

# Energy Benchmarking Report: 2010 to 2015 Results

Performance of the Canadian Office Sector



A photograph showing a lush green roof in the foreground, with a modern glass-walled building in the background. The scene is bright and sunny, with green grass and trees visible.

REALPAC is the national industry association dedicated to advancing the long-term vitality of Canada's real property sector

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# 1. Executive Summary

REALPAC, BOMA Canada and the Canada Green Building Council co-launched the “20 by ’15” target in 2009 to challenge Canadian office buildings to achieve an energy consumption target of 20 ekWh/ft<sup>2</sup>/yr by the year 2015, to lower the sector’s overall environmental impact and yield cost savings. Continuing to support these efforts, REALPAC has collected energy consumption data from office buildings across Canada for a six-year period between 2010 and 2015 through its Energy Benchmarking Surveys. This data has been analyzed to determine trends and patterns in building energy performance.

To obtain high quality and comparable data, REALPAC developed a proprietary Energy Normalization Methodology. The Methodology allowed buildings to be compared on a like-for-like basis. The Methodology has been reviewed and updated throughout the years of the Energy Benchmarking Program based on new insights and industry opinion. The normalized approach was used to calculate each building’s annual energy use because it adjusts for variables such as the building’s gross floor area, various energy sources, high intensity or exceptional energy use space types, weather, and occupant dependant variables (e.g. occupant density, vacancy and operating hours) to allow comparability on a like-for-like basis.

The population of buildings varied from year to year and not all buildings participated in the Survey year after year. Variations between the datasets were considered by analyzing the size, age, occupant density, vacancy rates and average weekly operating hours of the buildings.

Energy use was also analyzed with each of the data sets. The mean actual energy use intensity of the buildings in the 2015 data set was 28.8 ekWh/ft<sup>2</sup>/yr and the mean normalized energy use intensity was 29.0 ekWh/ft<sup>2</sup>/yr. There were 94 out of 437 buildings (22%) in 2015 that were at or below the 20 ekWh/ft<sup>2</sup>/yr target. When comparing energy use intensity between the six years, there was not a consistent decrease in energy use year after year. **However, from 2010 to 2015 overall, there was a 5.9% reduction in actual energy use and a 1.2% reduction in normalized energy use.** Further, 210 buildings have inputted data intermittently or consistently over the six-year period. This sub-group showed an average reduction in normalized energy use of 9.6% over the six years. There were 64 buildings which reported for 5 years consistently or intermittently and achieved an average reduction of 5.5%.

**Therefore, energy benchmarking over time does seem to support energy efficiency gains.** Energy use was also analyzed based on regional areas and high intensity and exceptional space type trends (e.g. data centers and enclosed parking).

**In conclusion, although only about a quarter of buildings achieved the 20 by ’15 target, overall energy usage did decrease for the participating buildings.**

## 2. Introduction

REALPAC's Energy Benchmarking Report: 2010–2015 Results - Performance of the Canadian Office Sector (the "Report") includes the results of the 2010, 2011, 2012, 2013, 2014 and 2015 REALPAC Energy Benchmarking Surveys (the "Surveys").

In this Report, all six years of data have been analyzed and compared to provide a comprehensive view of trends and patterns of building energy performance across Canada over time. REALPAC's Energy Benchmarking Survey is part of its 20 by '15 target which began in 2009. The target involved an energy consumption goal of 20 ekWh/ft<sup>2</sup>/yr for Canadian office buildings to achieve by 2015. Although not all buildings have met the 20 by '15 target over the six-year period,

progress has been made in energy reduction overall, particularly in buildings that have participated consistently or intermittently during the years of the Surveys.

Looking back over the six years of the REALPAC Energy Benchmarking Program, the growth of interest and activity related to energy measurement and savings, as well as the actual performance improvements at the building level, were evident. The continued participation of benchmarking performance over time is a testament to the heightened knowledge and level of sophistication organizations are bringing to the management of their assets' resource use.

## 3. Methodology

As the Energy Benchmarking Program has matured, REALPAC has reviewed a growing number of buildings and related data each year. Although the population of the database has changed slightly from year to year with the same buildings not necessarily participating in every Survey, the Program continues to use a normalized approach to calculate each building's annual energy use. Consistent with the original study, normalization adjusts total energy consumption for variables such as the building's gross floor area, various energy sources, high intensity or exceptional energy use space types, weather and occupant dependant variables (e.g. occupant density, vacancy and operating hours). The general impact of normalization is to adjust energy consumption downwards in most climates, thus producing a more "apples-to-apples" comparison of buildings with differing characteristics and tenant mixes. It is important to note that REALPAC's approach to normalization is based on best operating practices rather than average performance or processes as can currently be seen in the industry.

After review and revision in 2012, the Methodology provided four normalization metrics, beginning with a non-normalized actual building energy use metric and ending with a fully normalized building energy use metric that accounts for weather, location, and building characteristic variations. The four metrics, together, provide a richer picture of the building energy use and present the users with more choice in how they compare their buildings. These metrics are listed and described below:

1. Actual Building Energy Use (current year)
2. Building Characteristic Normalized Building Energy Use for YYYY (current year)
3. Weather Normalized Building Energy Use to Base Year 2009 (in building's original location), and
4. Location & Weather Normalized Building Energy Use to Toronto, ON ("Normalized Energy Use")<sup>1</sup>

<sup>1</sup> Only the Actual Building Energy Use metric and the Location & Weather Normalized Building Energy Use to Toronto, ON ("Normalized Energy Use") metric are used in this report for the analyses and charts.

In 2015, REALPAC made changes to the Weather Normalized Building Energy Use to Base Year 2009 metric and the Location & Weather Normalized Building Energy Use to Toronto, ON metric. The Weather Normalized Building Energy Use to Base Year 2009 metric was previously calculated by using the 2009 base year as a “model” year for weather. The model weather was compared to actual weather in each location and the adjustments of the model to the current year were applied to the current year energy use proportionately (adjustments made forward). It was noted that the more accurate approach would be to take the current year weather and compare to the model year. Then corresponding adjustments would be applied to the appropriate amount of current year energy to effectively “adjust back” to the base year. The revision was seen to impact the directionality (adjust forward vs. adjust backwards) of calculations. Subsequently, the Location & Weather Normalized Building Energy Use to Toronto, ON metric also changed because it uses the Weather Normalized Building Energy Use to Base Year 2009 metric in its calculation.

The REALPAC Energy Benchmarking Technical Committee agreed that this approach was more

accurate for users moving forward. This revised approach was incorporated into the 2015 Energy Normalization Database calculations and applied to previously entered data (2010 to 2014 Surveys) to allow alignment with the new calculations, thus permitting more accurate and meaningful year-over-year comparisons of building energy use performance.

While the normalization approach tries to account for differences in building characteristics and tenant mix or space use, there is less control over the accuracy of the data from the source. The data, as provided to REALPAC through the database, has its own limitations as it is unaudited and self-reported (by the landlord, property manager or consultant). The data may not represent the market as a whole because it may be self-selected and could contain errors ranging from inaccurate inputs to misunderstood requirements, to incomplete entries. REALPAC strives to review and work with submitters to ensure the data is as accurate as possible, but the ultimate responsibility for complete and up-to-date inputs lies with the submitters.

## 4. Data Set Characteristics

Buildings participating in the Survey in 2010 through 2015 continue to be varied with both large and small office buildings participating each year which are located in or near urban centres across Canada.

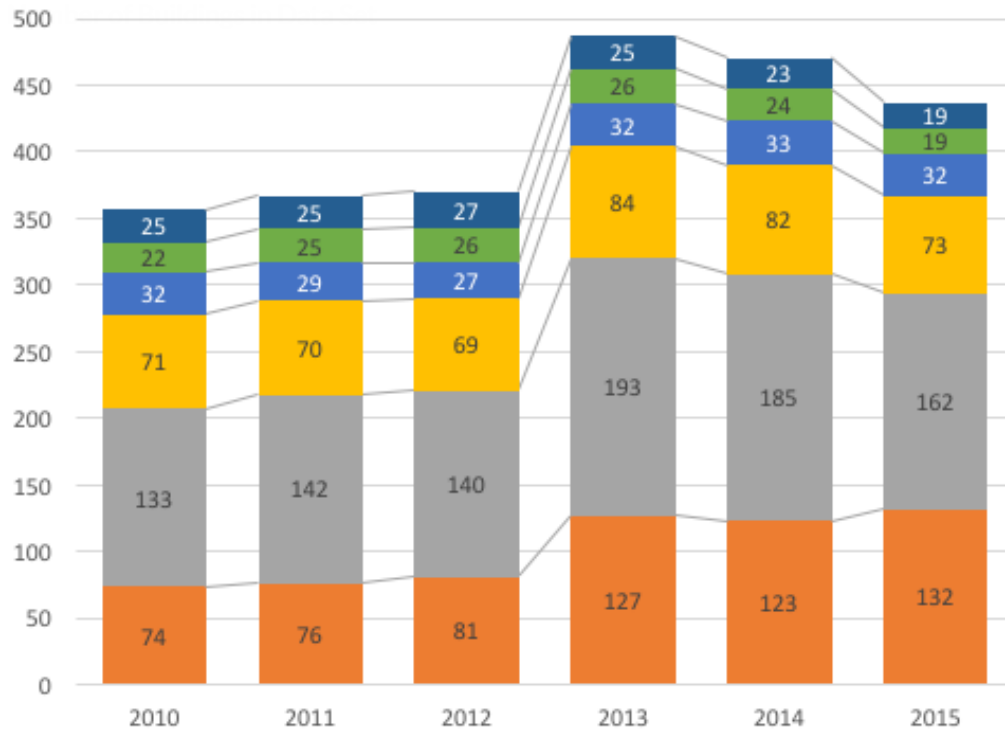
The number of buildings included in the 2010 data set totals 357 (over 128 million ft<sup>2</sup> of gross floor area), in the 2011 data set there are 367 buildings represented (over 131 million ft<sup>2</sup> of gross floor area), in the 2012 data set there are 370 buildings represented (over 134 million ft<sup>2</sup> of gross floor area), and in 2013, 487 buildings are included (almost 152 million ft<sup>2</sup> of gross floor area). A slight drop in participation was seen in 2014 with 470 buildings (over 146 million ft<sup>2</sup> of gross floor

area) and in 2015 with 437 buildings (over 129 million ft<sup>2</sup> of gross floor area), yet the relative proportions of buildings in different locations and with different characteristics remained similar.

The following charts, Figures 1 through 5, illustrate the various characteristics of the data sets each year including the size, age, occupant density, vacancy rates and average weekly operating hours and of the buildings. Each figure contains two charts. The first shows the number of buildings in each category, compared year-over-year. The second chart shows the relative percentage of the total data set contained in each category, compared year-over-year.

**Figure 1: Building Size Comparison by Category and Year**

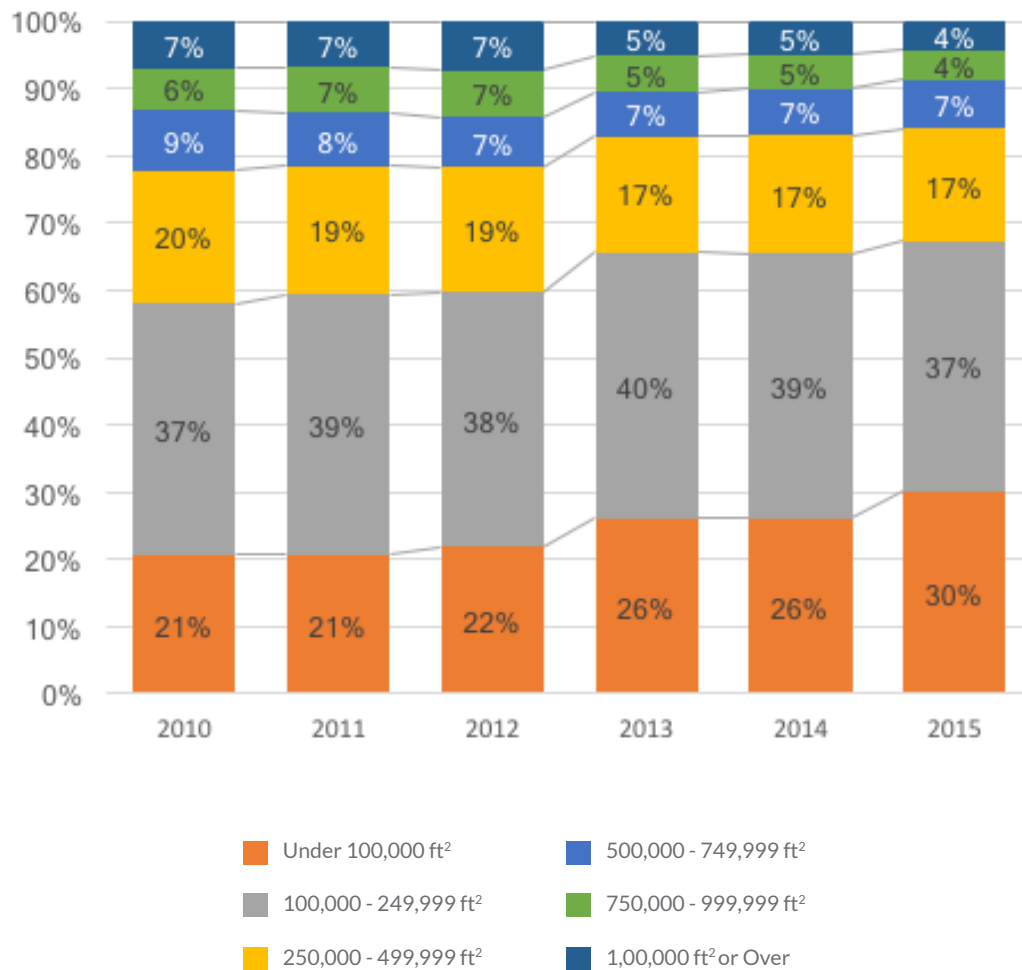
Number of Buildings in Data Set



- Under 100,000 ft<sup>2</sup>
- 500,000 - 749,999 ft<sup>2</sup>
- 100,000 - 249,999 ft<sup>2</sup>
- 750,000 - 999,999 ft<sup>2</sup>
- 250,000 - 499,999 ft<sup>2</sup>
- 1,000,000 ft<sup>2</sup> or Over



Relative Percentage of Total Buildings in Data Set

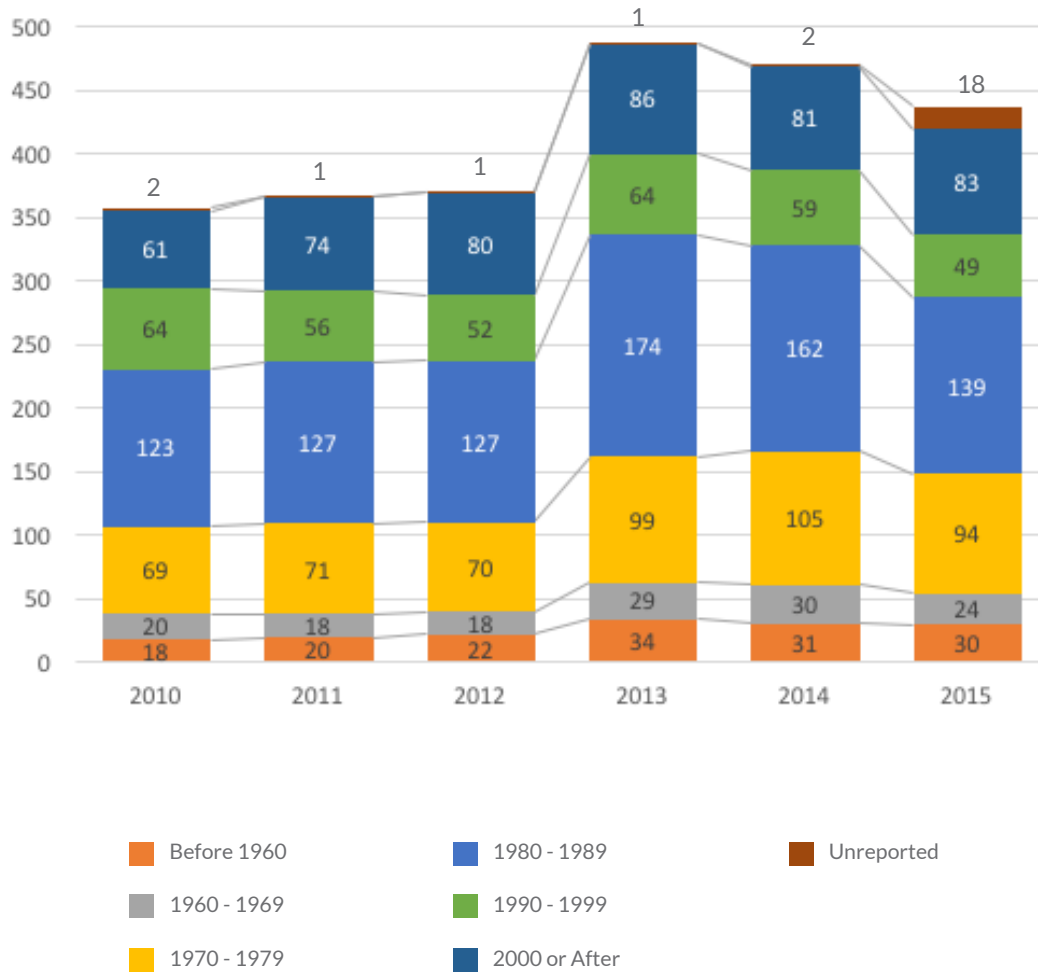


**Figure 1** shows the proportion of buildings in each data set that fall into different size categories, based on the reported gross floor area, from small (less than 100,000 ft<sup>2</sup>) to large (over 1,000,000 ft<sup>2</sup>).

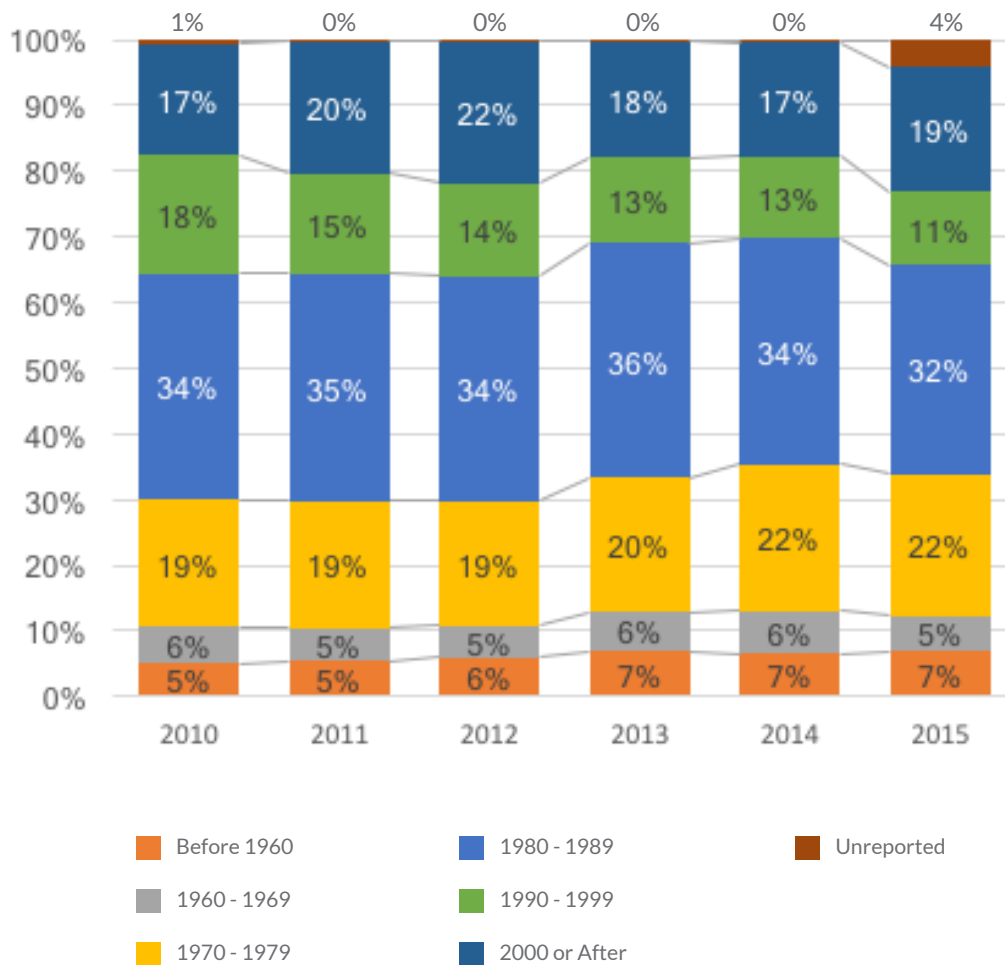
Although the absolute number of buildings in many of the size categories changed the most from 2010 to 2013, simply from the increase in participating buildings, the largest proportionate increase over the six years can be seen in the under 100,000 ft<sup>2</sup> category (increase of 9%) and the largest proportionate decrease can be seen in the 250,000–499,999 ft<sup>2</sup> category (decrease of 3%). As in the previous reports, the largest size category represented each year from 2010 to 2015 is that between 100,000 – 249,999 ft<sup>2</sup>.

**Figure 2: Building Age Comparison by Category and Year**

Number of Buildings in Data Set



Relative Percentage of Total Buildings in Data Set

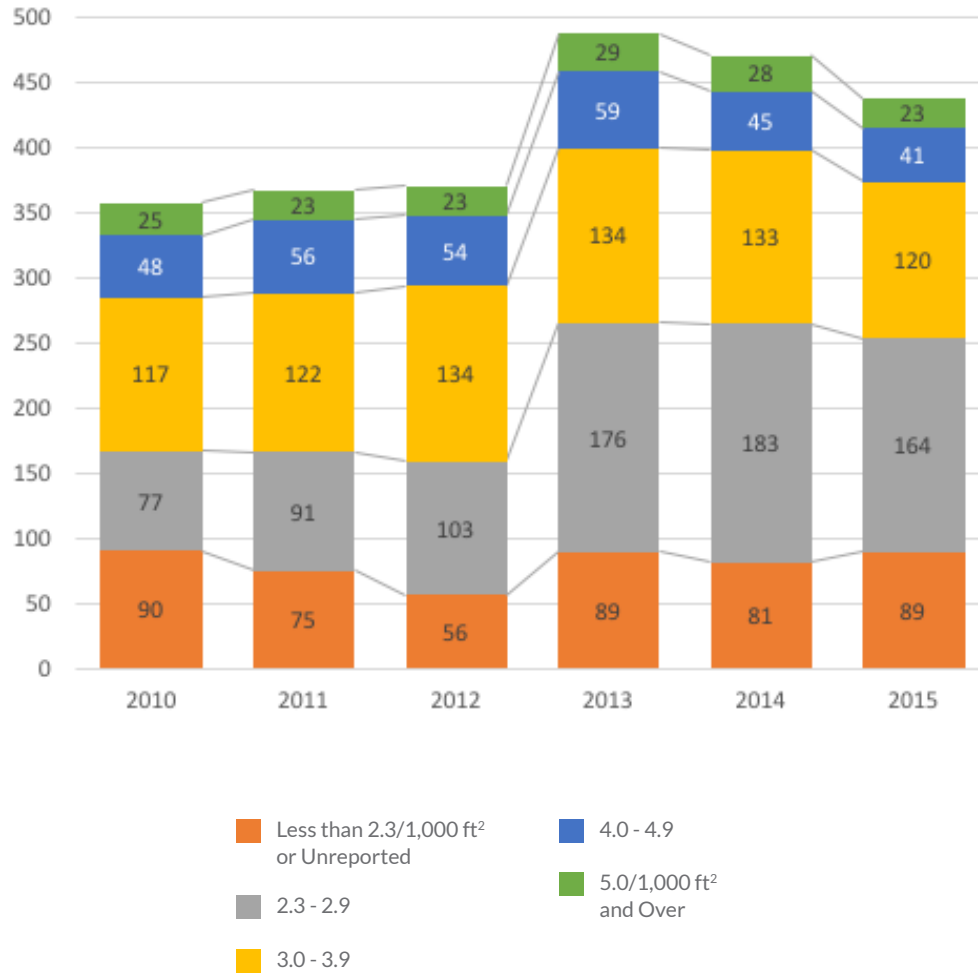


**Figure 2** illustrates the number and proportion of buildings in the data set that fall into different age categories, according to their original construction completion date, from older (built before 1960) to newer (built after 2000).

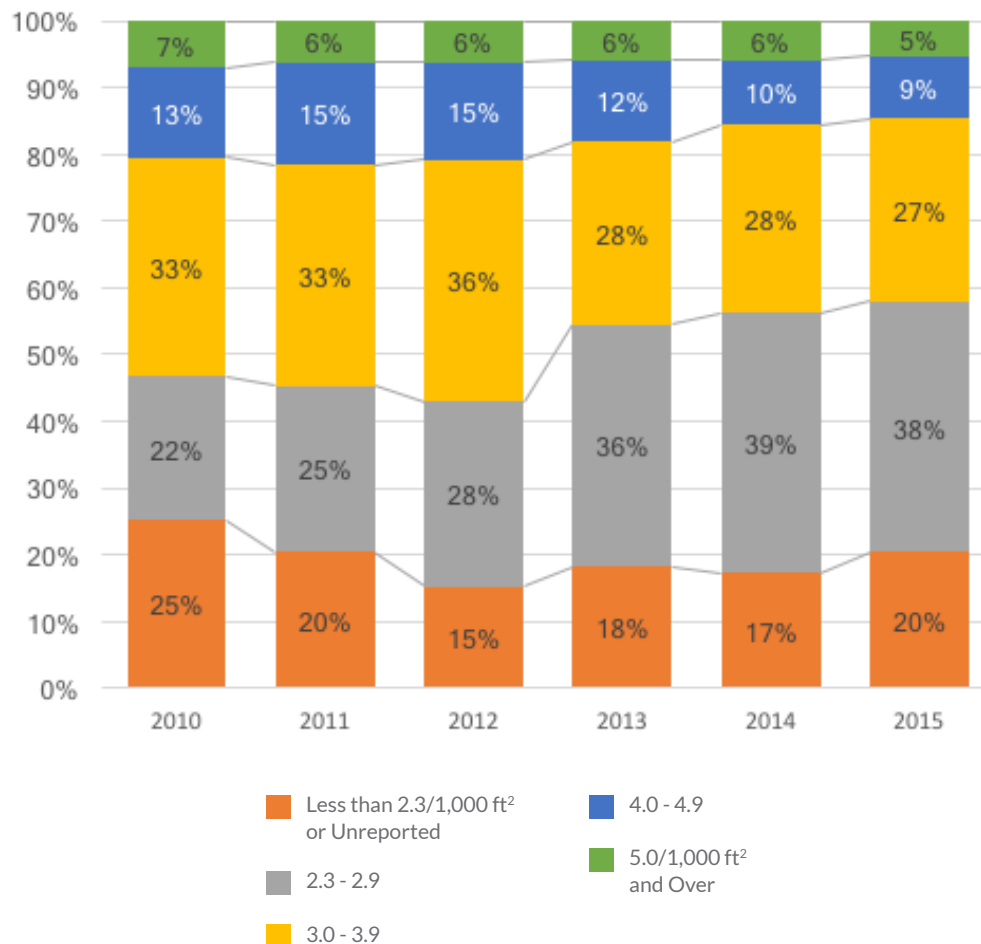
As compared to previous years, there are more buildings in the unreported category in 2015, possibly due to new submitter error or entry oversight, but this remains a small percentage as compared to the other categories. Looking at the relative percentage of buildings, an increase of 3% can be seen in those buildings built between 1970 – 1979, and a decrease of 7% can be seen in those buildings built between 1990 – 1999, while other age categories change about 1 – 2% over the six-year period. As in the previous data sets, the largest segment of the six data sets, both in number and percentage, is the group of buildings constructed between 1980 and 1989.

**Figure 3: Occupant Density Comparison by Category and Year**

Number of Buildings in Data Set



Relative Percentage of Total Buildings in Data Set



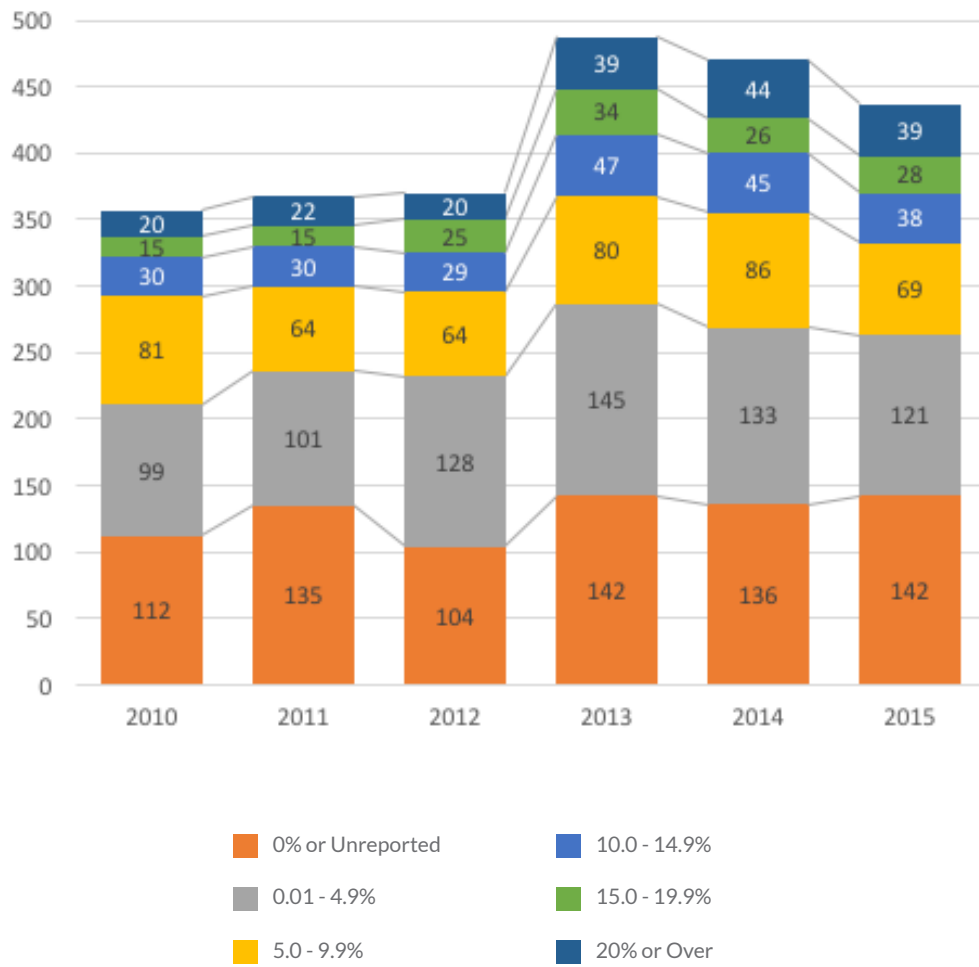
**Figure 3** presents the proportion of buildings in the data set that fall into different categories of occupant density, from less dense (less than 2.3 occupants/1,000 ft<sup>2</sup>) to more dense (5.0 occupants/1,000 ft<sup>2</sup> and over).

Occupant density is calculated by dividing the number of occupants in the building by the gross floor area/1,000 ft<sup>2</sup>. This results in an occupant density metric expressed in occupants/1,000 ft<sup>2</sup>.

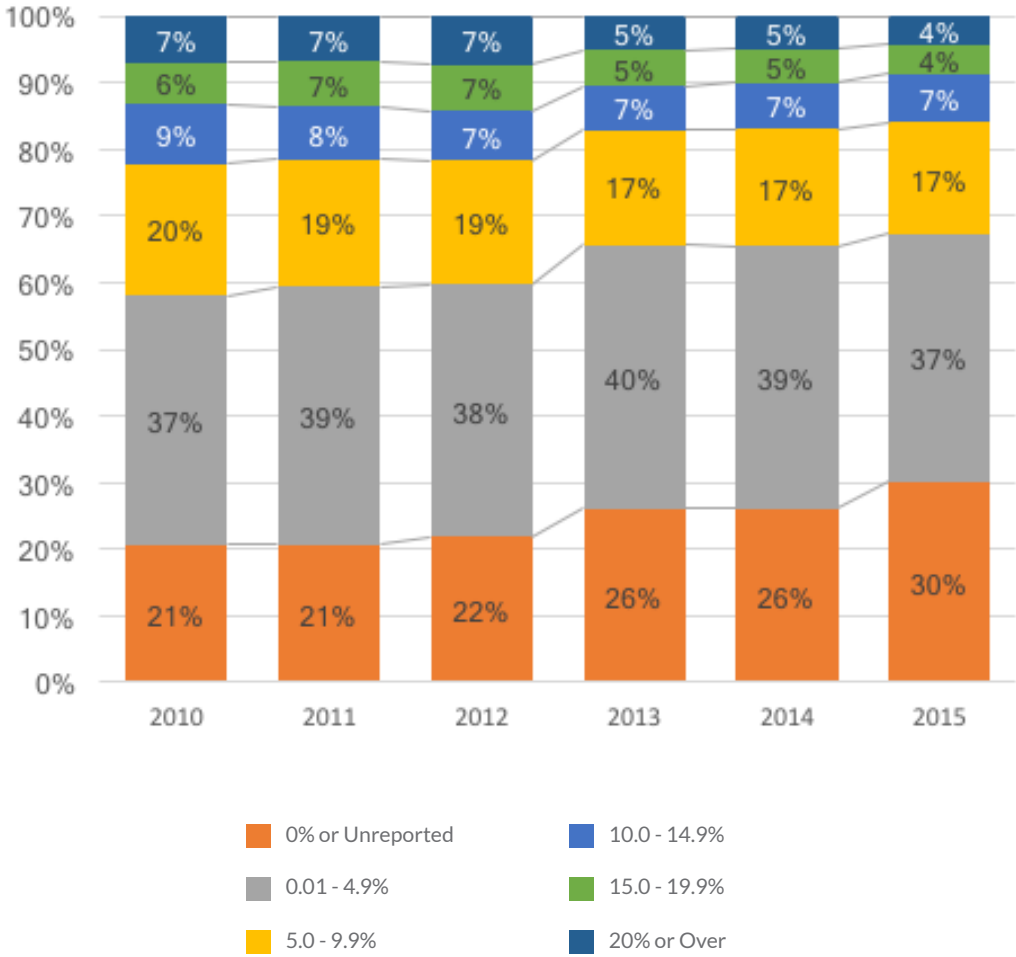
Only 23 – 29 buildings in any year have an occupant density at or over 5.0 occupants/1,000 ft<sup>2</sup>. While 2013 shows an increase in the number of buildings in this category, the relative proportion has remained similar over the six years, between 5% and 7%. It is interesting to note that the category of the least density (below 2.3/1,000 ft<sup>2</sup>) has decreased in its proportionate share of the data set since 2010 by 5% and the categories 3.0 – 3.9 and 4.0 – 4.9, have also decreased by 6% and 4%, respectively. The largest fluctuation and increase seen in percentage over the three years was in the 2.3 – 2.9 occupants/1,000 ft<sup>2</sup> category.

**Figure 4: Annual Vacancy Rate Comparison by Category and Year**

Number of Buildings in Data Set



Relative Percentage of Total Buildings in Data Set

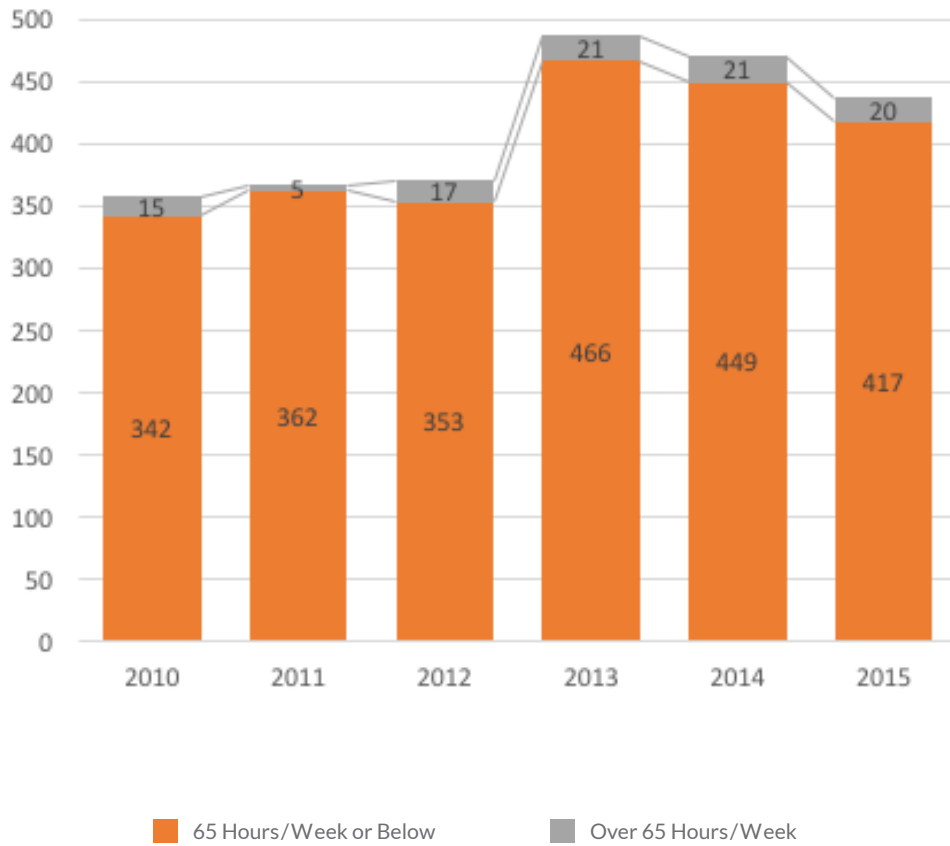


**Figure 4** illustrates the proportion of buildings in the data set that fall into different categories of annual tenant vacancy rates, from 0% vacancy (or unreported) to 20% vacancy or over for the year. The default vacancy rate in the Methodology is 0%, thus those buildings that experienced a 0% vacancy rate for any year and those participants who chose not to enter their vacancy data are grouped together within the largest segment of buildings in Figure 4.

In 2015, 9% of the buildings reported a vacancy rate of 20% or more over the year as compared to 6% in 2010. The largest proportionate decrease seen was in the 5.0 – 9.9% vacancy rate category, which swung from 23% to 16% over the six years.

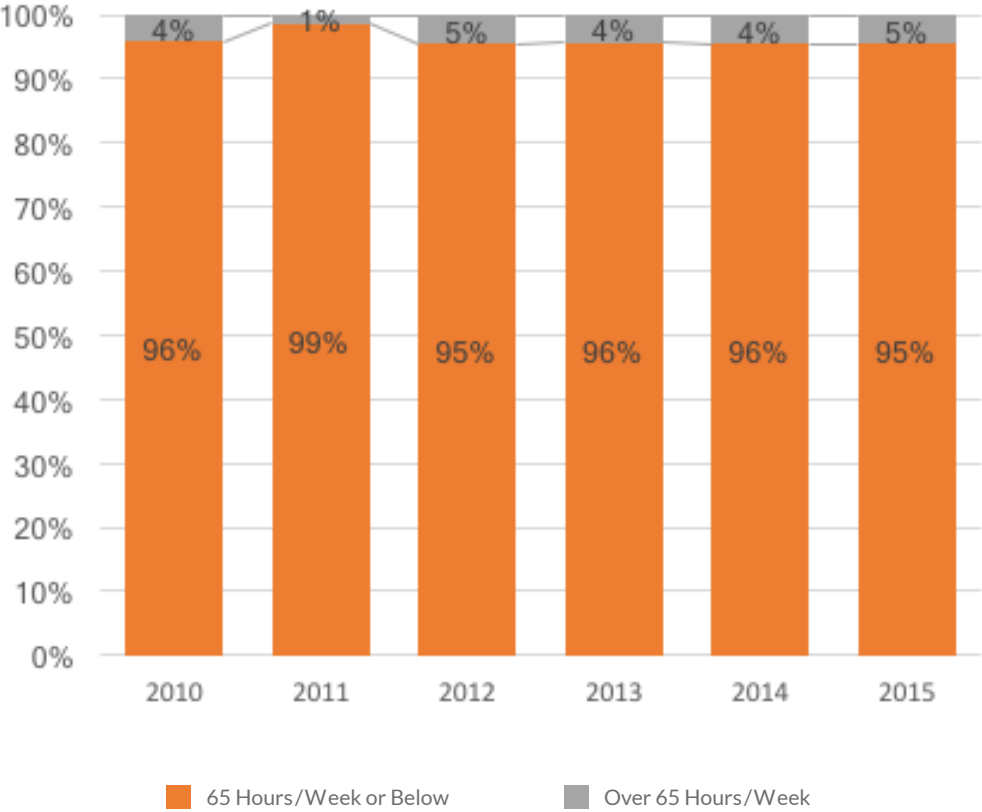
Figure 5: Average Weekly Operating Hours Comparison by Category and Year

Number of Buildings in Data Set





Relative Percentage of Total Buildings in Data Set



**Figure 5** shows the proportion of buildings in the data set that fall within different categories of average weekly operating hours. In the Methodology, weekly operating hours are defined as the number of hours per week that a building (or space within a building) is occupied by at least 75% of the tenant employees averaged over the year under review.

As can be seen in all data sets, the vast majority of buildings reported average weekly operating hours at or below 65 hours per week.

For buildings with extremely high operating hours, only one building reported weekly operating hours over 75 hours per week in 2010, and in 2015, nine buildings reported the same.

## 5. Analysis and Results

### 5.1 Building Characteristics

As was discussed in the 2010, 2012 and 2014 Energy Benchmarking Reports, energy performance has previously been analyzed in relation to building size<sup>2</sup> and age of the building, yet re-analysis of these variables within the context of REALPAC’s six data sets does not show strong correlations.

**Figure 6: Average Actual Energy Use vs. Average Normalized Energy Use by Building Size and Year**

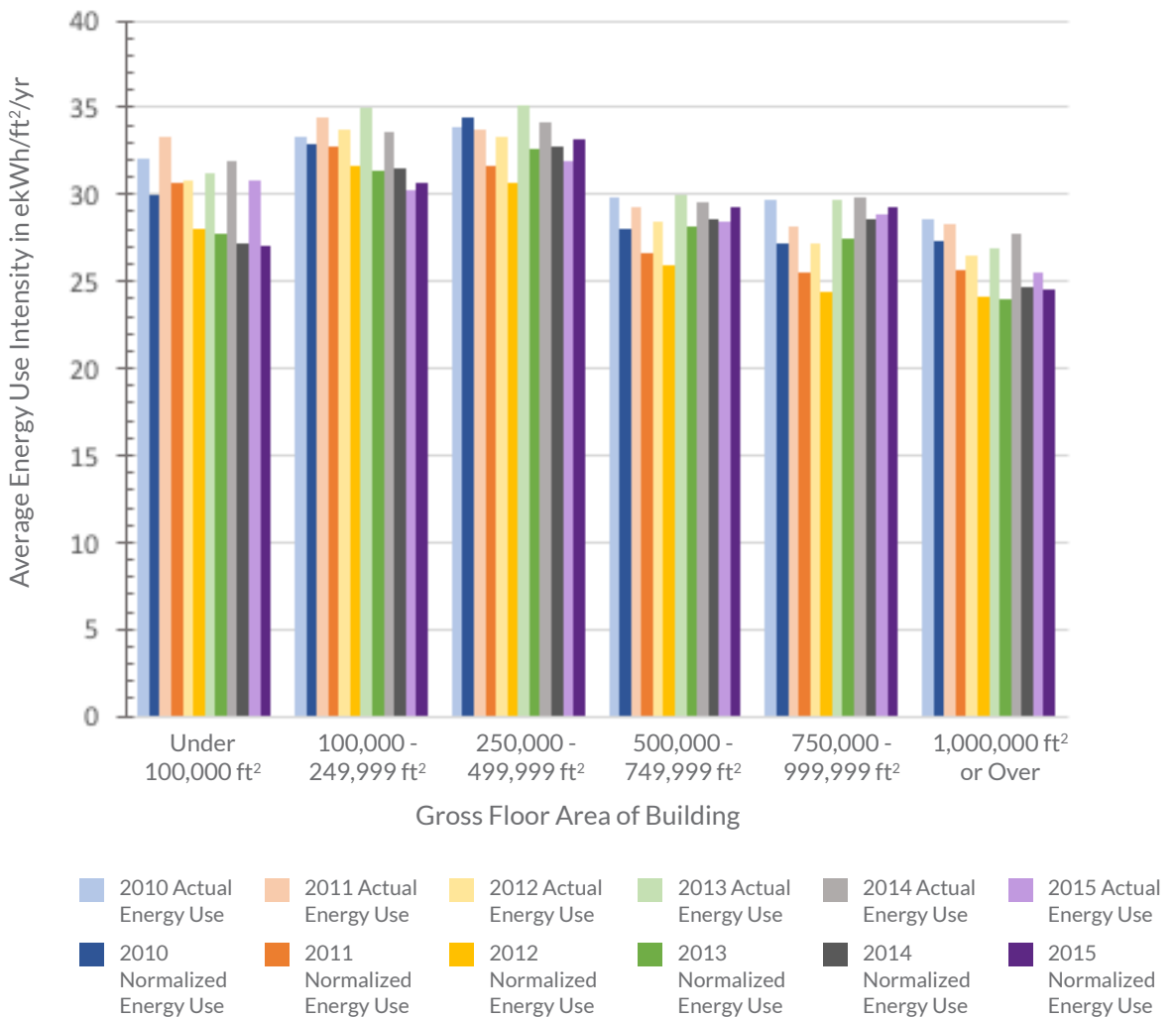


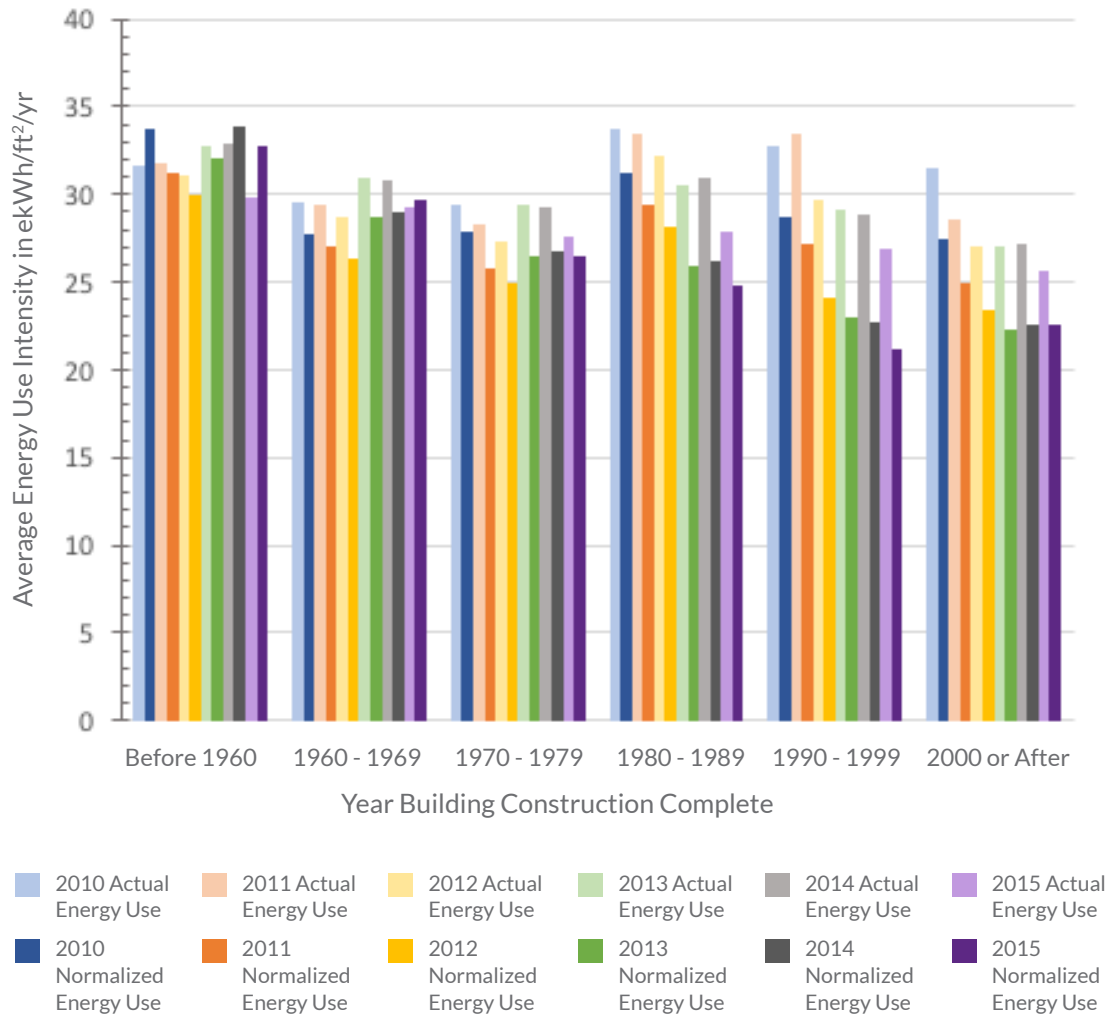
Figure 6 shows both the actual and the normalized average energy use intensity, by building size category and by year of data.

Looking at energy use trends in general, it can be seen that both the average actual and normalized energy use have generally decreased from 2010 to 2012, yet increased in 2013 only to decrease again from 2013 to 2015. When comparing size categories to each other, the average actual energy use is the highest in 2010, 2011 and 2012 in the 500,000 - 749,999 ft² category, while it is the highest in 2013,

<sup>2</sup> The Building Owners and Managers Association of Canada (BOMA Canada). BOMA BEST Energy and Environmental Report: National Green Building Report (BBEER 2014). Retrieved November 14, 2017 from <http://bomamanitoba.ca/wp-content/uploads/2014/12/BBEER-2014-Full-Report.pdf>

2014 and 2015 in the under 100,000 ft<sup>2</sup> category. For the normalized metrics, it can be seen that the under 100,000 ft<sup>2</sup> category results were higher than each other size category for each respective year, but no consistent trends are apparent for the full six-year period.

**Figure 7: Average Actual Energy Use vs. Average Normalized Energy Use by Building Age and Year**



**Figure 7** shows both the actual and the normalized average energy use intensity, by building age category and by year of data.

As seen in the figure above and in previous reports, general energy use trends show a slight increase then a dip, moving forward in time, from the construction dates before 1960. When comparing age categories to each other, the highest energy use averages seen for both actual and normalized intensity are either in the 1960 – 1969 category (2011, 2012) or in the 1970 – 1979 category (2010, 2013, 2014, 2015). All metrics in buildings built after 1980 are consistently lower than their corresponding metrics in buildings built before 1980, except 2013, 2014 and 2015 normalized energy use. In the 2015 data, the actual energy use intensity (light purple bars) ranges from 25.5 to 31.9 kWh/ft<sup>2</sup>/yr with the lowest average intensity seen in the 2000 or After category and the highest in the 1970 – 1979 category. Here, the same pattern can be seen in the normalized energy intensity use ranges (dark purple bars) where the lowest intensity is in the 2000 or After category at 24.6 kWh/ft<sup>2</sup>/yr and the highest is in the 1970 – 1979 category at 33.2 kWh/ft<sup>2</sup>/yr.

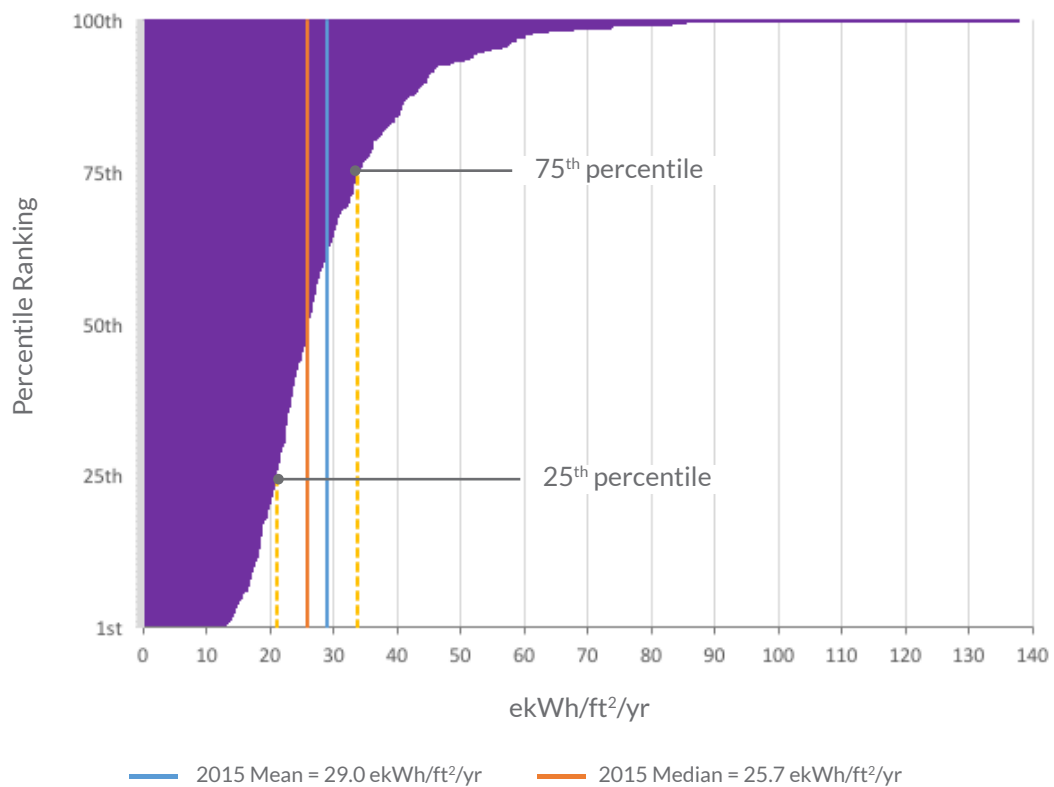
## 5.2. National Trends

The Canada-wide data set of annual building energy intensity for 2015 shows the mean actual energy use intensity to be 28.8 ekWh/ft<sup>2</sup>/yr. While this intensity is barely higher than the BOMA BEST average intensity of 28.7 ekWh/ft<sup>2</sup>/yr for 2015<sup>3</sup>, this difference could be expected to be larger given a building population that may or may not be certified under a green building rating system.

The mean normalized energy use intensity in REALPAC's 2015 data set is 29.0 ekWh/ft<sup>2</sup>/yr, slightly higher than 2011 through 2013.

In Figures 8 to 13, the Canada-wide data set of annual normalized building energy intensity is illustrated for each year separately, followed by Figure 14, which compares both the average actual and average normalized energy use metrics by year. Table 1 displays a year-over-year comparison of building intensity ranges, means, medians and numbers of buildings in the top quartiles and groups.

**Figure 8: Normalized Energy Use Intensity, Canada-wide Data Set for 2015**

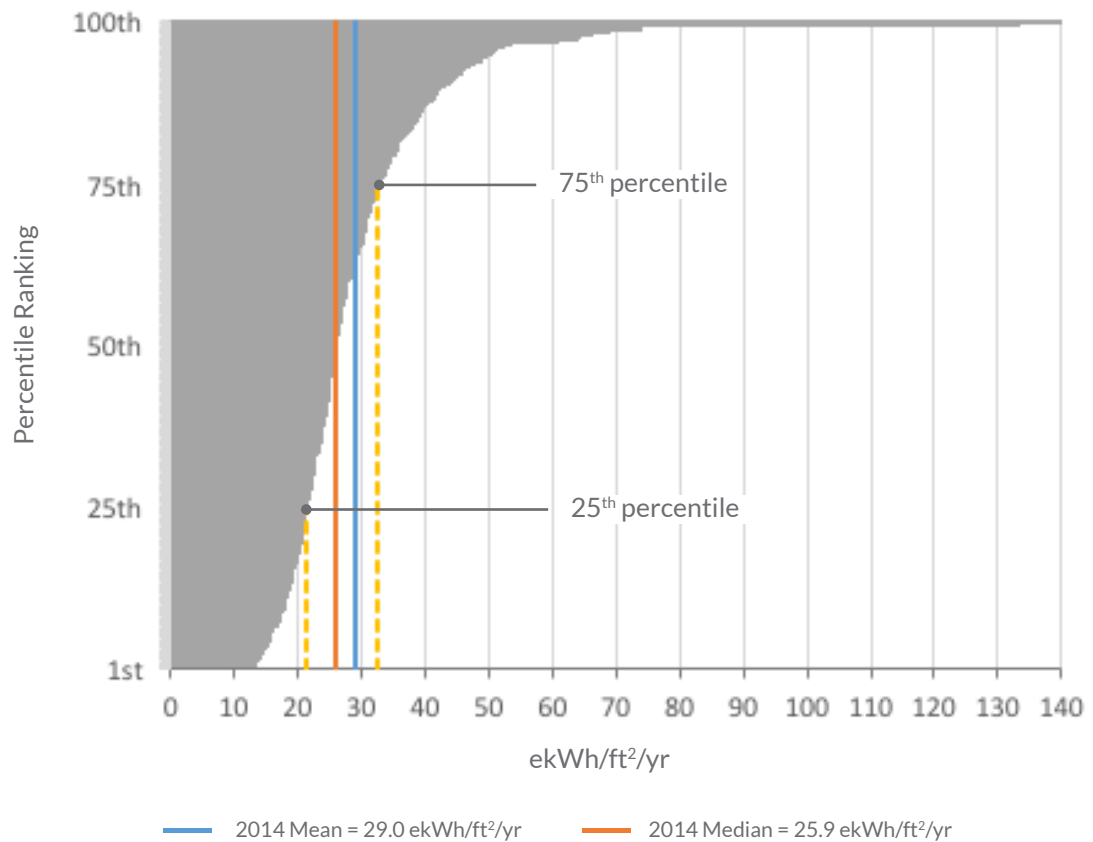


**Figure 8** shows the 437 buildings in the 2015 Canada-wide data set. The mean normalized energy use intensity is above the median at 29.0 ekWh/ft<sup>2</sup>/yr. The top 25<sup>th</sup> percentile of this data set begins at 20.9 ekWh/ft<sup>2</sup>/yr and the bottom 75<sup>th</sup> percentile begins at 33.6 ekWh/ft<sup>2</sup>/yr (as indicated by the dashed lines in Figure 8).

<sup>3</sup> The Building Owners and Managers Association of Canada (BOMA Canada). 2017 BOMA BEST® National Green Building Report. Retrieved November 14, 2017 from <http://bomacanada.ca/resources/ngbr/>

The lowest normalized building energy use intensity in the data set is at 11.6 ekWh/ft<sup>2</sup>/yr and the highest is at 137.8 ekWh/ft<sup>2</sup>/yr. There are 94 buildings with normalized energy use intensities at or below 20.0 ekWh/ft<sup>2</sup>/yr and there are 109 buildings in total with energy use performance within the top quartile, below 20.9 ekWh/ft<sup>2</sup>/yr.

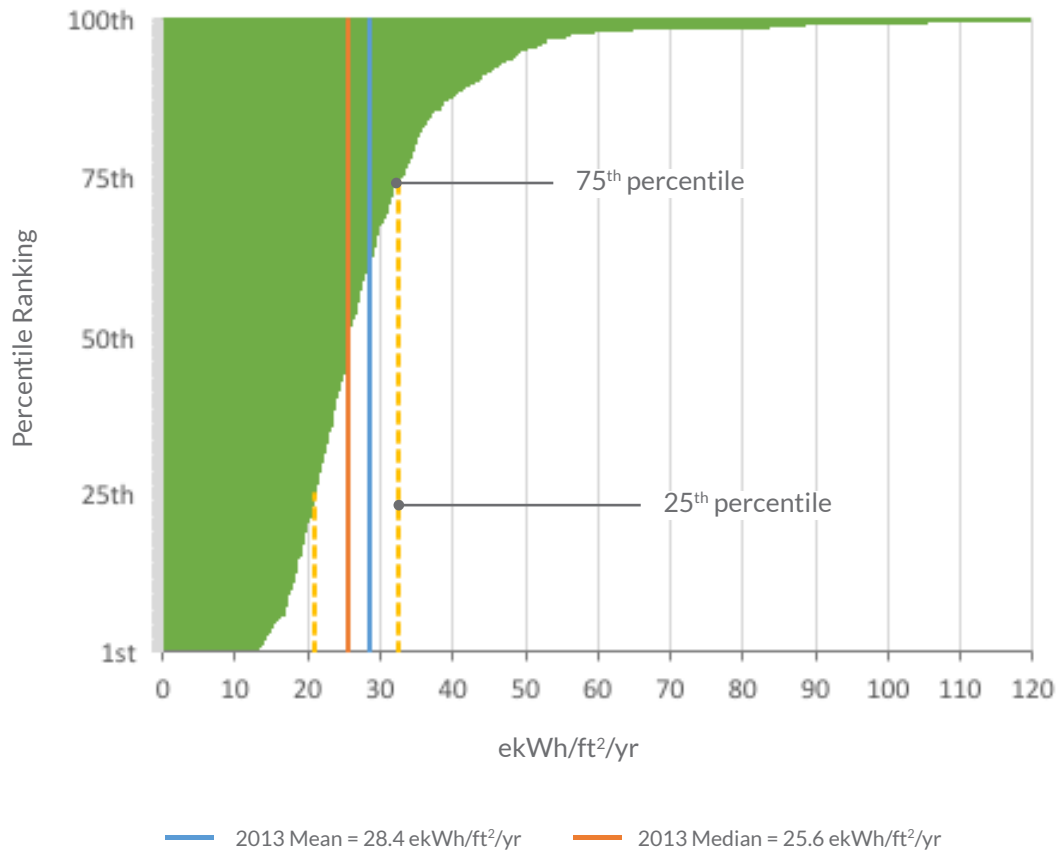
**Figure 9: Normalized Energy Use Intensity, Canada-wide Data Set for 2014**



**Figure 9** shows the 470 buildings in the 2014 Canada-wide data set. The mean normalized energy use intensity is above the median at 29.0 ekWh/ft<sup>2</sup>/yr. The top 25<sup>th</sup> percentile of this data set begins at 21.5 ekWh/ft<sup>2</sup>/yr and the bottom 75<sup>th</sup> percentile begins at 32.6 ekWh/ft<sup>2</sup>/yr (as indicated by the dashed lines in Figure 9).

The lowest normalized building energy use intensity in the data set is at 12.1 ekWh/ft<sup>2</sup>/yr and the highest is at 140.0 ekWh/ft<sup>2</sup>/yr. There are 81 buildings with normalized energy use intensities at or below 20.0 ekWh/ft<sup>2</sup>/yr and there are 118 buildings in total with energy use performance within the top quartile (below 21.5 ekWh/ft<sup>2</sup>/yr).

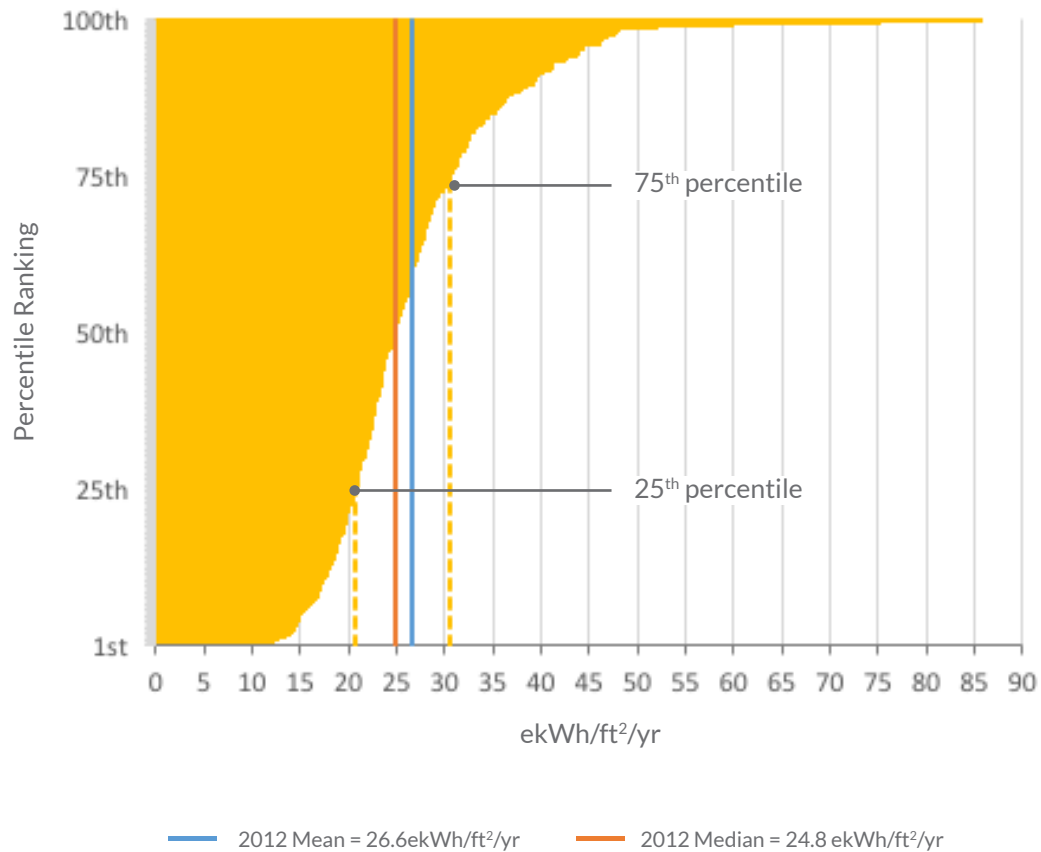
**Figure 10:** Normalized Energy Use Intensity, Canada-wide Data Set for 2013



**Figure 10** shows the 487 buildings in the 2013 Canada-wide data set. The mean normalized energy use intensity is above the median at 28.4 ekWh/ft<sup>2</sup>/yr. The top 25th percentile of this data set begins at 20.8 ekWh/ft<sup>2</sup>/yr and the bottom 75<sup>th</sup> percentile begins at 32.6 ekWh/ft<sup>2</sup>/yr (as indicated by the dashed lines in Figure 10).

The lowest normalized building energy use intensity in the data set is at 9.7 ekWh/ft<sup>2</sup>/yr and the highest is at 119.4 ekWh/ft<sup>2</sup>/yr. There are 102 buildings with normalized energy use intensities at or below 20.0 ekWh/ft<sup>2</sup>/yr. In addition, there are 122 buildings in total with energy use performance within the top quartile, below 20.8 ekWh/ft<sup>2</sup>/yr.

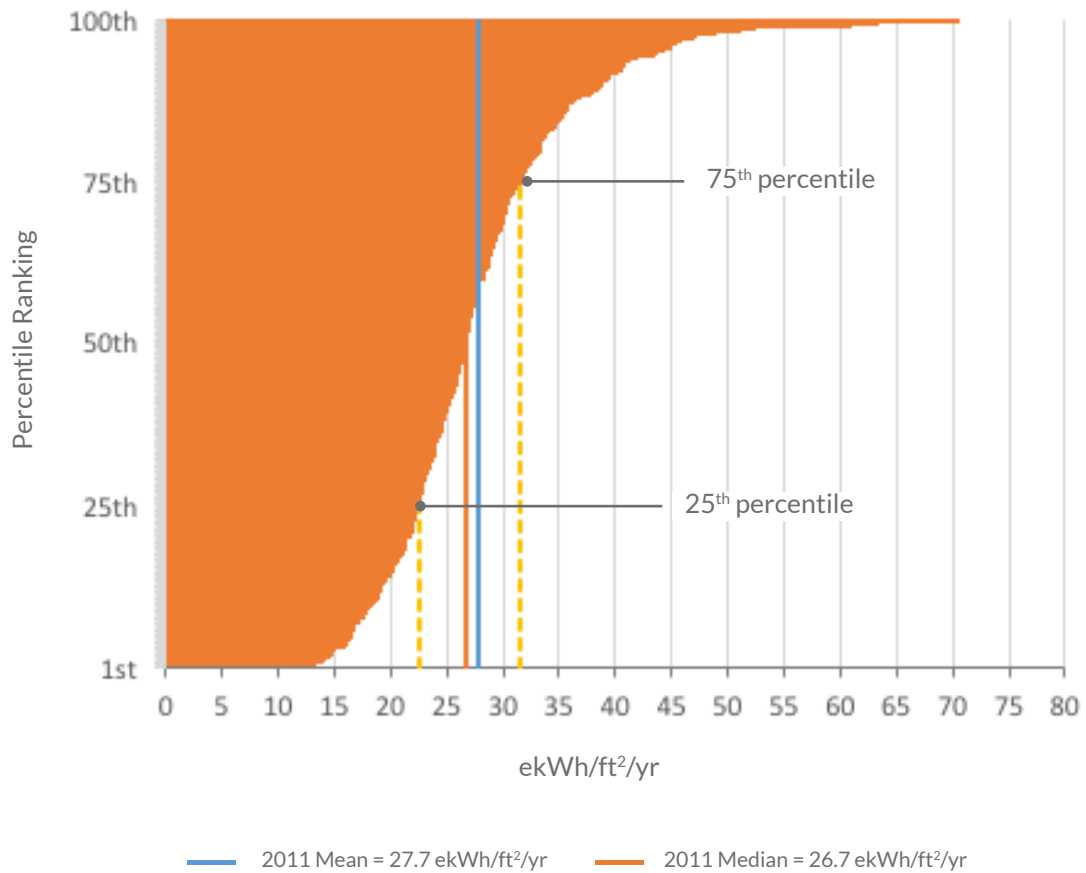
**Figure 11:** Normalized Energy Use Intensity, Canada-wide Data Set for 2012



**Figure 11** shows the 370 buildings in the 2012 Canada-wide data set. The mean normalized energy use intensity is above the median at 26.6 ekWh/ft<sup>2</sup>/yr. The top 25th percentile of this data set begins at 20.8 ekWh/ft<sup>2</sup>/yr and the bottom 75<sup>th</sup> percentile begins at 30.6 ekWh/ft<sup>2</sup>/yr (as indicated by the dashed lines in Figure 11).

The lowest normalized building energy use intensity in the data set is at 10.0 ekWh/ft<sup>2</sup>/yr and the highest is at 85.7 ekWh/ft<sup>2</sup>/yr. There are 83 buildings with normalized energy use intensities at or below 20.0 ekWh/ft<sup>2</sup>/yr. In addition, there are 93 buildings in total with energy use performance within the top quartile, below 20.8 ekWh/ft<sup>2</sup>/yr.

**Figure 12:** Normalized Energy Use Intensity, Canada-wide Data Set for 2011

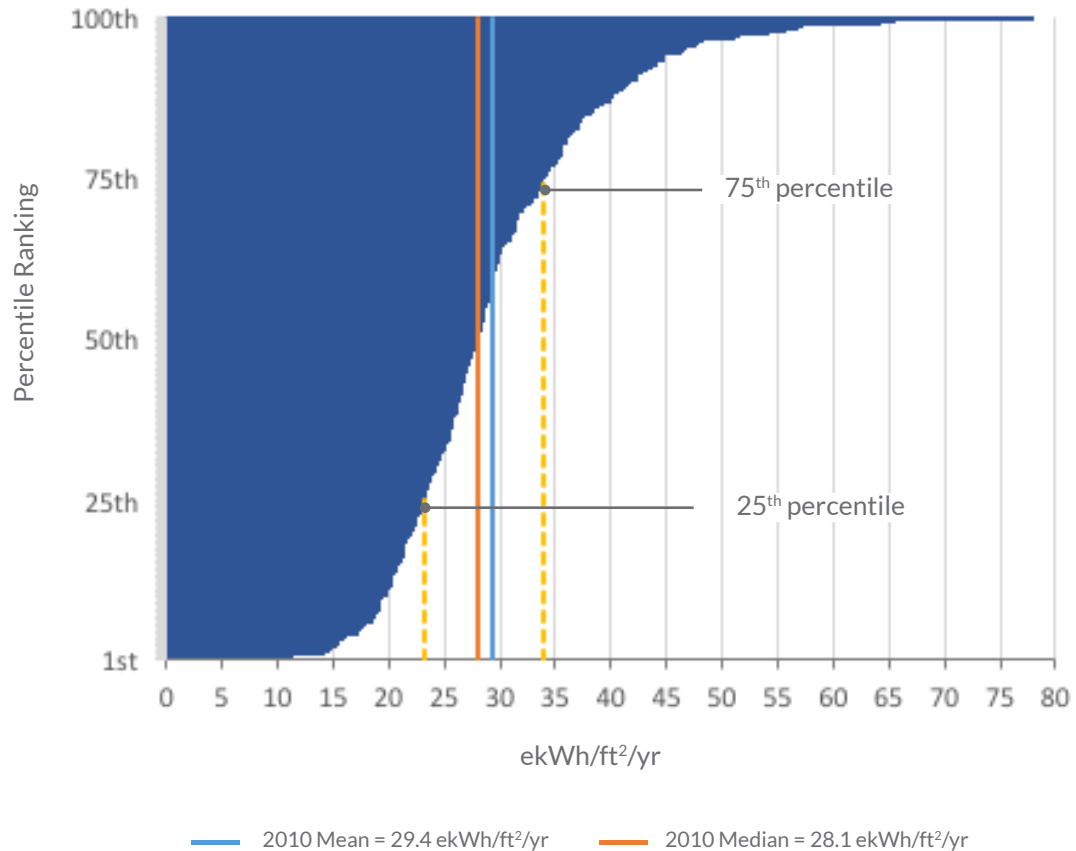


**Figure 12** shows the 367 buildings in the 2011 Canada-wide data set. The mean normalized energy use intensity is above the median at 27.7 ekWh/ft<sup>2</sup>/yr. The top 25<sup>th</sup> percentile of this data set begins at 22.6 ekWh/ft<sup>2</sup>/yr and the bottom 75<sup>th</sup> percentile begins at 31.5 ekWh/ft<sup>2</sup>/yr (as indicated by the dashed lines in Figure 12).

The lowest normalized building energy use intensity in the data set is at 8.2 ekWh/ft<sup>2</sup>/yr and the highest is at 70.6 ekWh/ft<sup>2</sup>/yr. There are 53 buildings with normalized energy use intensities at or below 20.0 ekWh/ft<sup>2</sup>/yr. In addition, there are 92 buildings in total with energy use performance within the top quartile, below 22.6 ekWh/ft<sup>2</sup>/yr.



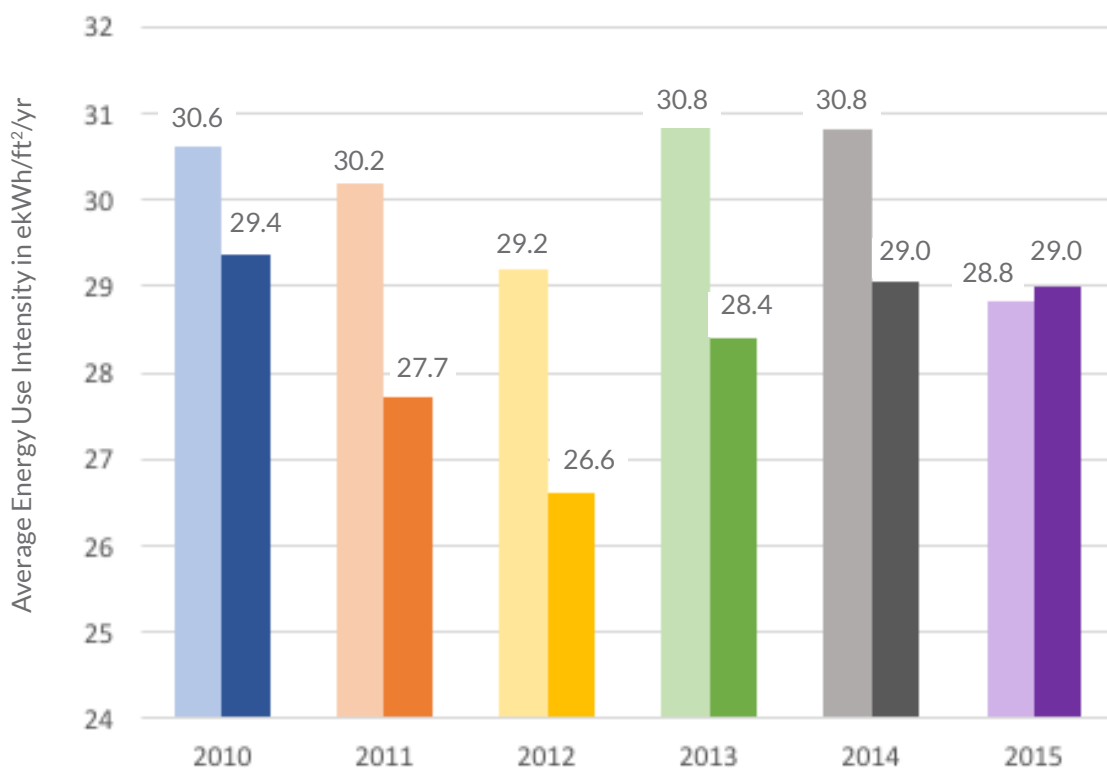
**Figure 13:** Normalized Energy Use Intensity, Canada-wide Data Set for 2010



**Figure 13** shows the 357 buildings in the 2010 Canada-wide data set. The mean normalized energy use intensity is above the median at 29.4 ekWh/ft<sup>2</sup>/yr. The top 25<sup>th</sup> percentile of this data set begins at 23.2 ekWh/ft<sup>2</sup>/yr and the bottom 75<sup>th</sup> percentile begins at 33.9 ekWh/ft<sup>2</sup>/yr (as indicated by the dashed lines in Figure 13).

The lowest normalized building energy use intensity in the data set is at 5.5 ekWh/ft<sup>2</sup>/yr and the highest is at 77.9 ekWh/ft<sup>2</sup>/yr. There are 40 buildings with normalized energy use intensities at or below 20.0 ekWh/ft<sup>2</sup>/yr. In addition, there are 89 buildings in total with energy use performance within the top quartile, below 23.2 ekWh/ft<sup>2</sup>/yr.

**Figure 14: Average Actual and Normalized Energy Use Intensity, Canada-wide, by Year**



Unlike previous Reports, the six-year trend does not show a declining trend, year-over-year, in either average actual energy use or average normalized energy use. While there was an overall absolute reduction in actual energy use and normalized energy use from 2010 to 2015, 5.9% and 1.2% respectively, the largest cumulative reductions were seen from 2010 to 2012 (4.6% and 9.5% respectively).

As in the previous Reports, there was a slight increase in the average normalized energy use from 2012 to 2015. This may be due to the addition of new buildings to the Survey that have yet to start down the path of reducing energy use, or a consequence of the changing mix of building submissions each year, or this increase may be caused by a combination of multiple factors at the property level or the asset management level.

In looking more closely at the data sets across all six years, it can be seen that 210 buildings have either inputted data intermittently (minimum in 2010 and 2015) or they have inputted data consistently every year. This sub-group shows an average reduction in normalized energy use of 9.6% over the six years. There are 64 buildings which reported for 5 years (consistently or intermittently) which achieved an average reduction of 5.5%. Finally, there are 66 buildings which reported for 4 years (consistently or intermittently) with negligible reductions.

**Therefore, it can be concluded that over time, energy benchmarking does support energy efficiency gains.**

Year after year, there are more buildings performing at lower and lower energy intensities, yet the mean or median values do not illustrate this properly. In 2010, more than half of the buildings in the Canada-wide data set performed better than 28.1 ekWh/ft<sup>2</sup>/yr, yet in 2015, more than half of the buildings performed better than 25.7 ekWh/ft<sup>2</sup>/yr. In the highest performing buildings, there is a greater shift seen in energy reductions over time. For example, only 11% of the data set was at 20.0 ekWh/ft<sup>2</sup>/yr normalized energy use intensity or below in 2010 and now 22% of the data set is at 20.0 ekWh/ft<sup>2</sup>/yr or below for 2015. **This shift demonstrates that there is still room for improvement within high performing buildings and those buildings which have worked hard to reduce their energy use significantly in past years are not stopping at a fixed target, but are pushing past performance levels once thought to be realistically unattainable.**

**Table 1: Summary Statistics of Annual Normalized Energy Use Intensity of Canada-wide Data Set**

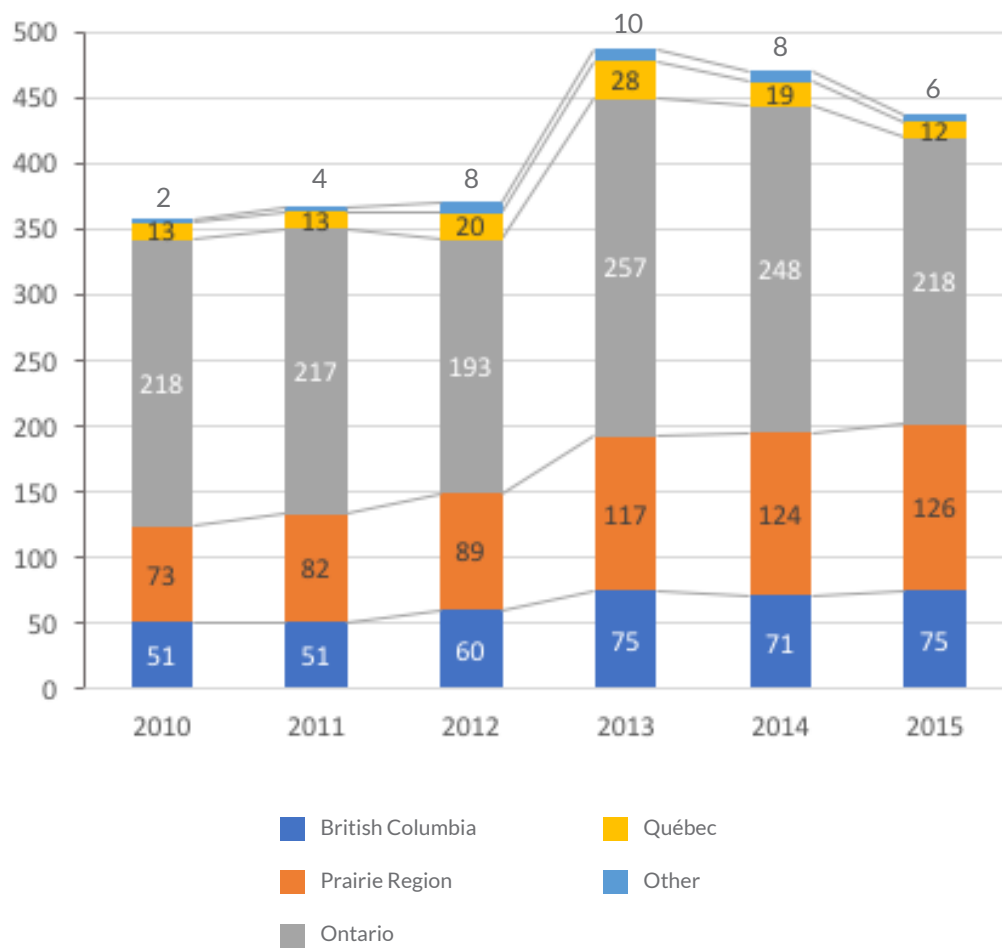
Year	Number of Buildings	Data Set Range Min. (ekWh/ft <sup>2</sup> /yr)	Data Set Range Max. (ekWh/ft <sup>2</sup> /yr)	Mean Normalized Energy Use Intensity (ekWh/ft <sup>2</sup> /yr)	Median Normalized Energy Use Intensity (ekWh/ft <sup>2</sup> /yr)	Number of Buildings at the 25 <sup>th</sup> Percentile or lower	Number of Buildings at or Below 20.0 ekWh/ft <sup>2</sup> /yr	Proportion of Data Set at or Below 20.0 ekWh/ft <sup>2</sup> /yr
2010	357	5.5	77.9	29.4	28.1	89	40	11%
2011	367	8.2	70.6	27.7	26.7	92	53	14%
2012	370	10.0	85.7	26.6	24.8	93	83	22%
2013	487	9.7	119.4	28.4	25.6	122	102	21%
2014	470	12.1	140.0	29.0	25.9	118	81	17%
2015	437	11.6	137.8	29.0	25.7	109	94	22%

### 5.3. Regional Trends

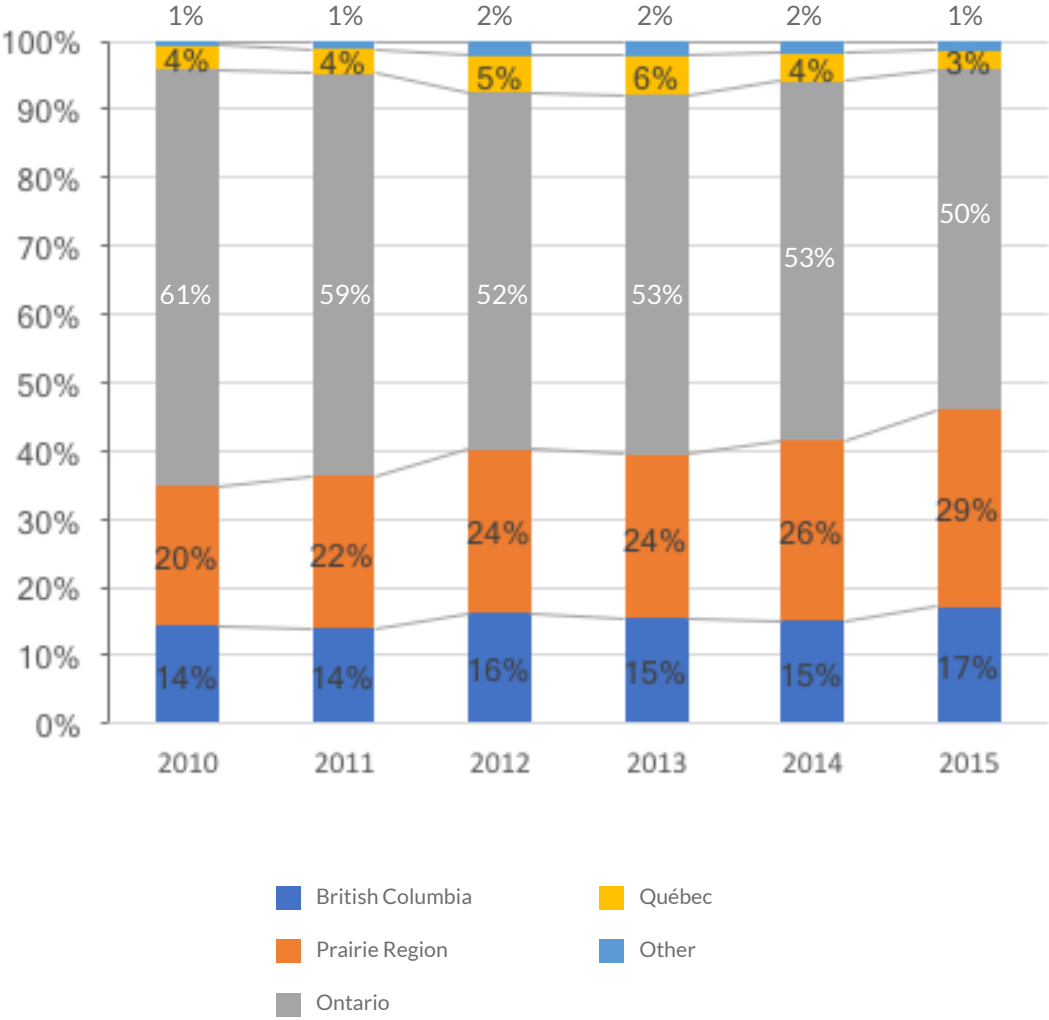
Even with fluctuations in the total number of buildings in the Surveys, the relative proportion of buildings located in the various regions remains consistent. The charts in Figure 15 illustrate the proportion of buildings that can be found in provinces/geographic regions such as British Columbia, the Prairie Region (Alberta, Manitoba and Saskatchewan), Ontario and Québec. As was the case in the previous Reports and notwithstanding drops or jumps in building participation, the vast majority of buildings in the 2015 data set are located in Ontario (50%) followed by the next significant proportion which are located in the Prairie Region (29%).

Figure 15: Regional Distribution Comparison by Category and Year

Number of Buildings in Data Set

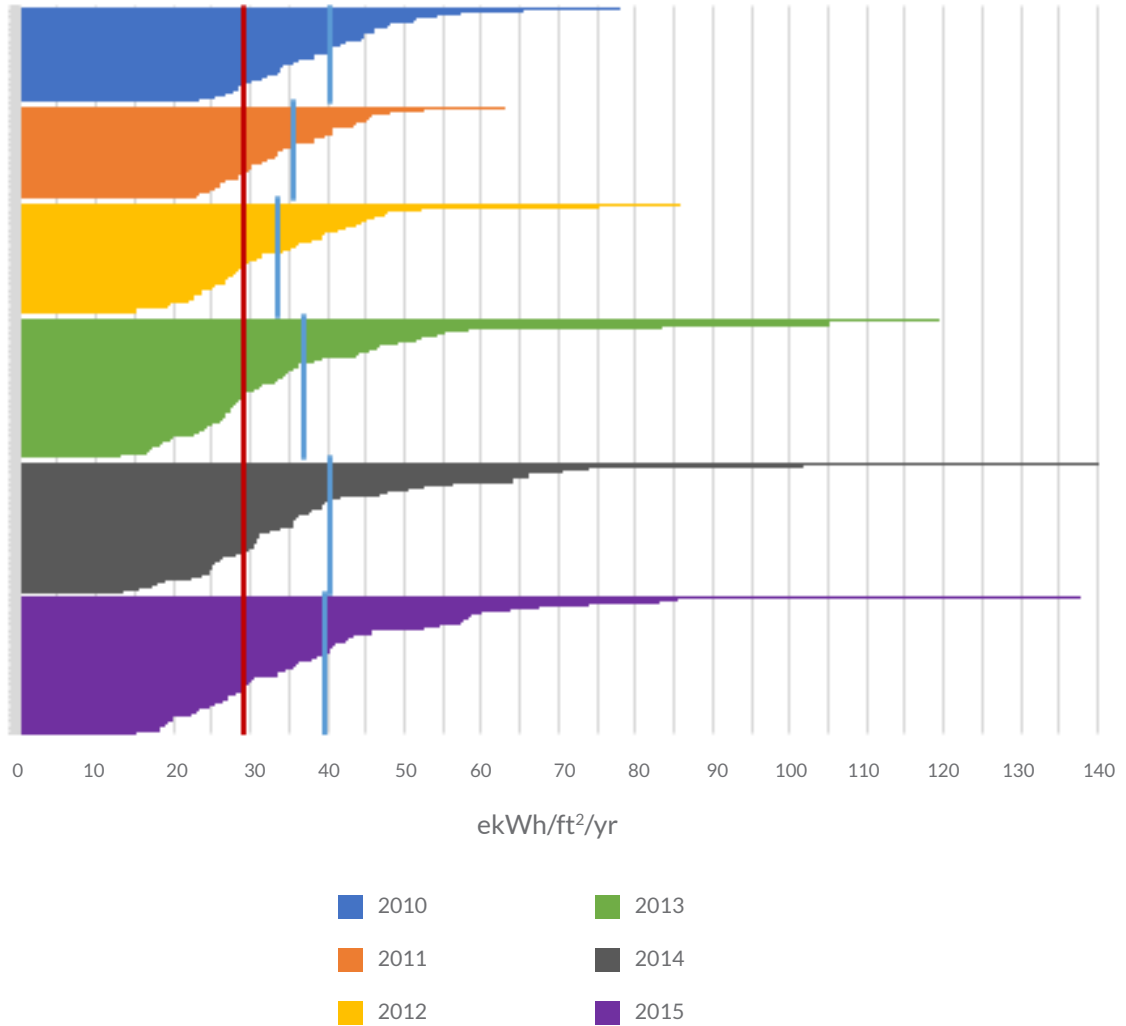


Relative Percentage of Total Buildings in Data Set



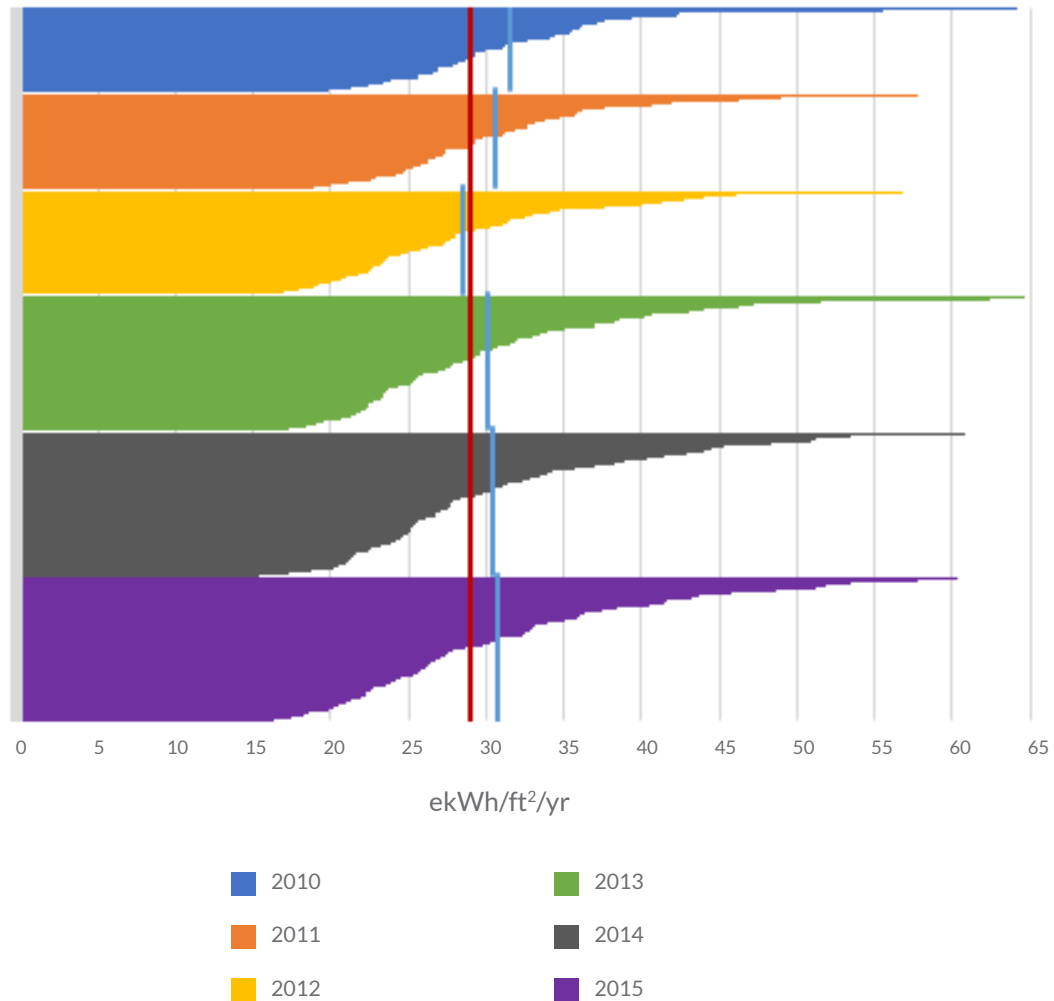
The following three charts exhibit the normalized annual energy use intensity of buildings within British Columbia, the Prairie Region and Ontario separately and include data compared over six years. Québec is excluded in this analysis due to its small number of buildings included in the data set.

**Figure 16: Normalized Building Energy Use Intensity for British Columbia, by Year**



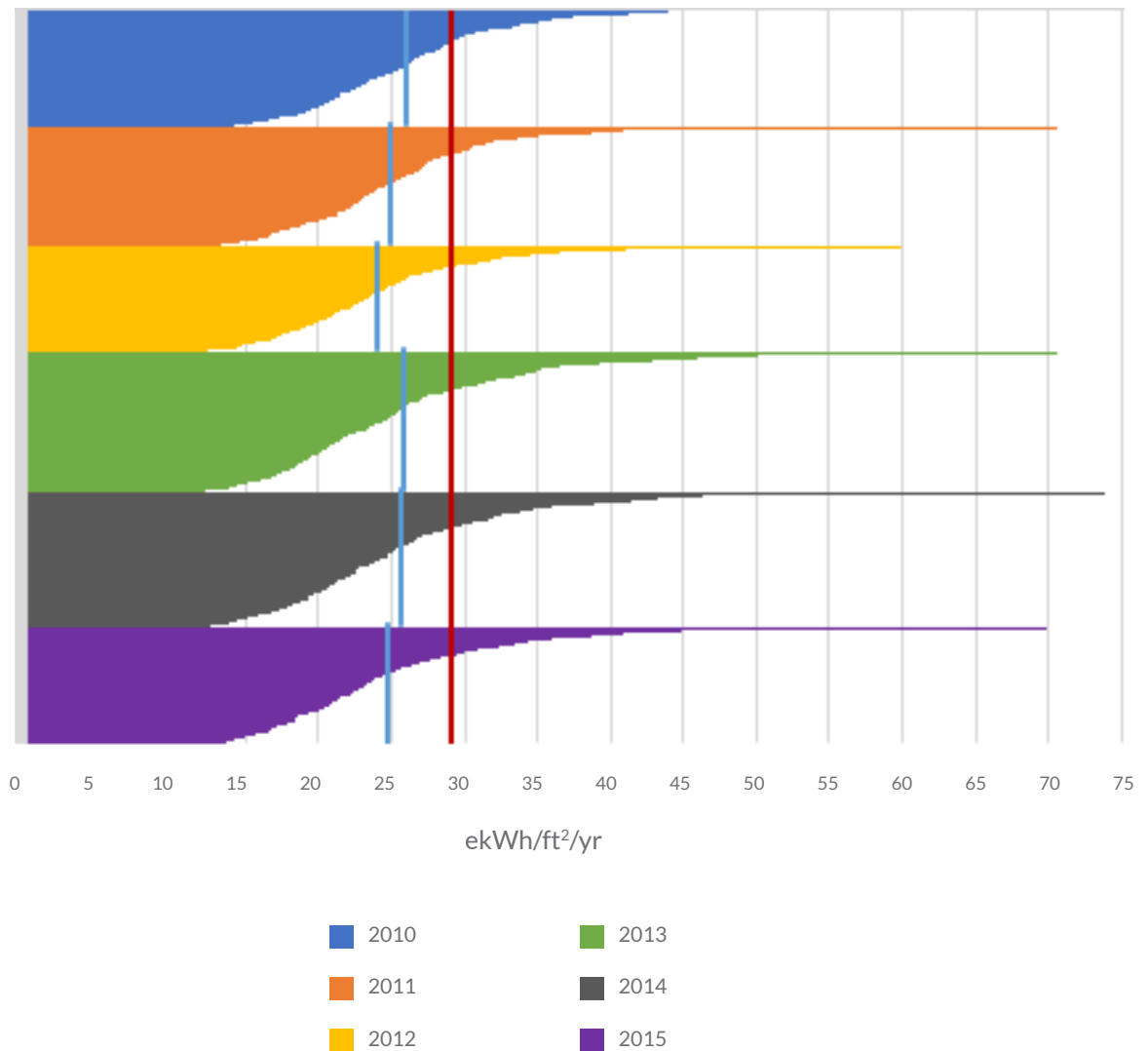
**Figure 16** highlights the mean normalized energy intensity for the Canada-wide data set in 2015 (red bar, 29.0 kWh/ft²/yr) and the mean normalized energy intensity for each year in British Columbia (blue bars). For all six years, the mean in British Columbia has been above the 2015 national mean, the lowest is at 33.5 kWh/ft²/yr in 2012 and the highest at 40.4 kWh/ft²/yr in 2014.

**Figure 17:** Normalized Building Energy Use Intensity for the Prairie Region, by Year



**Figure 17** highlights the mean normalized energy intensity for the Canada-wide data set in 2015 (red bar, 29.0 ekWh/ft²/yr) and the mean normalized energy intensity for each year in the Prairie Region (blue bars). Almost like the British Columbia data set, the mean in the Prairie Region has been above the national mean each year, except in 2012. In 2010, the mean was highest at 31.5 ekWh/ft²/yr and then decreased to its lowest at 28.4 ekWh/ft²/yr in 2012, followed by an increase to 30.7 ekWh/ft²/yr in 2015.

**Figure 18:** Normalized Building Energy Use Intensity for Ontario, by Year



**Figure 18** highlights the mean normalized energy intensity for the Canada-wide data set in 2015 (red bar, 29.0 kWh/ft<sup>2</sup>/yr) and the mean normalized energy intensity for each year in Ontario (blue bars). The Ontario data set contrasts with those of both British Columbia and the Prairie Region because it is much larger in its number of buildings each year and the provincial mean has been below the national mean in all of the years surveyed. The movement of the mean is from the highest in 2010 at 26.1 kWh/ft<sup>2</sup>/yr and then decreases to its lowest at 24.1 kWh/ft<sup>2</sup>/yr in 2012, and increases again in 2014 to 25.8 kWh/ft<sup>2</sup>/yr. In 2015 the Ontario mean normalized energy intensity was 24.7 kWh/ft<sup>2</sup>/yr.



Figure 19: Average Normalized Building Energy Use by Region and Year

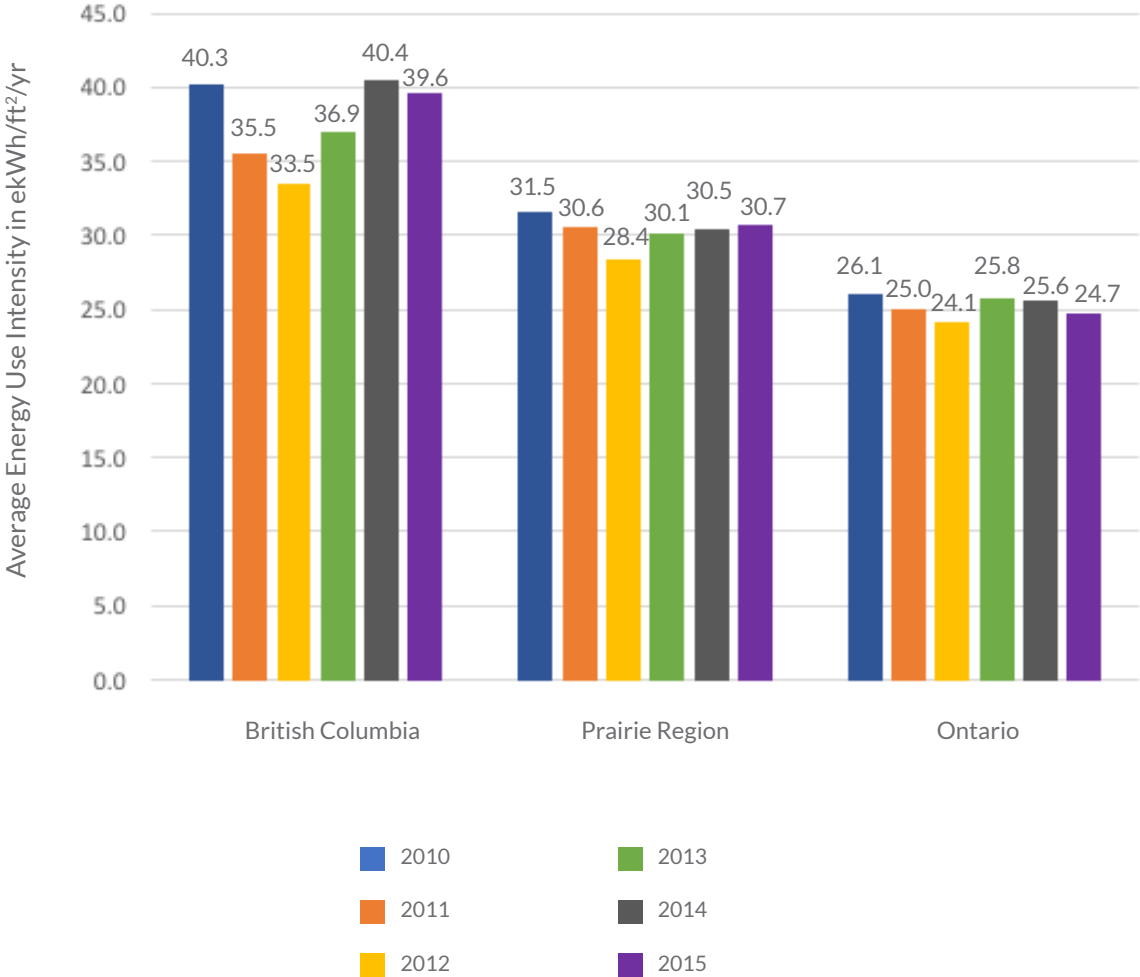
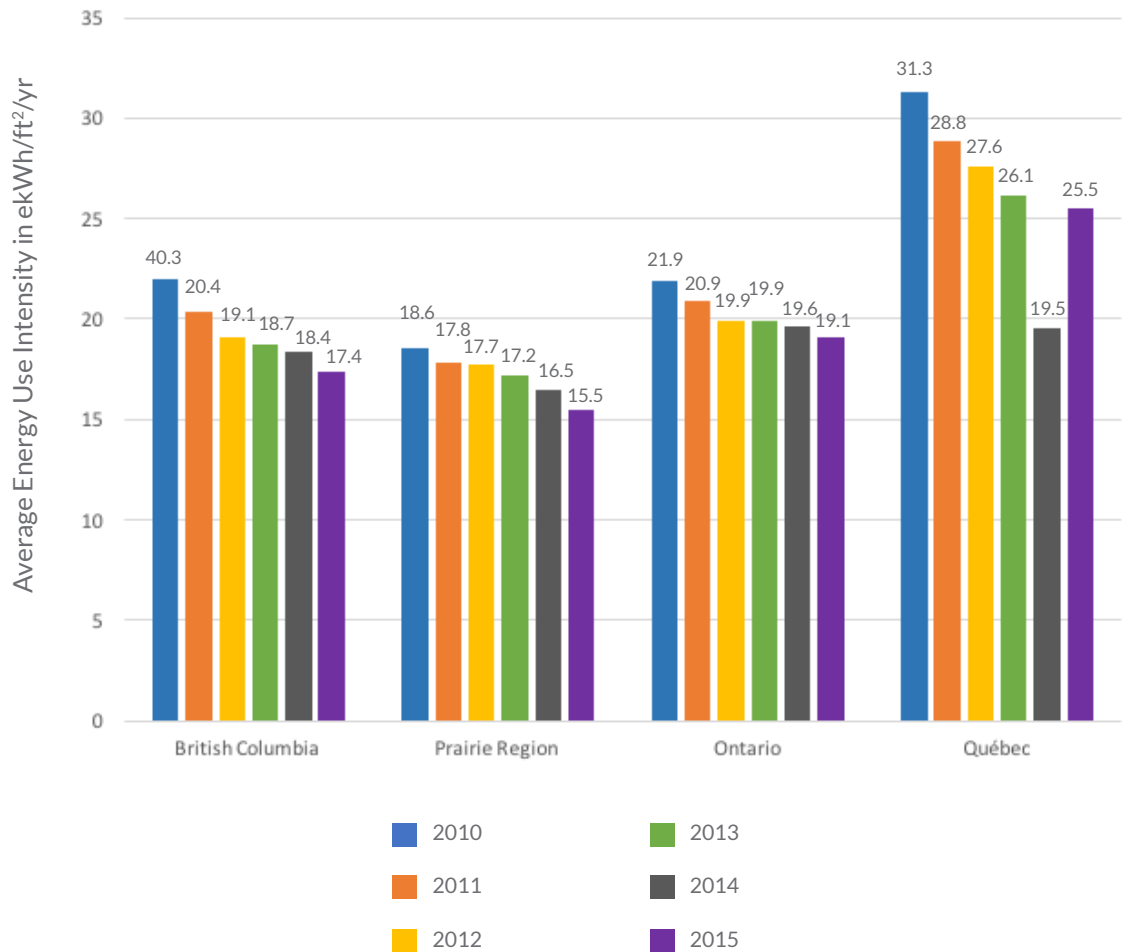


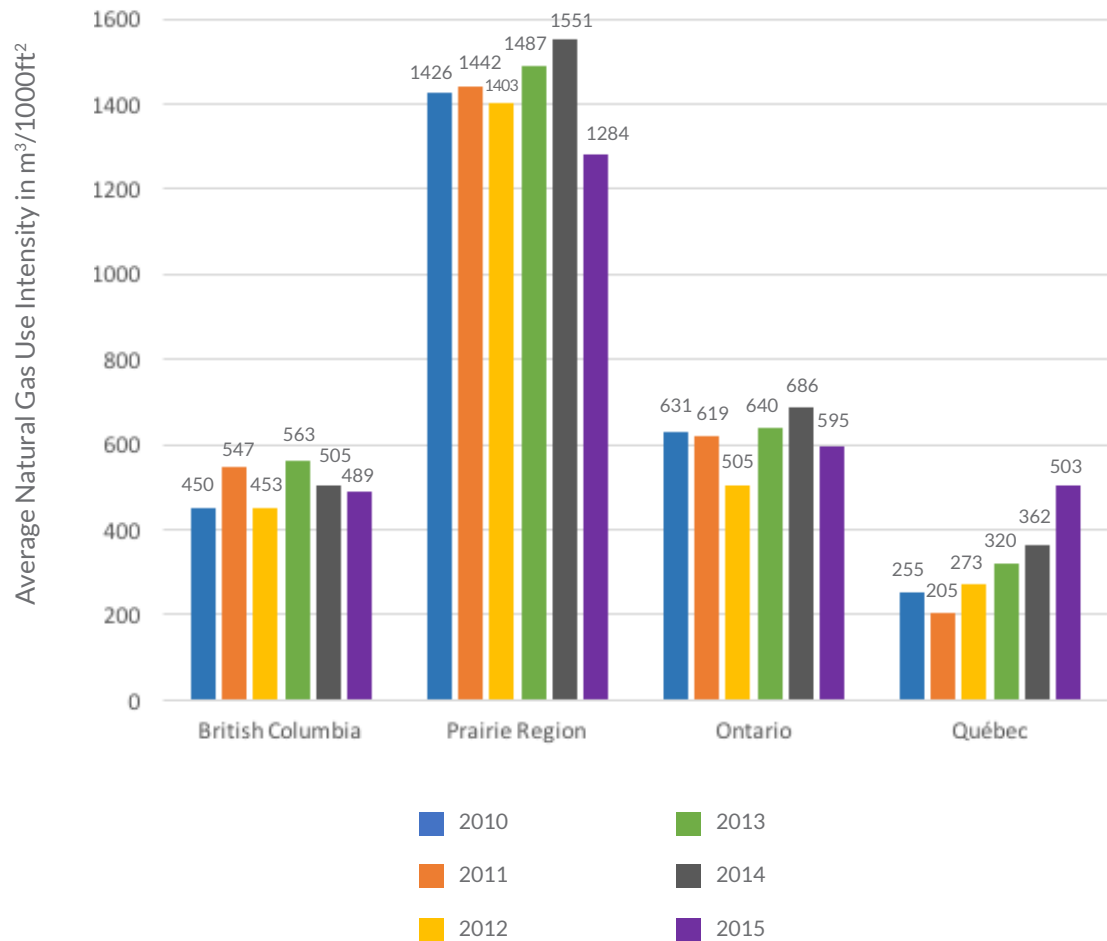
Figure 19 comparatively illustrates trends in average normalized energy use in British Columbia, the Prairie Region and Ontario.

**Figure 20: Average Actual Electricity Use Intensity by Region and Year**



As was done in the previous Energy Benchmarking Reports, analysis of electricity use and natural gas use has been performed for each region and is compared over the six-year period. Figure 20 displays the average actual electricity use intensity in each region and shows that Québec had a higher intensity each year than the other regions, except for 2014. Québec’s average intensities range from 31.3 to 25.5 kWh/ft<sup>2</sup>, in 2010 and 2015, respectively. British Columbia’s range of intensities is second highest to Québec at 40.3 to 17.4 kWh/ft<sup>2</sup>, from 2010 to 2015, respectively. The Prairie Region is entirely below the Ontario range with Ontario starting at 21.9 kWh/ft<sup>2</sup> in 2010, then lowering to 19.1 kWh/ft<sup>2</sup> in 2015. The Prairie Region moves from a lower intensity of 18.6 kWh/ft<sup>2</sup> in 2010, to 15.5 kWh/ft<sup>2</sup> in 2015.

The overall trend observed in this chart is a steady reduction in electricity use, yet the values reported are not weather normalized and will be influenced by weather variations, specifically variations in cooling degree days between years, potentially resulting in increases and/or decreases in use.

**Figure 21: Average Actual Natural Gas Use Intensity by Region and Year**

**Figure 21** displays the average natural gas use intensity (in  $\text{m}^3/1,000 \text{ ft}^2$ ) in each region and indicates, as per all previous reports, a large inconsistency between the intensity of natural gas use in the Prairie Region as compared to British Columbia, Ontario and Québec. For all years except 2015, Québec shows a lower average intensity than any other region. British Columbia's range of intensities is second lowest to Québec with values between 450 and 563  $\text{m}^3/1,000 \text{ ft}^2$ . Overlapping with British Columbia is Ontario, with 505  $\text{m}^3/1,000 \text{ ft}^2$  as the lowest metric in 2012 and increasing to 686  $\text{m}^3/1,000 \text{ ft}^2$  in 2014. The Prairie Region has by far the greatest natural gas use intensity, shifting from a six-year high of 1551  $\text{m}^3/1,000 \text{ ft}^2$  in 2014 to a six-year low of 1284  $\text{m}^3/1,000 \text{ ft}^2$  in 2015.

The trends observed in this chart are partially reductions and partially increases in natural gas use across the country, from 2010 to 2015. However, as in Figure 20, the values reported are not weather normalized and will integrate weather variations in the different regions, specifically variations in heating degree days between years, into perceived increases and/or decreases in use.

### 5.4. City Centre Trends

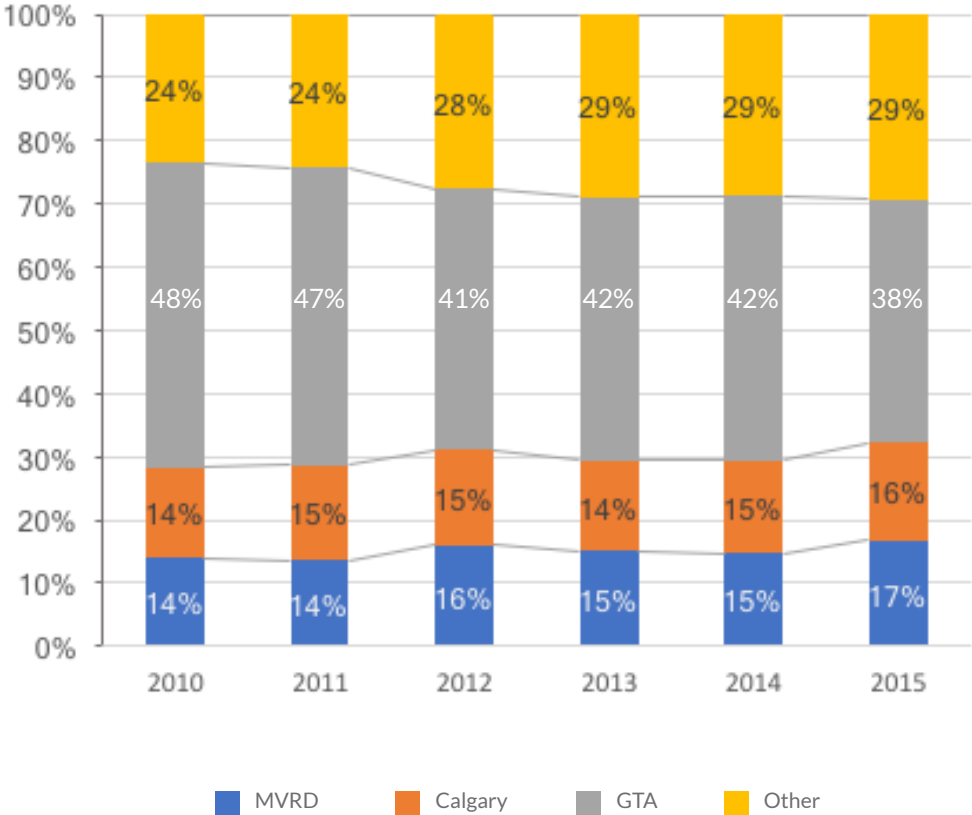
Although each of the Surveys completed to date have collected data on buildings from across Canada, most of those buildings are located in major city centres. All three of the following data sets are sufficiently large to provide meaningful breakouts and analysis of sub-regional and city centre data. Figures 21 through 24 illustrate the trends in the normalized energy use intensity data for the Greater Toronto Area (GTA), Calgary and the Metro Vancouver Regional District (MVRD).

**Figure 22: City Centre Distribution Comparison by Category and Year**

Number of Buildings in Data Set

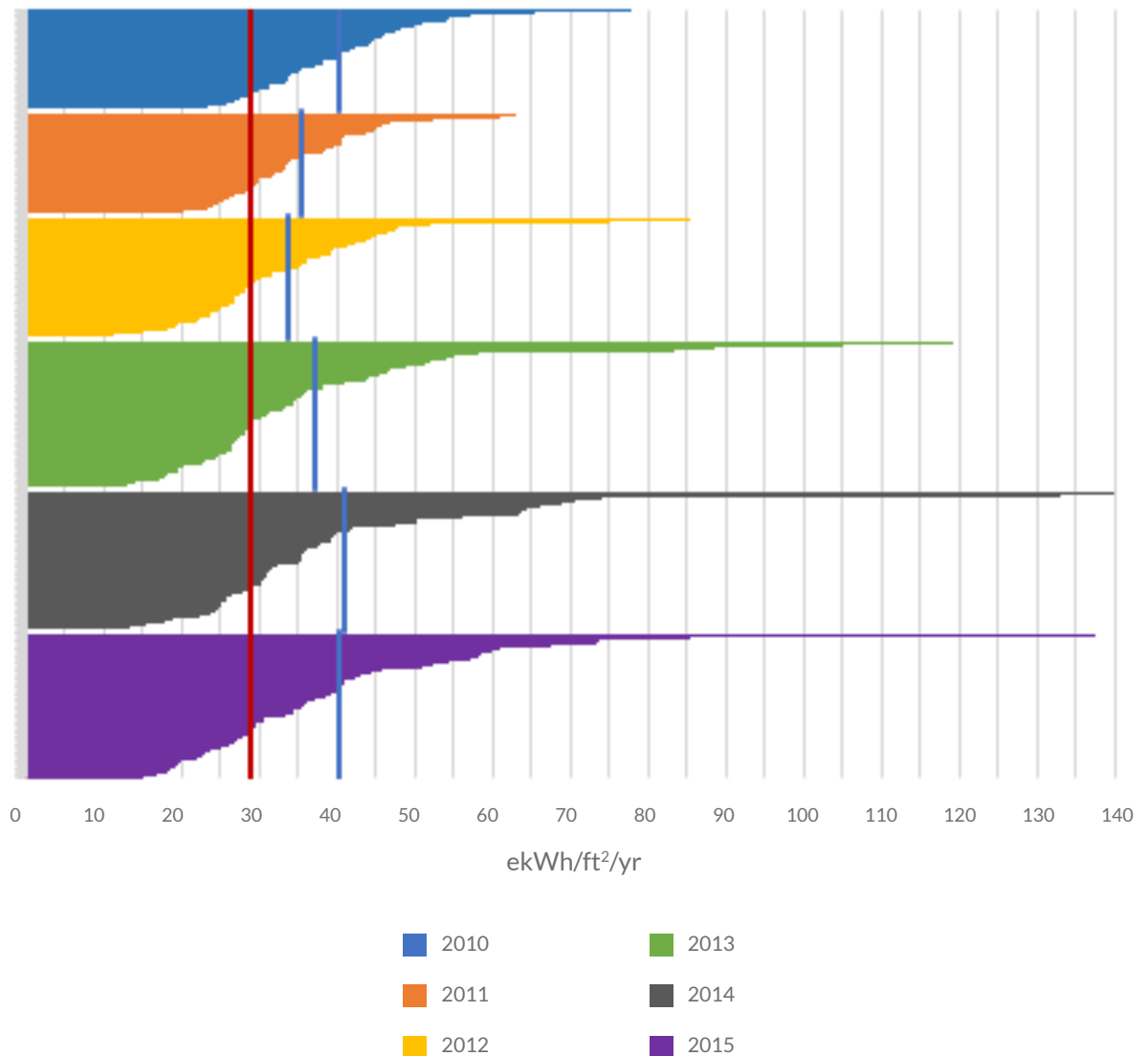


Relative Percentage of Total Buildings in Data Set



As is the case for previous data, the proportion of buildings located in the GTA in all six years is consistently more than both Calgary and the MVRD combined. In 2015, there are 168 buildings in the GTA data set (38% of total), 68 buildings in the Calgary data set (16% of total) and 73 buildings in the MVRD data set (17% of total).

**Figure 23: Average Normalized Energy Use Intensity for the Metro Vancouver Regional District, by Year**

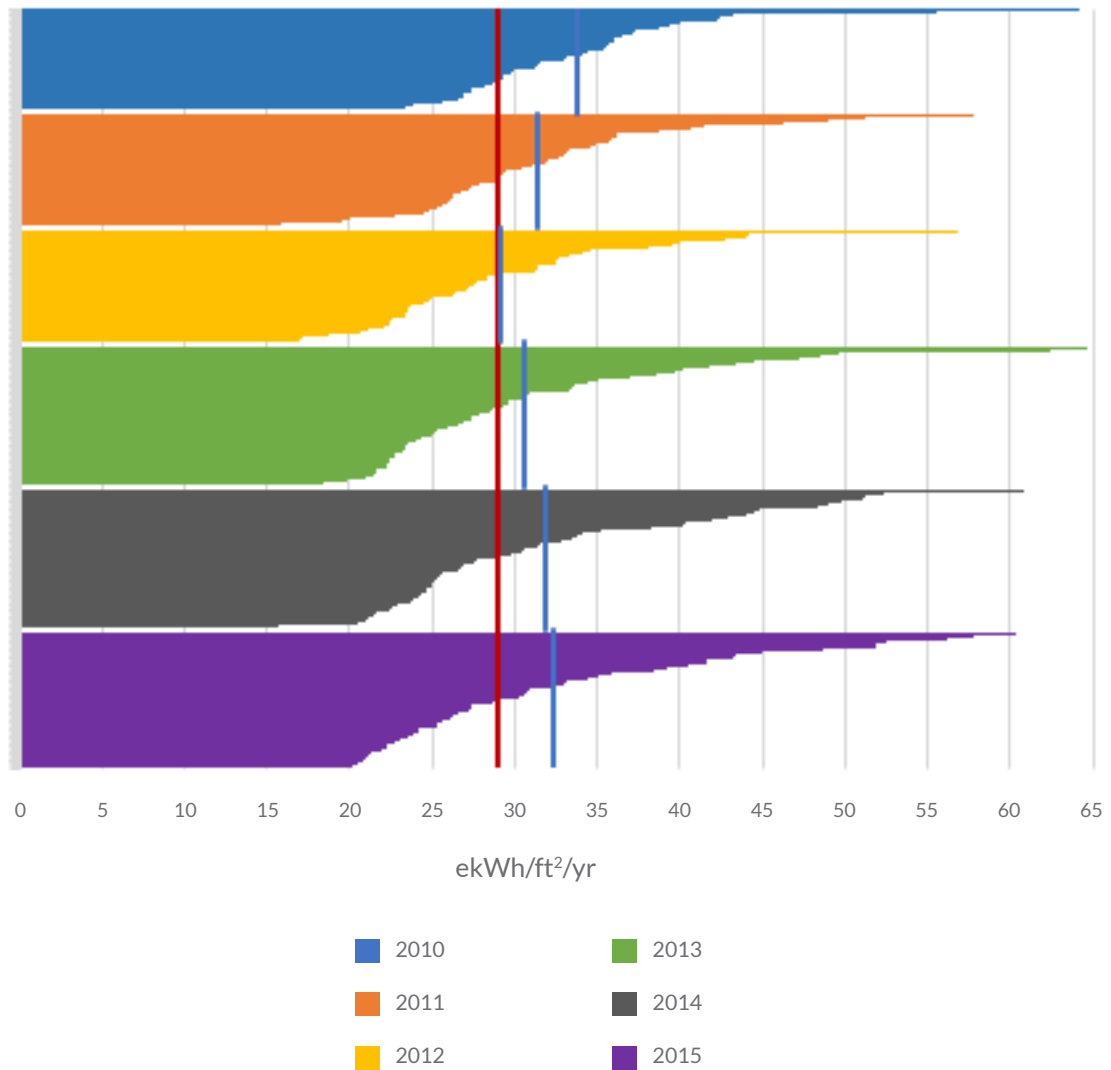


**Figure 23** shows the average national normalized intensity in 2015 (29.0 ekWh/ft²/yr) with a red bar and the average of the MVRD data sets each year in blue. In 2010, the MVRD average was 40.5 ekWh/ft²/yr, and then decreased to its lowest at 33.7 ekWh/ft²/yr in 2012, and then rose to 41.0 ekWh/ft²/yr in 2014, before ending at 39.6 ekWh/ft²/yr in 2015.

In the 2015 data set, the lowest normalized building energy use intensity is at 15.2 ekWh/ft²/yr and the highest is at 137.8 ekWh/ft²/yr with the top 25th percentile of the MVRD data set beginning at 26.8 ekWh/ft²/yr and the bottom 75th percentile beginning at 45.8 ekWh/ft²/yr.

In 2015, there are nine buildings with a normalized energy use intensity at or below 20.0 ekWh/ft²/yr and there are 18 buildings with energy use performance within the top quartile, below 26.8 ekWh/ft²/yr.

**Figure 24:** Average Normalized Energy Use Intensity for Calgary, by Year

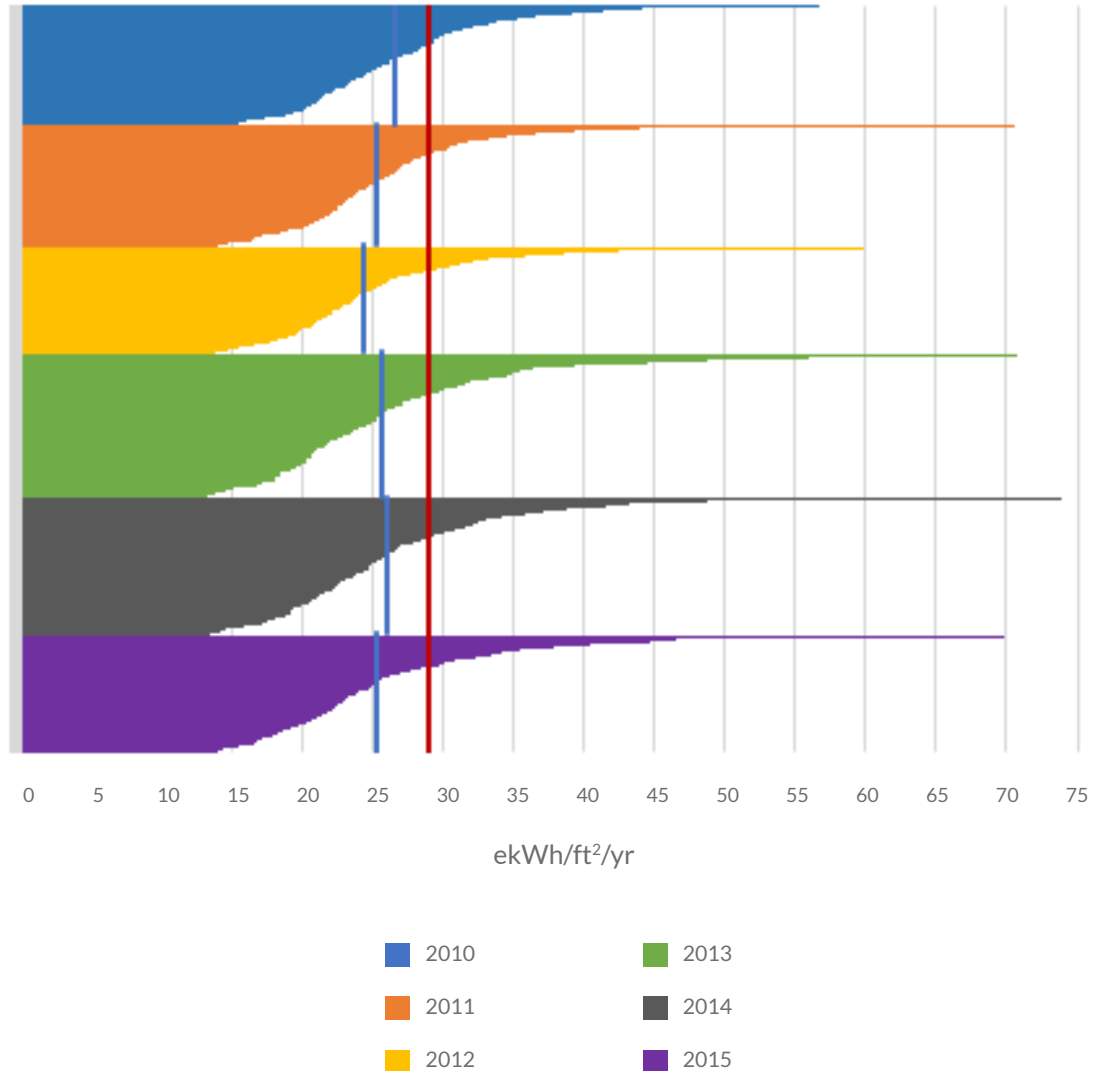


**Figure 24** shows the average national normalized intensity in 2015 (29.0 ekWh/ft²/yr) with a red bar and the average of the Calgary data sets each year in blue. In 2010, the Calgary average was 33.8 ekWh/ft²/yr, and then decreased to 29.1 ekWh/ft²/yr in 2012, followed by an increase to 32.4 ekWh/ft²/yr in 2015.

In the 2015 data set, the lowest normalized building energy use intensity is at 17.5 ekWh/ft²/yr and the highest is at 60.4 ekWh/ft²/yr with the top 25<sup>th</sup> percentile of the Calgary data set beginning at 23.8 ekWh/ft²/yr and the bottom 75<sup>th</sup> percentile beginning at 40.1 ekWh/ft²/yr.

There is one building with normalized energy use intensity at or below 20.0 ekWh/ft²/yr and there are 17 buildings with energy use performance within the top quartile, below 23.8 ekWh/ft²/yr.

**Figure 25:** Average Normalized Energy Use Intensity for the Greater Toronto Area, by Year



**Figure 25** shows the average national normalized energy use intensity in 2015 (29.0 ekWh/ft<sup>2</sup>/yr) with a red bar and the average GTA data sets each year in blue. In 2010, the average was 26.6 ekWh/ft<sup>2</sup>/yr, and then decreased to 24.4 ekWh/ft<sup>2</sup>/yr in 2012, followed by an increase in 2014 to 25.6 ekWh/ft<sup>2</sup>/yr, ending in 2015 at 25.3 ekWh/ft<sup>2</sup>/yr.

In the 2015 data set, the lowest normalized building energy use intensity is at 11.6 ekWh/ft<sup>2</sup>/yr and the highest is at 69.8 ekWh/ft<sup>2</sup>/yr with the top 25th percentile of the GTA data set beginning at 19.9 ekWh/ft<sup>2</sup>/yr and the bottom 75th percentile beginning at 29.3 ekWh/ft<sup>2</sup>/yr.

There are 44 buildings with a normalized energy use intensity at or below 20.0 ekWh/ft<sup>2</sup>/yr and there are 42 buildings with energy use performance within the top quartile, below 19.9 ekWh/ft<sup>2</sup>/yr.



Figure 26: Average Normalized Energy Use by City Centre and Year

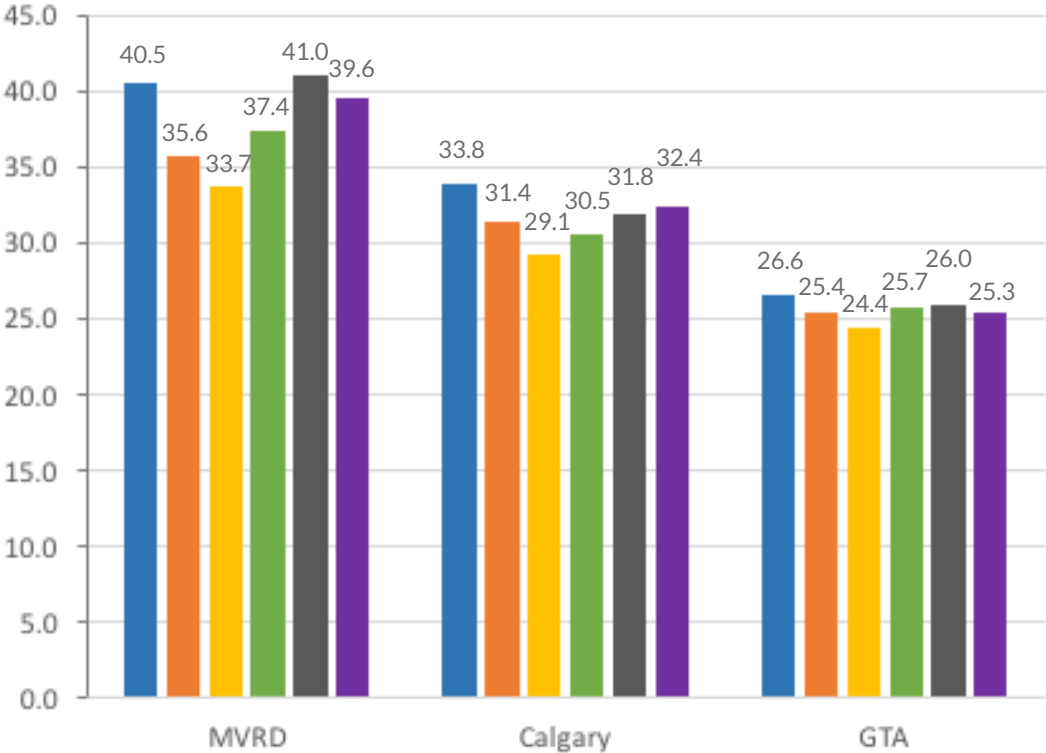
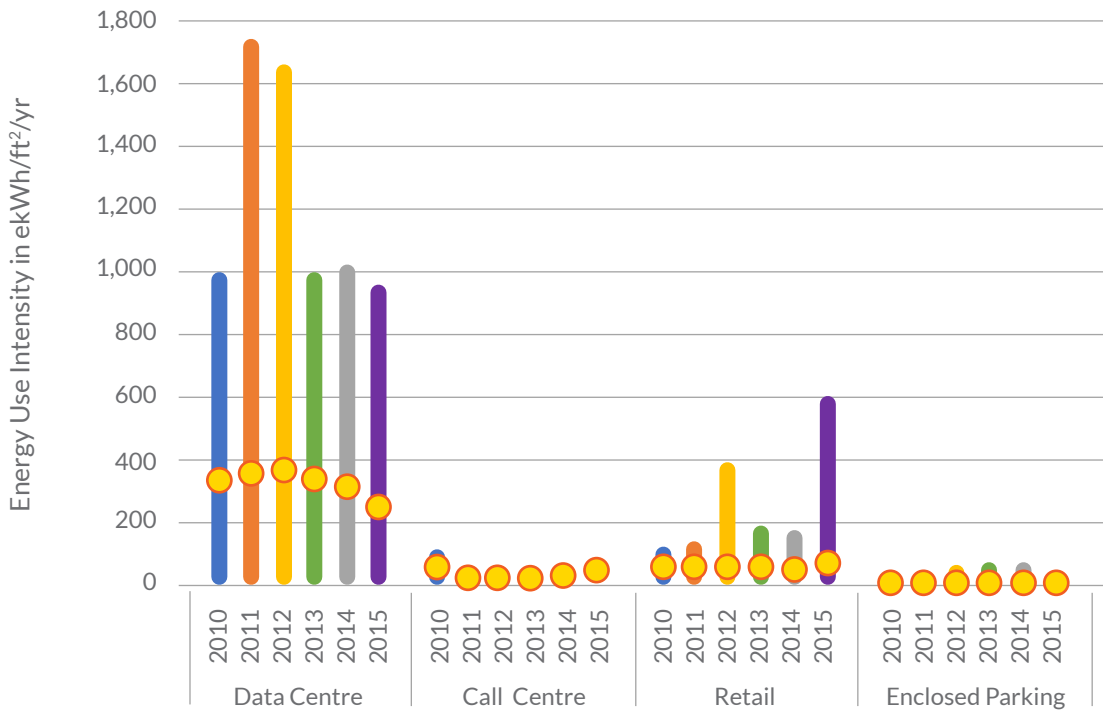


Figure 26 comparatively illustrates trends in average normalized energy use in each city centre.

### 5.5. High Intensity or Exceptional Space Type Trends

Over the six years of the Survey, more and more participants have reported having sub-metered high intensity space types (e.g. data centre, retail) or exceptional space types within their buildings.

**Figure 27: High Intensity/Exceptional Energy Use Intensity – Mean and Ranges by Space Type and Year**



**Figure 27** shows that the ranges for electricity use in high intensity energy use space types can be wide for some categories and the mean intensities for each space type may vary over the years. The annual energy use intensity for data centres runs between 11.7 kWh/ft²/yr (2015) and 1,721.3 kWh/ft²/yr (2011) with a mean intensity of 248.3 kWh/ft²/yr for 2015. The annual energy use intensity for retail spaces for 2015 covers 7.4 to 578.4 kWh/ft²/yr and has a mean of 54.6 kWh/ft²/yr, but the range expands lower in 2014, down to 2.2 kWh/ft²/yr.

Other space types can include, but are not limited to, restaurants, fitness centres, or medical centres and has also included meters for telecommunication towers and public transit stations in recent years. The range in electricity use intensity for this category has spread over the six years with the range extending from 0.5 kWh/ft²/yr (2013) to 2,496,256 kWh/ft²/yr (2012). Due to this large range of values compared to the other categories, other space types were not included in Figure 27.

## 6. Conclusion

The purpose of the 20 by '15 target was to challenge Canadian office buildings to achieve an energy consumption target of 20 ekWh/ft<sup>2</sup>/yr by 2015. In 2015, there were 437 buildings in the data set and 94 of them (22%) achieved or were below the 20 ekWh/ft<sup>2</sup>/yr target. The mean actual energy use intensity for all buildings was 28.8 ekWh/ft<sup>2</sup>/yr and their mean normalized energy use intensity was 29.0 ekWh/ft<sup>2</sup>/yr.

Although about a quarter of the participating buildings achieved the 20 ekWh/ft<sup>2</sup>/yr target, it is important to note that not all of them had participated for the full duration of the Program. Overall, a reduction of total energy use was still observed. From 2010 to 2015, there was a 5.9% overall absolute reduction in actual energy use and a 1.2% overall absolute reduction in normalized energy use.

**When looking at the 210 buildings that consistently or intermittently participated in the Survey over the six years, there was a 9.6% reduction in normalized energy use. The 64 buildings which reported for 5 years (consistently or intermittently) achieved a 5.5% reduction in normalized energy use. Therefore, this seems to prove that over time, energy benchmarking does support energy efficiency gains.**

There are also regulatory implications for buildings that have participated in the 20 by '15 target. For example, Ontario is implementing mandatory energy and water reporting and benchmarking for commercial and some multi-

unit residential and industrial buildings of 50,000 ft<sup>2</sup> or larger. This reporting requirement will be phased in over three years, starting July 1, 2018 for buildings that are 250,000 ft<sup>2</sup> or greater. Buildings that have participated in 20 by '15 will already have familiarity with energy reporting and benchmarking and will have a head start complying with this regulation. Furthermore, if other provinces implement similar regulations or energy targets, 20 by '15 buildings will be a step ahead.

REALPAC's Energy Benchmarking Program has made a significant impact on the commercial office sector over the past six years. It has provided a path toward actively measuring and benchmarking energy use in buildings, generated lively debate around relative vs. absolute energy performance metrics and filled a gap in the marketplace where there once was a lack of comparable, Canada-wide benchmarking data available.

**After six years of recording trends and watching the industry evolve in their management of building energy consumption, it is gratifying to see the direction of the overall trend is toward energy use reductions.** REALPAC is pleased to advance the long-term vitality of Canada's real property sector and will continue to support green initiatives and energy efficient practices in commercial buildings.

<sup>4</sup> Ontario Government. Ontario Regulation 20/17: Reporting of Energy Consumption and Water Use. Retrieved November 14, 2017 from [https://www.ontario.ca/laws/regulation/r17020.?\\_ga=2.55163179.1831305613.1505225830-135744608.1505225830](https://www.ontario.ca/laws/regulation/r17020.?_ga=2.55163179.1831305613.1505225830-135744608.1505225830)



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