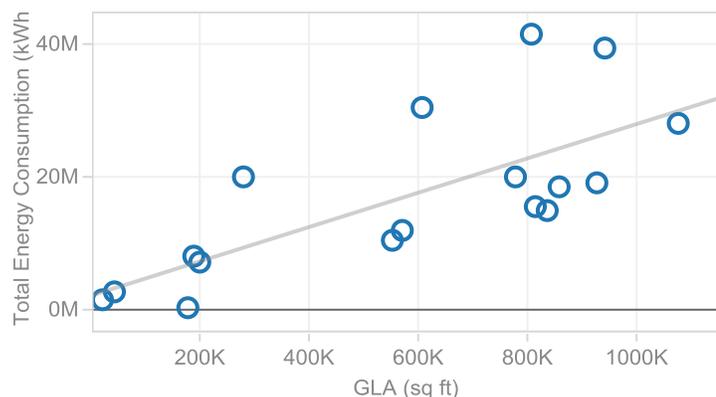
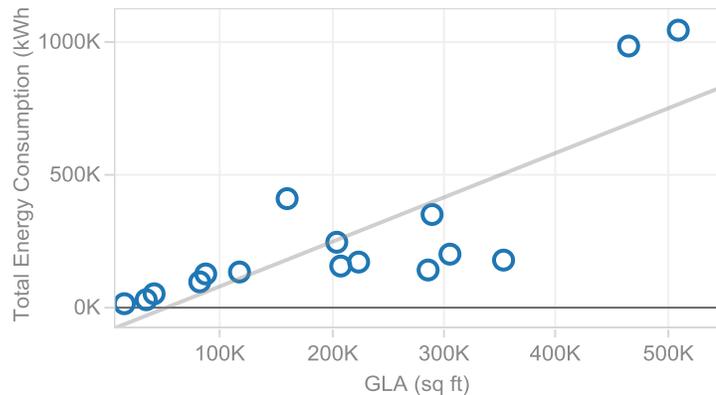
#### CERTAINTY

The 95% confidence interval is from 0.9 kWh / sq ft to 1.5 kWh / sq ft.

### Group 25, ASHRAE Climate Zone 7, Tenants Included, Enclosed (17 properties)

**Mean EUI – 33.7 kWh / sq ft**

#### PROPERTY GROUP DESCRIPTION / ANALYSIS



Properties in this property group are located in ASHRAE Climate Zone 7, which indicates a very cold climate dominated by heating loads nearly year round. Since properties in this group are enclosed and have included tenant energy use, the energy consumption is likely due to heating the common areas and tenants in the shopping center.

The average EUI of an enclosed shopping center in a very cold climate, including tenant energy usage is 33.7 kWh / sq ft. The large number of heating days required for the enclosed space, and the inclusion of the tenants' consumptions dramatically increases the energy usage compared to similar property groups. 17 properties were included in this group.

#### CERTAINTY

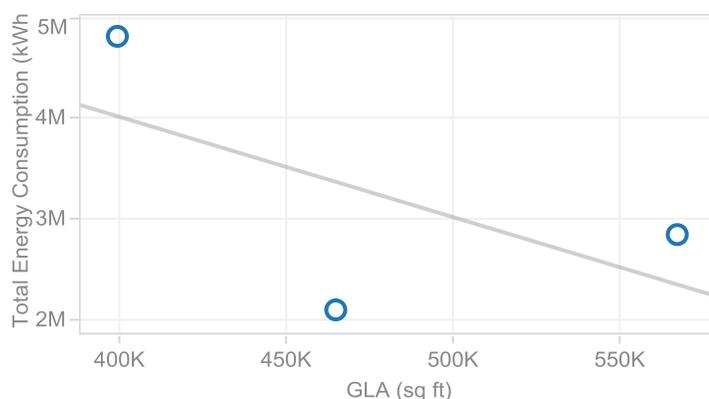
The 95% confidence interval is from 24.5 kWh / sq ft to 42.9 kWh / sq ft.

### Group 26, ASHRAE Climate Zone 7, Tenants Excluded, Enclosed (3 properties)

**Mean EUI – 7.2 kWh / sq ft**

#### PROPERTY GROUP DESCRIPTION / ANALYSIS

Properties in this property group are located in ASHRAE Climate Zone 7, which indicates a very cold climate dominated by heating loads nearly year round. Since properties in this group are enclosed and have excluded tenant energy use, the majority of the energy consumption is likely related to heating the common areas in the shopping center.



The average EUI of an enclosed shopping center in a very cold climate, excluding tenant energy usage is 7.2 kWh / sq ft. While the large number of heating days required for the enclosed space increase the overall EUI, the exclusion of the tenants' consumptions dramatically reduces the energy usage compared to similar property groups. Three properties were included in this group.

#### CERTAINTY

The 95% confidence interval is from 2.3 kWh / sq ft to 12.0 kWh / sq ft.

### Group 27, ASHRAE Climate Zone 7, Tenants Included, Open Air (0 properties)

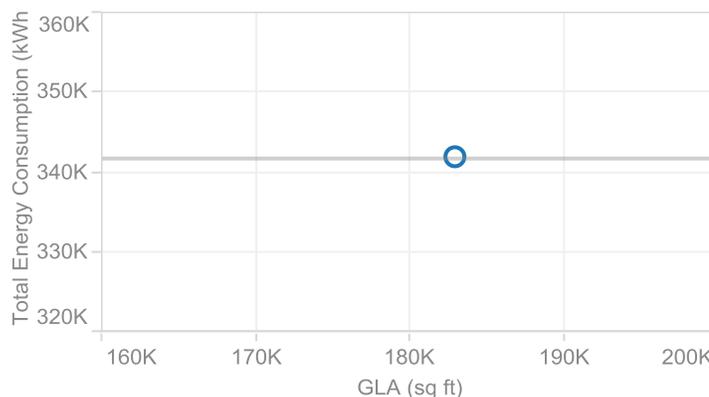
No properties were provided for this group. No conclusions were drawn about this property type.

### Group 28, ASHRAE Climate Zone 7, Tenants Excluded, Open Air (1 property)

**Mean EUI – 1.9 kWh / sq ft**

#### PROPERTY GROUP DESCRIPTION / ANALYSIS

Properties in this property group are located in ASHRAE Climate Zone 7, which indicates a very cold climate dominated by heating loads nearly year round. Since properties in this group are



open air and have excluded tenant energy use, the majority of the energy consumption is likely related to lighting the external common areas.

The average EUI of an open air shopping center in a very cold climate, excluding tenant energy usage is 1.9 kWh / sq ft. One property was included in this group.

### CERTAINTY

Only one property was submitted in this property group, therefore strong conclusions were not drawn and no confidence interval was determined.

### Risk and Uncertainty

As noted in each of the individual 28 sub-groups, the 95% confidence interval (CI) is a measure of the uncertainty in the data set. The 95% CI indicates that if the same data collection and analysis process was completed 100 times, the mean EUI would fall within this range 95 times, so we can be reasonably sure that the mean EUI for this property type is contained within this range.

Figure 8 below shows the mean EUI for each of the 28 property sub-groups, including the 95% CI. The dots indicate the mean for our samples, while blue lines indicate the 95% CI with longer lines indicating larger uncertainties.

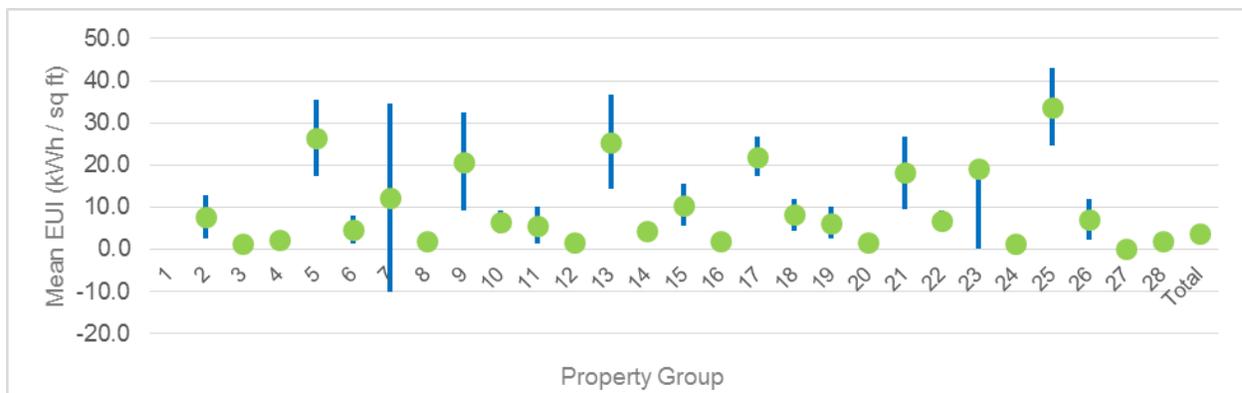


Figure 8 – EUI by Property Group, 95% Confidence Intervals

The uncertainty is controlled by the variation in site EUIs as well as the number of respondents in each group, and helps identify property types with large improvement potential, as described earlier. In addition to confidence intervals, histograms and quartiles were utilized to identify the properties and groups with large uncertainty (e.g., Enclosed property groups with tenant data included). Quality assurance was completed to ensure any variation is solely due to site variability rather than errors in reported data.

## Additional Sub-Group Definitions and Details

Group Description	Mean EUI (kWh / sq ft)	Included Properties	Excluded Properties
Group 1, ASHRAE Climate Zone 1, Tenants Included, Enclosed	-	0	1
Group 2, ASHRAE Climate Zone 1, Tenants Excluded, Enclosed	7.7	4	0
Group 3, ASHRAE Climate Zone 1, Tenants Included, Open Air	1.2	1	1
Group 4, ASHRAE Climate Zone 1, Tenants Excluded, Open Air	2.2	63	31
Group 5, ASHRAE Climate Zone 2, Tenants Included, Enclosed	26.5	9	0
Group 6, ASHRAE Climate Zone 2, Tenants Excluded, Enclosed	4.6	6	0
Group 7, ASHRAE Climate Zone 2, Tenants Included, Open Air	12.2	2	3
Group 8, ASHRAE Climate Zone 2, Tenants Excluded, Open Air	2.0	209	103
Group 9, ASHRAE Climate Zone 3, Tenants Included, Enclosed	20.8	16	1
Group 10, ASHRAE Climate Zone 3, Tenants Excluded, Enclosed	6.4	11	2
Group 11, ASHRAE Climate Zone 3, Tenants Included, Open Air	5.7	15	14
Group 12, ASHRAE Climate Zone 3, Tenants Excluded, Open Air	1.8	246	150
Group 13, ASHRAE Climate Zone 4, Tenants Included, Enclosed	25.4	13	2
Group 14, ASHRAE Climate Zone 4, Tenants Excluded, Enclosed	4.3	10	0
Group 15, ASHRAE Climate Zone 4, Tenants Included, Open Air	10.5	20	28
Group 16, ASHRAE Climate Zone 4, Tenants Excluded, Open Air	2.0	239	226
Group 17, ASHRAE Climate Zone 5, Tenants Included, Enclosed	21.9	9	17
Group 18, ASHRAE Climate Zone 5, Tenants Excluded, Enclosed	8.2	10	1
Group 19, ASHRAE Climate Zone 5, Tenants Included, Open Air	6.2	17	21
Group 20, ASHRAE Climate Zone 5, Tenants Excluded, Open Air	1.5	179	184
Group 21, ASHRAE Climate Zone 6, Tenants Included, Enclosed	18.2	6	2
Group 22, ASHRAE Climate Zone 6, Tenants Excluded, Enclosed	6.7	12	7
Group 23, ASHRAE Climate Zone 6, Tenants Included, Open Air	19.0	1	0
Group 24, ASHRAE Climate Zone 6, Tenants Excluded, Open Air	1.2	16	27
Group 25, ASHRAE Climate Zone 7, Tenants Included, Enclosed	33.7	17	0
Group 26, ASHRAE Climate Zone 7, Tenants Excluded, Enclosed	7.2	3	0
Group 27, ASHRAE Climate Zone 7, Tenants Included, Open Air	-	0	0
Group 28, ASHRAE Climate Zone 7, Tenants Excluded, Open Air	1.9	1	1
<b>Total</b>	<b>3.8</b>	<b>1135</b>	<b>1163</b>

Table 9 – Additional Sub-Group Definitions and Details