BOULDER BUILDING PERFORMANCE PROGRAM

2015/2016 Report

CONTENTS

I. **Executive Summary** 2

II. **Introduction** 4

III. **Building Performance Ordinance** 7

Building Performance Program 9

IV. **Rating & Reporting Results** 11

Compliance 12

Commercial & Industrial Reporting 13

Large Industrial Campus Reporting 27

How Does Boulder Compare? 29

Savings Potential 32

V. **Next Steps** 35

Building Report Cards 35

Data Publication 35

Reporting Timeline 35

VI. **Acknowledgments** 37

VII. **Glossary** 38

Appendix A 39

I. EXECUTIVE SUMMARY

Energy consumption from the commercial and industrial (C&I) sector accounts for over 50 percent of the City of Boulder's greenhouse gas (GHG) emissions footprint. Boulder City Council adopted the Building Performance Ordinance in October 2015 to require actions that reduce energy use and emissions in the C&I sector and improve the quality of Boulder's C&I building stock. The ordinance was adopted with the objectives of increasing awareness of building energy performance, realizing cost effective energy savings, informing design of future programs and driving market transformation. Further, the ordinance is a key initiative toward achieving the community's recently adopted Climate Commitment goal of an 80 percent reduction in GHG emissions by 2050.

In 2016, the first year of the Boulder Building Performance Program, Boulder achieved an unprecedented 100 percent compliance rate, collected energy use data on its largest C&I buildings and identified energy and cost savings potential throughout the C&I sector. This report presents the program results for the 2016 reporting year, which covers energy data for calendar year 2015.

RATING & REPORTING HIGHLIGHTS

Compliance

165 buildings

representing over 16 million square feet (sf), were subject to the Building Performance Ordinance in 2016.

50% represented

These buildings represent nearly 50% of the total city-owned and private commercial and industrial square footage in Boulder.

5 buildings received exemptions;

the remaining 160 were required to report calendar year 2015 energy data to the city.

The program achieved 100% compliance in 2016.

Energy & Emissions

143 building energy reports

After exemptions and data cleaning, as well as the removal of large industrial campuses,[1] analysis was conducted on 143 building energy reports, representing a total of just under 12 million sf.

83 Boulder Median EUI (kBTU/sf) | **70** Median ENERGY STAR® score

The median energy use intensity (EUI) of 83 kBTU/sf-year and the median ENERGY STAR® score of 70 indicate Boulder's largest buildings are performing similar to other leading cities, such as Chicago, Seattle and Cambridge.

23% of C&I Emissions

The total emissions reported by the 143 buildings represent 23% of the C&I footprint and 12 % of the overall community footprint based on the 2015 community greenhouse gas inventory.

Based on analysis of 2015 energy data reported, potential savings opportunities of 467,000 MMBTU exist in the largest buildings of the C&I sector. Capturing these savings would require approximately $25 million in energy efficiency investments, and could result in $10 million in energy cost savings annually, a reduction of 94,000 metric tons of carbon-dioxide equivalent (MT CO2e) and the creation of over 120 jobs.

[1] Large industrial campuses were not included in data analysis due to their custom rating and reporting requirements.

COMMERCIAL AND INDUSTRIAL (C&I) BUILDING ENERGY USE ACCOUNTED FOR

51%

OF BOULDER'S GREENHOUSE GAS EMISSIONS IN 2015.

II. INTRODUCTION

The City of Boulder, CO is located approximately 30 miles northwest of Denver, at the base of the Rocky Mountain foothills. Home to the flagship campus of the University of Colorado and 14 federal labs, the city's population of approximately 107,000 is civically engaged and highly supportive of sustainability initiatives.

The city is home to a thriving private sector, defined by a high concentration of start-up companies as well as longstanding companies including Ball Aerospace and IBM. The city's key industry clusters include clean tech, aerospace, biosciences, natural and organic foods and outdoor recreation companies.

Boulder has long understood the importance of local climate action. Boulder's residents and businesses were among the first in the country to implement programs like the Climate Action Plan Tax (CAP Tax) and a host of other energy efficiency and conservation programs. Further, City Council recently adopted ambitious community climate commitment goals.

In support of these community energy and climate goals, the Boulder City Council adopted the Boulder Building Performance Ordinance (BPO) in October 2015.[2] These commercial and industrial (C&I) building rating and reporting and energy efficiency requirements move beyond the current voluntary programs to require actions that reduce energy use and improve the quality of Boulder's building stock.

As identified in the community's 2015 greenhouse gas (GHG) inventory, the city's more than 3,700 C&I buildings represent over half of the community's emissions footprint.[3]

[2] Prior to the adoption of the Building Performance Ordinance, city staff conducted substantial outreach efforts including stakeholder engagement and working groups within the community. Please see bouldercolorado.gov/lead/boulder-building-performance-background for more information.

[3] Note – not all of the C&I buildings in Boulder are subject to the BPO as municipal ordinances do not apply to county, state, or federally owned properties.

The city anticipates that the Boulder Building Performance Ordinance will generate significant long-term emissions and economic benefits for our community. In addition to these high-level community benefits, the city anticipates a number of direct benefits to C&I business owners and tenants, including:

- Saving money on utility bills through cost-effective efficiency measures;
- Helping building owners understand and manage their buildings' energy use;
- Educating tenants and real estate professionals about building energy performance;
- Informing future energy programs and services for the C&I sector;
- Reducing GHG emissions; and
- Improving the quality of Boulder's C&I building stock.

Boulder is one of nearly 20 cities[4] in the country to adopt such a policy. Though many of the elements of Boulder's policy are similar to those implemented by other cities, Boulder's policy is one of a select few that moves beyond building energy performance awareness and requires efficiency actions to achieve building performance improvement.

CITY OF BOULDER'S CLIMATE COMMITMENT

On Dec. 6, 2016, Boulder City Council unanimously adopted a community emissions reduction goal of 80 percent reduction in GHG emissions below 2005 levels by 2050.

The Building Performance Ordinance plays a significant role in the community's efforts to meet this goal. More information on this goal, and other community climate goals, is available at:

BOULDERCLIMATE.COM

III. BUILDING PERFORMANCE ORDINANCE

The Boulder Building Performance Ordinance affects privately-owned C&I buildings 20,000 square feet (sf) and larger, newly constructed C&I buildings 10,000 sf and larger and city-owned buildings 5,000 sf and larger.

The ordinance requires affected building owners to carry out the following actions:

1. Use an approved ENERGY STAR® tracking tool to annually rate and report (R&R) building energy use, which will be publicly disclosed after a grace period;
2. Perform energy assessments (EA) every 10 years;
3. Perform retrocommissioning (RCx) every 10 years and implement cost effective RCx measures within two years of the study; and
4. Perform one-time lighting upgrades.

Large industrial or manufacturing campuses where multiple buildings are served by a central plant or single utility meter are also subject to the Building Performance Ordinance. However, due to their unique nature, these campuses are subject to the following custom requirements:

- Annually provide a publicly-disclosed written narrative on campus energy and emissions reduction goals and activities;
- Annually provide an oral report to city staff on energy use and energy savings achieved in the reporting year compared to the previous year.
- Perform energy assessments every 10 years and implement cost effective EA measures within one year of the assessment; and
- Perform one-time lighting upgrades.

[6] The ENERGY STAR® tools approved by the City of Boulder for compliance are Portfolio Manager or the Energy Tracking Tool (for manufacturing facilities only).

The Building Performance Ordinance requirements are phased in based on building size as shown in the compliance timeline in Figure 1.

FIGURE 1. ORDINANCE COMPLIANCE TIMELINE

Ordinance Requirement	City Buildings ≥ 5,000 sf	Existing Buildings ≥ 50,000 sf New Buildings ≥ 10,000 sf	Existing Buildings ≥ 30,000 sf	Existing Buildings ≥ 20,000 sf	Large Industrial Campuses
Rating & Reporting	2016	2016	2018	2020	2016
Public Disclosure	2019	2019	2021	2023	2016
Energy Assessments	2019	2019	2021	2023	2019
Lighting Upgrades	2021	2021	2023	2025	2025
Retro-commissioning	2021	2021	2023	2025	N/A
Implement Cost Effective Measures	2023	2023	2025	2027	2021

The city chose to phase in the requirements to allow time to fine tune systems and procedures, while providing building owners time to plan for upcoming requirements. Phasing in the largest buildings first kept the first year of the program manageable given the limited number of buildings, but also ensured that a large amount of the floor area would be impacted.

Starting with city-owned buildings 5,000 sf and larger and privately-owned buildings 50,000 sf and larger impacts almost 50 percent of the city-owned and privately-owned combined C&I floor area, but only about nine percent ofthe total number of city-owned and privately-owned buildings.

Building Performance Program

To help building owners comply with these ordinance requirements, the City of Boulder created the Building Performance Program. This program supports affected building owners by offering services and resources to increase awareness and understanding of the ordinance, while also providing assistance with compliance efforts.

As part of the Building Performance Program, the city developed a central web location for affected building owners, service providers and the community to find information relevant to the requirements: BoulderBuildingPerformance.com. The website hosts all program-related materials, including detailed how-to guides, timelines, rebates and resources. In addition to the website, the city and its partners offer a range of services, resources and guidance. Those offered throughout the first year of the program are detailed below.

Outreach

In October 2015, the city issued notification letters to all affected building owners and launched an online "Claim your Building" form. This claim form allowed affected building owners to identify a key contact person for the purposes of compliance, as well as correct any building information listed on the public list of affected buildings, such as incorrect square footage. Following the completion of the claim form, which nearly all building owners submitted by the end of the year, the city created an email listserve that kept owners and building contacts up to date on upcoming trainings, new resources and deadlines. The city also created a subscription-based monthly newsletter to provide program updates to building owners, service providers and interested community members.

OVER 90

building owners and program stakeholders participated in the trainings and webinar.

Training & Support

Two in-person trainings were held in Spring 2016 to provide building owners hands-on assistance with understanding the rating and reporting requirements. The city also partnered with Boulder County's Partners for a Clean Environment (PACE)[7] and the local utility, Xcel Energy, during these trainings to provide additional information to affected building owners about current rebate program offerings, guidance on accessing energy data and a demonstration of ENERGY STAR® Portfolio Manager (ESPM). The city also hosted a public webinar to explain the ordinance requirements, timelines, exemptions and available resources.

[7] Partners for a Clean Environment (PACE) provides FREE expert advisor services, financial incentives and a certification program to help businesses in the City of Boulder and Boulder County measure and gain recognition for their energy, waste, water and transportation achievements. http://www.pacepartners.com/

PACE Business Sustainability Advisors were available to provide one-on-one support to affected building owners, specifically on using ESPM. The city also funded the Colorado Industrial Energy Challenge, managed by the Southwest Energy Efficiency Project, to provide individual assistance to manufacturing facilities, particularly those electing to use the Energy Tracking Tool for rating and reporting.

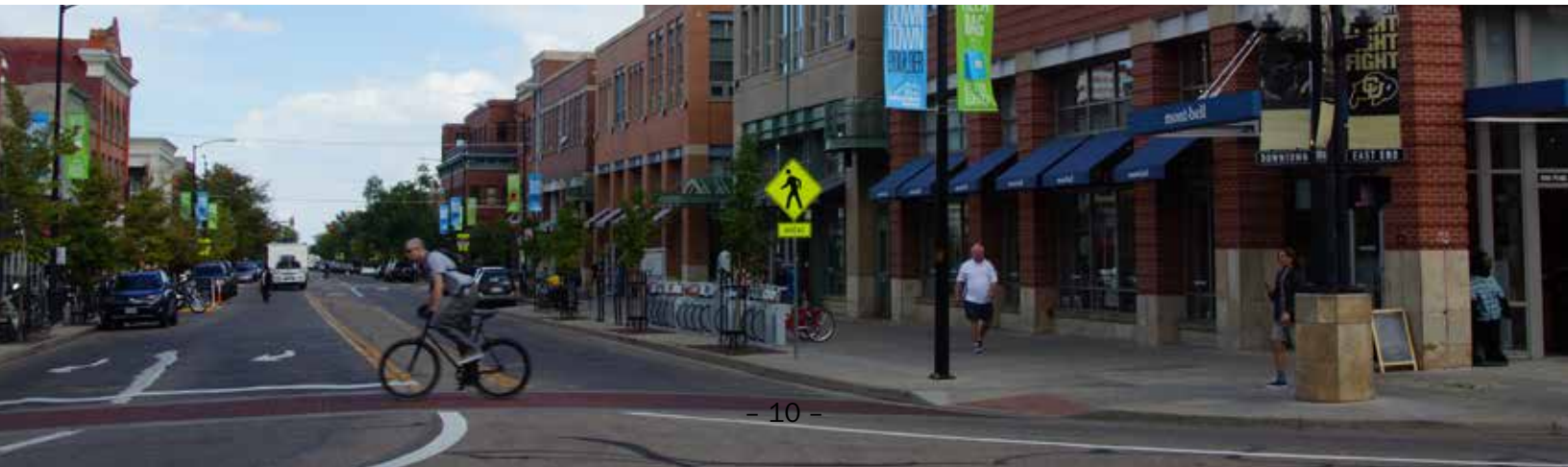
Energy Data Access

The Building Performance Ordinance requires affected building owners to report whole-building energy data – including electricity and natural gas – to the city annually using ESPM or the Energy Tracking Tool. Both tools require building owners to enter monthly energy data. This can be an onerous task for building owners, particularly for owners of multi-tenant buildings, given the stringent data privacy rules enacted by the Colorado Public Utilities Commission.

To meet customer needs, Xcel Energy developed an energy benchmarking service that provides a direct feed of whole-building energy usage data from Xcel Energy's metered data repository into the building owners' ESPM account. After completing the initial connection steps, Xcel Energy automatically uploads whole-building energy data in the ESPM account on a monthly basis. This automatic service is a key attempt to ease the data collection burden on affected building owners, with the majority opting to use this service in the first year.

Service Providers

Building owners are not required to use a service provider to complete rating and reporting, but must use a qualified service provider to complete the energy assessment and retro-commissioning requirements of the ordinance. Therefore, the city developed a training for service providers and published a list of qualified service providers to ensure affected building owners could easily find an appropriate provider to implement these efficiency requirements for compliance purposes.



IV. RATING & REPORTING RESULTS

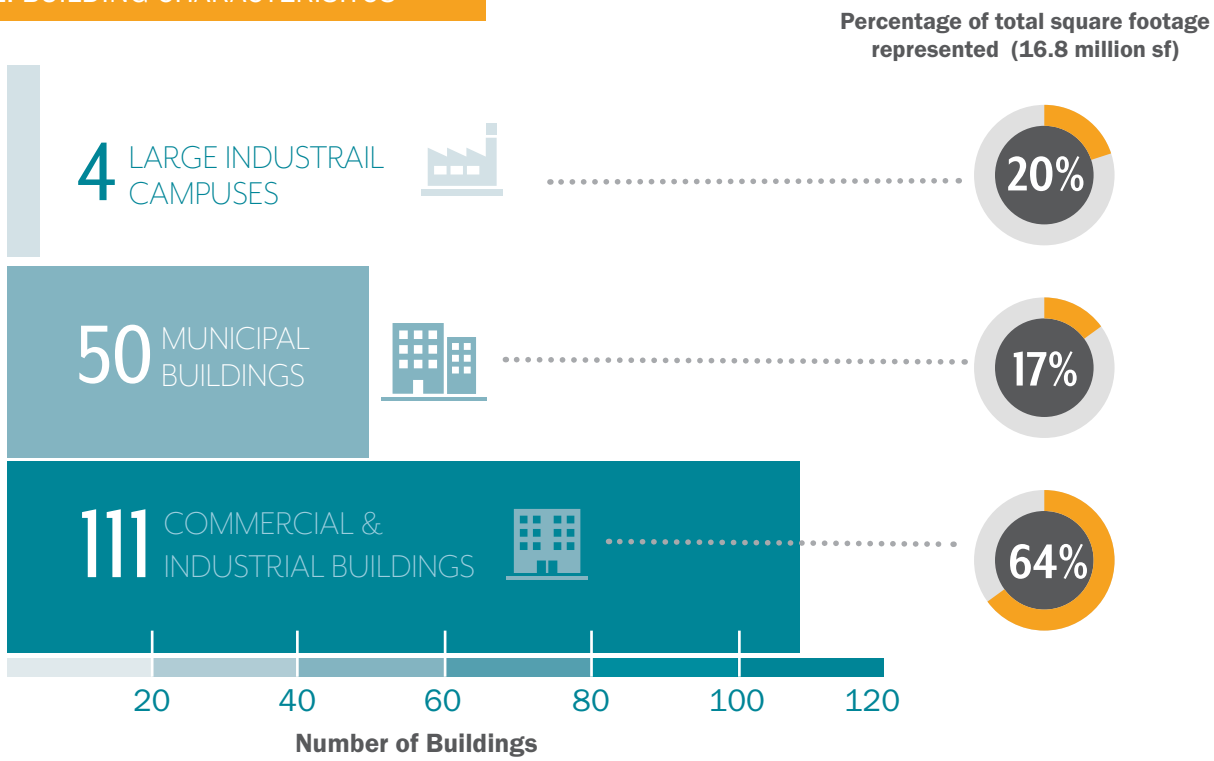
In 2016, 165 buildings were required to rate and report on 2015 calendar year energy data, representing over 16.8 million square feet. These 165 buildings included 50 city-owned municipal buildings, 111 privately-owned commercial and industrial buildings and four large industrial campuses. These affected buildings were categorized into nine major building types for analysis.

BUILDING TYPES FOR ANALYSIS

Building Type:
Healthcare
Industrial/Manufacturing
Lodging
Office
Other[8]
Parking Garage
Retail
Supermarket
Warehouse/Distribution Center

As shown in Figure 2, privately-owned commercial and industrial buildings represent the majority of the square footage affected by the ordinance requirements in 2016. However, the four large industrial campuses combined represent 20 percent of the total square footage

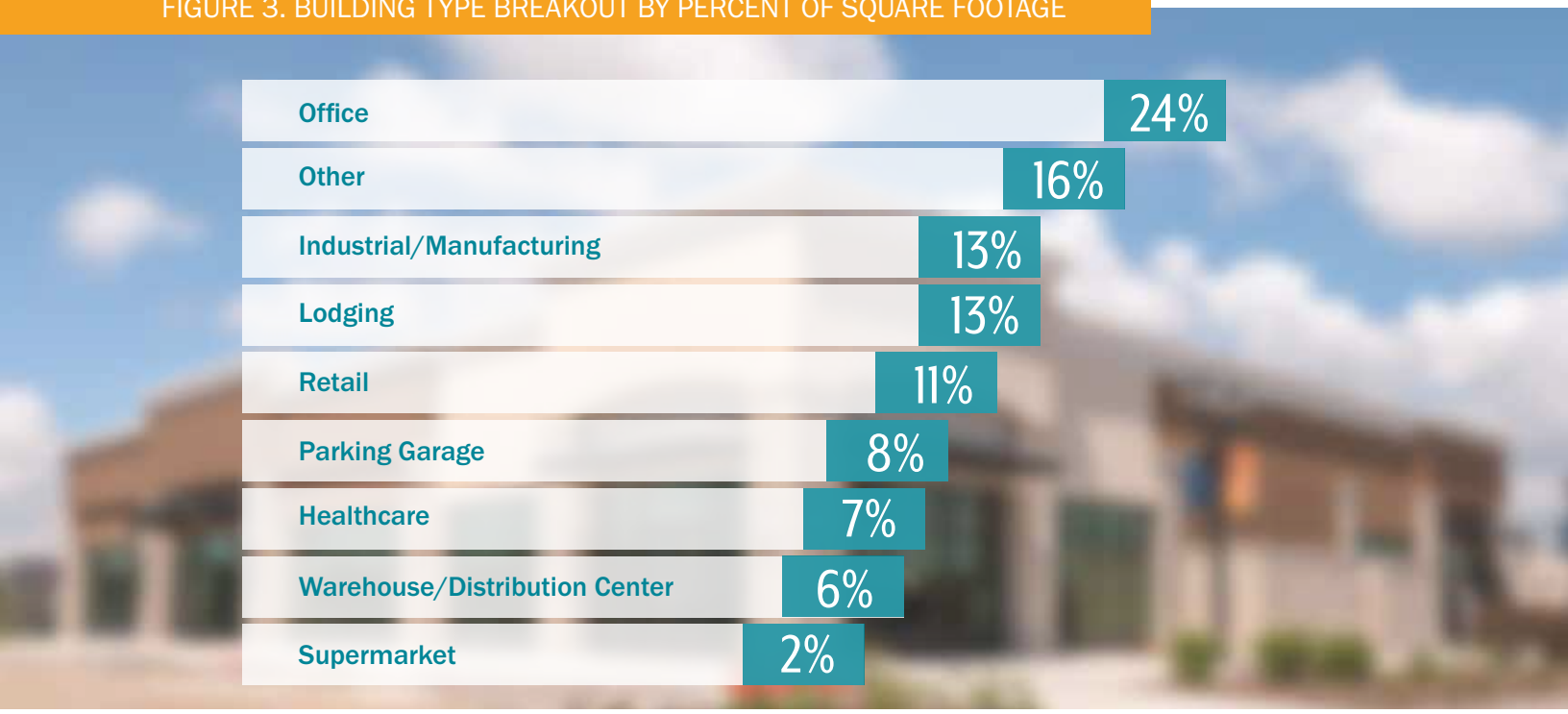
FIGURE 2. BUILDING CHARACTERISITCS



[8] "Other" building type includes fitness/health centers, libraries, fire stations, museums, worship facilities, etc.

Excluding the four large industrial campuses, which must comply with custom reporting requirements, Figure 3 shows office buildings make up the largest portion of the affected building square footage, with 46 office buildings representing 3.2 million square feet. This is followed by other, industrial/manufacturing, lodging and retail to round out the top five building types reporting energy data in 2016.

FIGURE 3. BUILDING TYPE BREAKOUT BY PERCENT OF SQUARE FOOTAGE



Compliance

The deadlines that applied to the affected buildings in 2016 are shown in Table 2.

TABLE 2. 2016 REPORTING DEADLINES

Building Group Building Group	Reporting Deadline
City-owned buildings (5,000 sf and larger)	May 1, 2016
Large Industrial Campuses	June 1, 2016
Privately-owned C&I buildings (50,000 sf and larger)	Aug. 1, 2016

As 2016 was the first year of reporting in Boulder, effort was made to extend deadlines and provide program resources and individual support to as many building owners as possible.

Of the 165 buildings required to rate and report in 2016, five were granted exemptions. The city allows few exemptions from rating and reporting, but those accepted include having less than one year of energy data available based on the initial certificate of occupancy date, demolitions or other extenuating circumstances.

Of the remaining 160 private and city-owned buildings, all submitted the required 2015 energy reports to the city, resulting in 100 percent compliance for the Building Performance Program's first year.

Commercial & Industrial Reporting

For the 160 buildings required to report 2015 energy use, eight percent of the building energy reports received were excluded from analysis for various data quality reasons, including data errors or missing data, or were submitted after the analysis deadline. Further, the four large industrial campuses were not included in the energy analysis because of the custom requirements that apply to those sites. Therefore, the following rating and reporting analysis presented in this report represents calendar year 2015 energy consumption from 143 buildings and 11.9 million sf.[9]

Energy Use Intensities

When rating a building's energy use, one of the primary metrics is energy use intensity (EUI). This metric expresses a building's energy consumption as a function of its floor area (square footage). This is similar to a vehicle's miles-per-gallon rating. EUI is often expressed in total energy consumed in a reporting year (in thousand British thermal units or kBTU) divided by the gross floor area of the building (kBTU/sf-year).[10]

This EUI metric is automatically calculated in the rating and reporting tools offered by ENERGY STAR®, most notably Portfolio Manager. Of the 143 buildings reporting in 2016, 141 used Portfolio Manager.[11]

EUI is the annual energy used per square foot of gross floor area.

[9] Additional detail on the energy performance analysis and methodologies is listed in VIII. Appendix A.
[10] Site EUI was used for analysis purposes, which represents the annual amount of all the energy the property consumes onsite, as reported on utility bills.
[11] The remaining two used the ENERGY STAR® Energy Tracking Tool, which caters to energy-intensive manufacturing facilities.

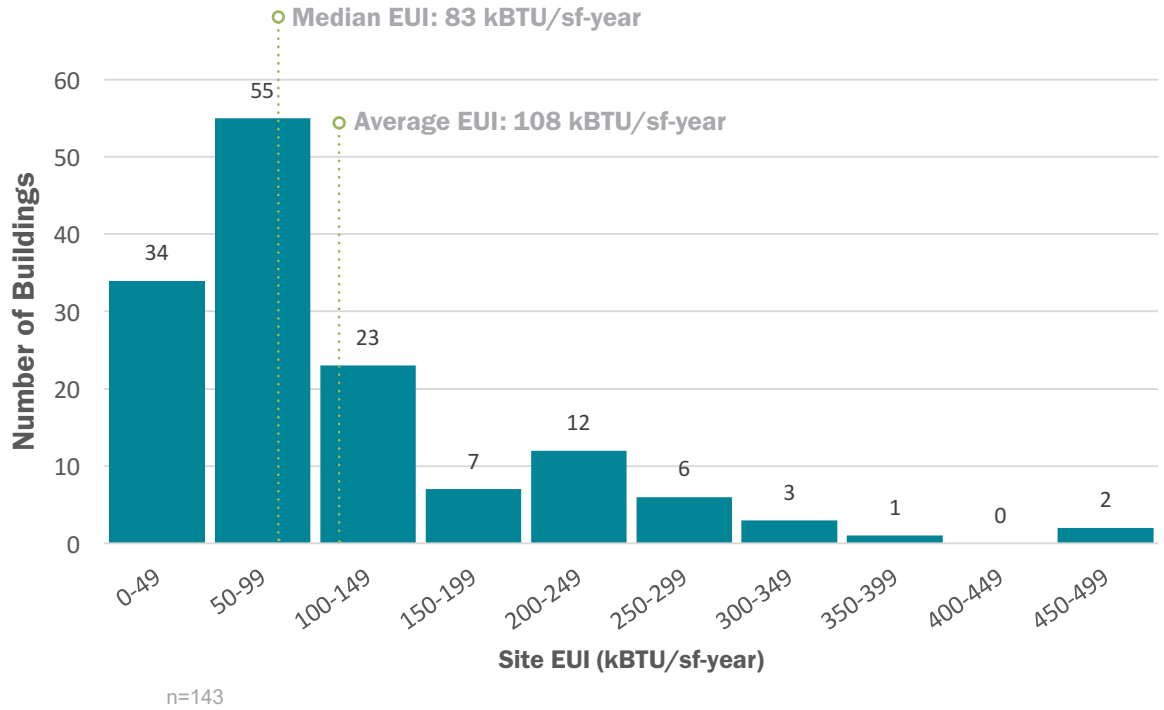
ENERGY STAR® PORTFOLIO MANAGER

Portfolio Manager is a free, online, industry best practice tool used to measure and track building energy and water performance. The tool calculates over 100 metrics to assess building performance, including EUI. More information is available at: energystar.gov/buildings/facility-owners-and-managers/existing-buildings/use-portfolio-manager

A low EUI generally signifies good energy performance in a building. However, certain property types, such as manufacturing, are highly energy intensive and will always have higher EUIs than other property types, such as offices. Therefore, it is important when comparing EUIs to do so after normalizing by building types and by climate. Fortunately, Portfolio Manager normalizes this data automatically to provide a more accurate comparison to like buildings.

The median[12] site EUI of all reporting buildings was just over 83 kBTU/sf-year, as shown in Figure 4. The average site EUI for all reporting buildings was 108 kBTU/sf-year.

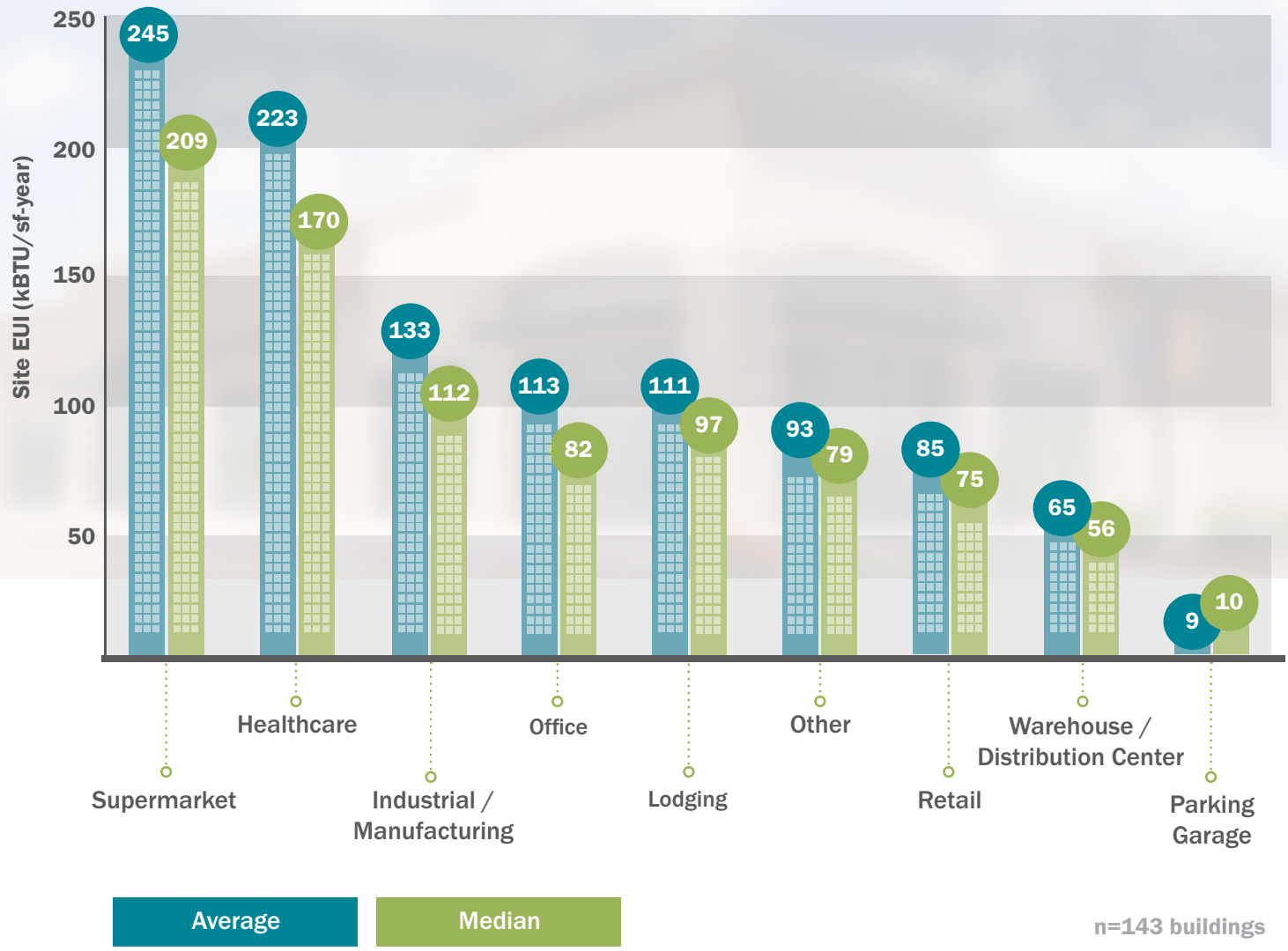
FIGURE 4. EUI DISTRIBUTION FOR ALL BUILDING TYPES



[12] Per ENERGY STAR®, "The median value is the middle of the national population – half of buildings use more energy, half use less. The median works better than the mean (arithmetic average) for comparing relative energy performance, because it more accurately reflects the midpoint of energy use for most property types." The City of Boulder has chosen to show both median and average values as relevant to align with other reporting cities as well as city Climate Commitment goals.

When looking at the median and average EUI by building type (Figure 5), we see the most energy intensive building types overall are supermarkets, followed by healthcare and industrial/manufacturing facilities. The least energy-intensive building types, as expected, were warehouses and parking garages.

FIGURE 5. EUI BY BUILDING TYPE



CASE STUDY CROSSROADS GARDEN OFFICE BUILDING — 1800 30TH ST.

Rating and reporting energy use provides insight into tenant use and efficiency opportunities

Constructed in 1972, Crossroads Garden opened as a tennis and sports center complex and was later converted to an office building. Over the years, the building has undergone several renovations, including a partial LED lighting upgrade for parking and common use areas, and additional LED upgrades are planned.

In partnership with the city's Boulder Building Performance program (BBP), the owner of Crossroads Garden received support to interpret the energy metrics, such as energy-use intensity (EUI), derived during the rating and reporting (R&R) process and to identify no- and low-cost efficiency measures based on building energy use data.

Review of the R&R results and monthly energy data revealed that, although recent LED lighting upgrades had lowered energy use, Crossroads Garden had higher than usual baseline electric use as compared to other buildings of similar type, size and use. The report also revealed that a single tenant accounted for more than one-third of the building's energy use.

Review of the building energy use data identified opportunities for no- and low-cost energy efficiency measures such as occupancy sensors and adjusting, fixing or upgrading inoperable or missing common space energy controls to improve scheduling. The most energy-intensive tenant has committed to working with the building owner to improve energy efficiency moving forward.

Planned lighting upgrades and implementation of the recommended measures are estimated to increase Crossroads Garden's ENERGY STAR® score from its current 67 to a 78. In addition to cost savings from improved efficiency, a score of 78 would be high enough to apply for ENERGY STAR® certification and would result in an exemption from the remaining ordinance requirements. A complete list of recommended no- and low-cost efficiency measures, as well as their anticipated results are reflected on the right.

BUILDING DATA

53,971	78	67.3
square feet (sf)	*kBTU/sf-year*	*kBTU/sf-year*
Gross floor area	**Site EUI**	**National median EUI**

Office	Over 50	67
Building type	**Tenants**	**ENERGY STAR® score**

BENCHMARK ANALYSIS

- ENERGY STAR® score indicates opportunity to save energy
- Monthly energy data correlation to Boulder climate shows higher than usual electric baseline – leading to identification of high-use tenant
- Rating and reporting results combined with building walkthrough identified potential lighting and schedule control measures

RECOMMENDED MEASURES

- Add or include lighting occupancy sensors for meeting rooms, restrooms and other intermittent use spaces
- Convert analog thermostats to digital programmable thermostats with scheduling capability
- Vending machine energy controller
- Continued engagement with city business sustainability advisors
- Adjust, fix or upgrade common space energy controls to improve scheduling
- Special attention to high-use tenant space to find additional savings

ANTICIPATED RESULTS

- **Current electric use:** 840,000 kWh/year
- **Estimated energy savings:** 76,500 kWh/year
- **Estimated savings percent:** 9%
- **Estimated cost savings:** $9,200
- **Estimated measure cost:** $11,000
- **Simple payback:** 1.2 years
- **ENERGY STAR® score:** 78

ENERGY STAR® Scores

ENERGY STAR® Portfolio Manager assigns a score from 1 to 100 for those building types where a large enough national dataset is available to set scores (a higher score represents a high performing, energy efficient building). Currently 21 building types can earn scores.[13] This score compares a building's performance to similar buildings nationwide, normalizing for type and climate. A score of 50 means your building is performing better than 50 percent of like buildings. Buildings that receive a score of 75 or higher (i.e. perform better than 75 percent of like buildings) may be eligible for ENERGY STAR® certification.

ENERGY STAR® Certification

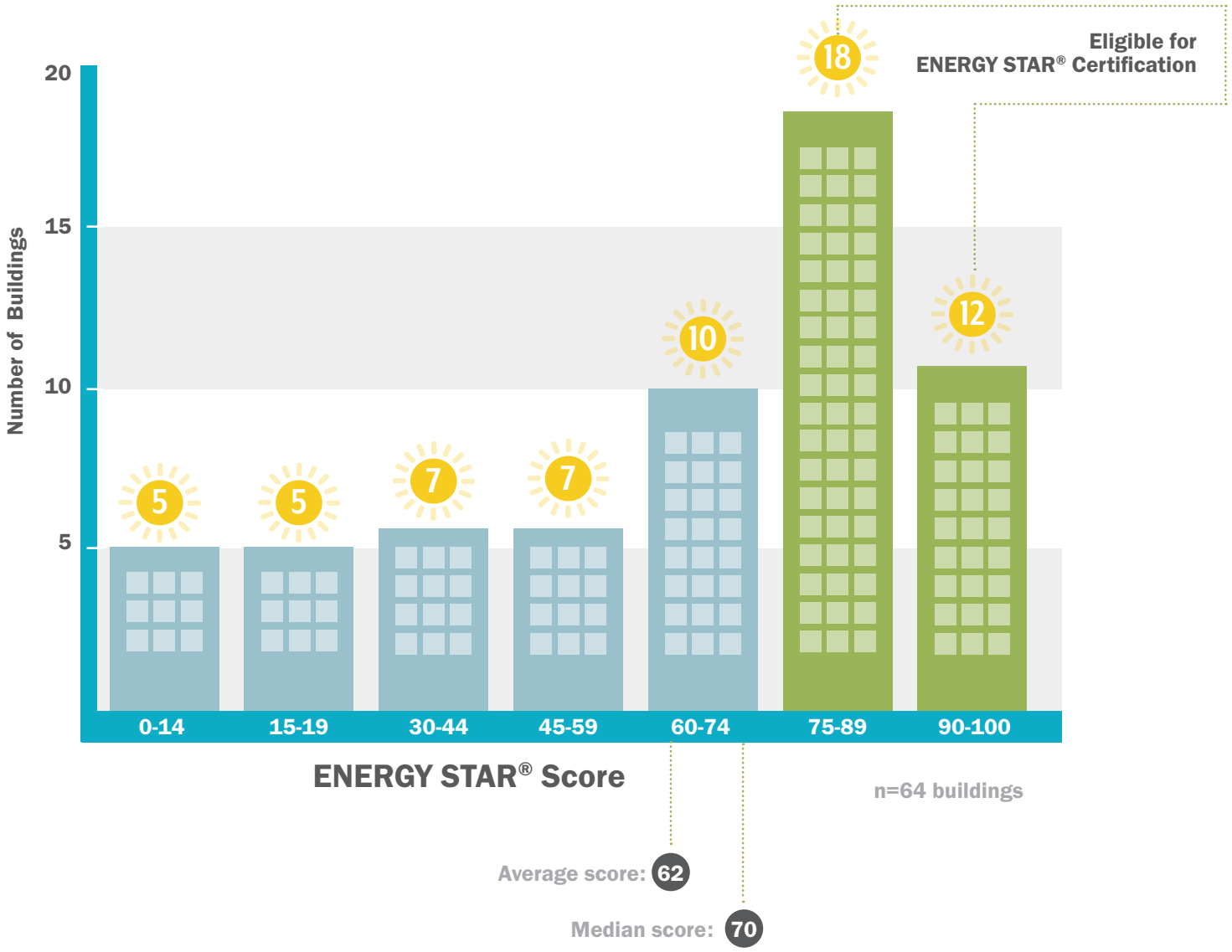
A building receiving an ENERGY STAR® score 75 or higher may be eligible for ENERGY STAR® certification. Receiving certification would also exempt the building from the Building Performance Ordinance efficiency requirements.

More information on scores and certification are available at:
www.energystar.gov/buildings/about-us/energy-star-certification

[13] For the list of building types eligible for ENERGY STAR® score, see: https://www.energystar.gov/buildings/facility-owners-and-managers/existing-buildings/use-portfolio-manager/identify-your-property-type-0

Of the 143 buildings in this analysis, 64 received ENERGY STAR® scores. The median ENERGY STAR® score for Boulder was 70 and the average score was 62. Of these 64 buildings, 30 received scores that are eligible for certification,[14] as shown in Figure 6.

FIGURE 6. ENERGY STAR® SCORE BY BUILDING TYPE



[14] Though some buildings subject to the Building Performance Ordinance may have received ENERGY STAR® certification in previous years, none had received 2015 certification at the time of ordinance compliance.

The median and average scores by building type are shown in Figure 7. This data indicates that Boulder's healthcare and lodging facilities received the lowest scores and therefore have the largest opportunity for savings of all the building types receiving scores.

FIGURE 7. ENERGY STAR® SCORE BY BUILDING TYPE

ATHLETA
1137
FOR LEASE
古茶屋
KU CHA HOUSE OF TEA
Boba Tea

CASE STUDY
KING SOOPERS — 1650 30TH ST.

Rating and reporting reveals no-and low-cost path to high performance

King Soopers supermarket at 1650 30th St. has undergone several renovations since it was originally constructed in 1982, including enclosing the atrium area near the front entrance, upgrading all interior lighting to more efficient T8s and retrofitting refrigeration case lighting to LED technology. The store has central refrigeration and recycles much of the excess energy to condition the surrounding space.

In partnership with the city's Boulder Building Performance Program (BBP), King Soopers received support to interpret the energy metrics, such as energy-use intensity (EUI), derived during the rating and reporting (R&R) process and to identify no- and low-cost efficiency measures based on building energy use data.

Review of the R&R results revealed the hours of operation were not accounted for correctly in the reporting tool, ENERGY STAR® Portfolio Manager. Emphasizing the importance of accurate data entry, simply correcting the operating hours entered to reflect true operating hours increased the building's ENERGY STAR® score from 59 to 66.

Review of the energy metrics also revealed a peak in winter electric use and a building walkthrough identified opportunities for no- and low-cost energy efficiency improvements. The improvements include heater controls, cooler case doors and retro-commissioning, which could be paid for in part by incentives provided by the current utility provider Xcel Energy. The impact of implementing these measures is estimated to increase King Soopers' ENERGY STAR® score to 72.

A list of these recommended no- and low-cost efficiency measures, as well as their anticipated results, is reflected on the right.

Additional opportunities for upgrading interior and exterior lighting to LEDs, which King Soopers has expressed interest in, could further raise the building ENERGY STAR® score up to 85. In addition to cost savings from improved efficiency, a score of 85 would be high enough to apply for ENERGY STAR® certification and would result in an exemption from the remaining BBP ordinance requirements.

BUILDING DATA

61,317	187.1	209.2
square feet (sf)	*kBTU/sf-year*	*kBTU/sf-year*
Gross floor area	**Site EUI**	**National median EUI**

Supermarket/ Grocery Store	66
Building type	**ENERGY STAR® score**

BENCHMARK ANALYSIS

- ENERGY STAR® score indicates opportunity to save energy
- Monthly energy data correlation to Boulder climate shows high base electric energy use and peak in winter – leading to search for causes
- Quick building walkthrough identified other recommended measures listed below

RECOMMENDED MEASURES

- HVAC retro-commissioning to identify cause of electricity increase in winter and identify other operational savings such as better control of infrared heating elements on mezzanine
- Retrofit of open multi-deck cooler cases with solid glass doors

ANTICIPATED RESULTS

- **Current electric use:** 2,770,000 kWh/year
- **Estimated energy savings:** 91,600 kWh/year
- **Estimated savings percent:** 3.3%
- **Estimated cost savings:** $7,300
- **Estimated measure cost:** $27,000
- **Simple payback:** 3.6 years
- **ENERGY STAR®72**

Greenhouse Gas Emissions

Greenhouse gas (GHG) emissions related to building operation are determined by the total fuel consumption of the building and are largely influenced by the fuel type consumed. In Boulder, the main fuel source is electricity, as seen in Figure 8. Though the use of electricity in a building does not in itself emit greenhouse gases, the combustion of fuels – largely coal and natural gas – at power plants to generate this electricity produce significant amounts of GHGs.

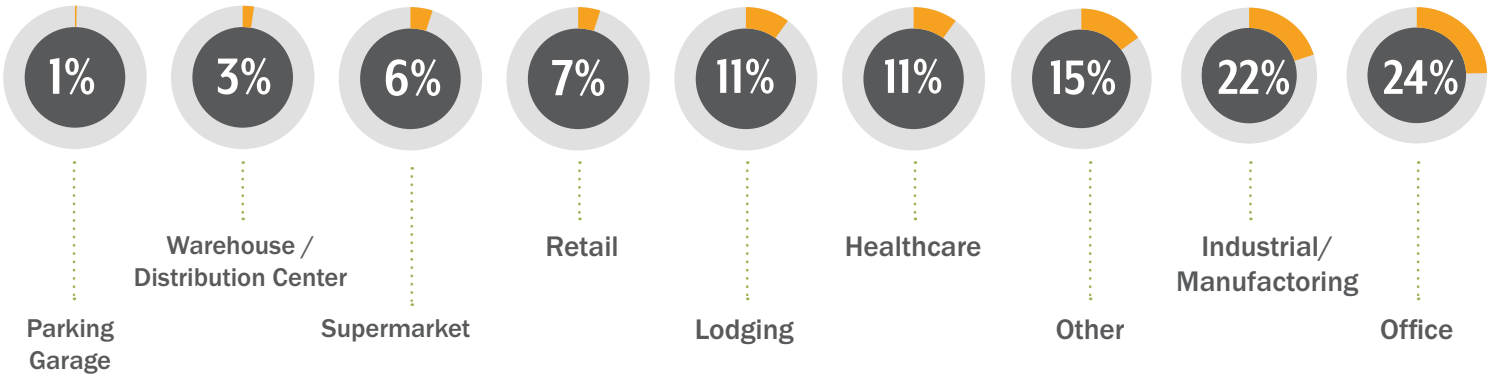
FIGURE 8. REPORTED FUEL MIX

40% Electricity

60% Natural Gas

The total GHG emissions generated by the 143 reporting buildings is 217,000 metric tons of carbon dioxide-equivalent (MT CO2e). This is approximately 23 percent of the C&I sector and 12 percent of the overall community footprint based on the City of Boulder's 2015 community GHG inventory. Not surprisingly, office buildings are the largest emitters of the reporting buildings, which is in line with their share of total square footage.

FIGURE 9. EMISSIONS BY BUILDING TYPE



n = 143

However, gross floor area does not always correlate to the emissions footprint of a building, as seen in Figure 10. Industrial and manufacturing building types, as well as healthcare and supermarkets, all have higher median EUIs due to the energy intensive nature of the work done in those buildings.

FIGURE 10. 2015 EMISSIONS AND SQUARE FOOTAGE BY BUILDING TYPE

SECTOR SNAPSHOT – OFFICE BUILDINGS

Office buildings represent nearly one-quarter of the total square footage rated and reported in 2016. In 2016, 46 office buildings representing 3.2 million square feet were subject to the Building Performance Ordinance. The GHG emissions reported by these office buildings equates to 24 percent of the total GHG emissions reported by all ordinance-affected buildings and 3 percent of the total community GHG footprint in 2015.

When looking at the average values for reporting offices in 2016, municipal office buildings have a slightly lower average EUI and higher ENERGY STAR® score compared to privately-owned buildings.

This difference may be attributable to privately-owned office buildings being more likely to have secondary space uses included in their energy use that are more energy intensive, such as restaurants and retail space.

Average Office EUI:
110
kBTU/sf-year

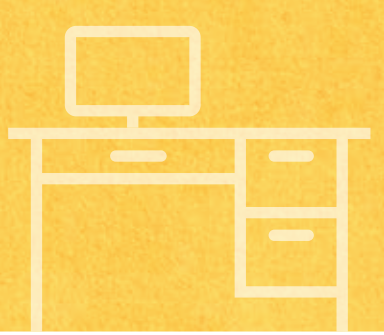
Private C&I Office Average EUI: **110 kBTU/sf-year**

Municipal Office Average EUI: **71 kBTU/sf-year**

Average Office ENERGY STAR® Score:
65

Private C&I Office Average Score: **63**

Municipal Office Average Score: **72**



Sixteen office buildings are eligible for ENERGY STAR® Certification based on 2016 rating and reporting results. The most energy-intensive office buildings used nearly 24 times more energy per square foot than the least energy-intensive office buildings, representing a significant opportunity for the sector to improve performance and reduce energy cost. More information on savings potential can be found in section IV.E. Savings Potential.

Large Industrial Campus Reporting

As discussed above, large industrial campuses were subject to the following custom rating and reporting requirements: submitting a written report on campus energy and emissions reduction goals and activities, and providing an oral report to city staff on energy use and energy savings achieved in the reporting year, as compared to the previous year.

In 2016, four large industrial campuses were subject to these rating and reporting requirements. These four large industrial campuses represented 3.3 million square feet of commercial and industrial building area, or about 20 percent of the total square footage required to rate and report in 2016. A variety of space uses and activities are conducted on these campuses, including engineering, research, office use, distribution warehousing and manufacturing.

Given the energy-intensive activities occurring at these large industrial campuses, all four campuses have taken action to improve efficiencies and reduce energy consumption in 2015. These actions have included:

- Lighting upgrades and controls, such replacement to LEDs;
- Equipment replacements such as higher efficiency motors;
- Optimization of existing processes and systems, such as chilled water plants.

Large industrial campus-specific actions can be reviewed in each narrative linked below.

FIGURE 11. LARGE INDUSTRIAL CAMPUS NARRATIVES

"IBM has a long history of driving energy conservation and sustainability through all parts of our business and has been recognized by numerous outside organizations for achieving significant results.'

"IBM Boulder maintains a very aggressive local energy goal of achieving 5 percent energy conservation year-on-year, which is in excess of the corporate-level goal. IBM's Boulder campus achieved this ambitious goal in 2015 and is currently on track to do the same in 2016."

6300 Diagonal Hwy.

"Corden Pharma Colorado participates in a variety of federal, state, local and industry-wide initiatives that set challenging pollution prevention standards...Corden Pharma Colorado continues to identify, evaluate and implement energy reduction measures."

"From 2010 to 2015, the company reduced electricity consumption by 20 percent and natural gas consumption by 2 percent. Overall, energy consumption at Corden Pharma Colorado decreased by 13 percent from 2010 to 2015 and by 25 percent since 2005 when the company's original energy goals were set."

2075 N 55th St.

"Ball's corporate sustainability priorities are innovation, operations, talent management, recycling, supply chain and community. Ball has been recognized globally for our sustainability efforts and achievements."

"In fact, our energy consumption per square foot has continually decreased since 2010. For the reporting year of 2015, Ball Aerospace implemented many energy sustainability projects within its Colorado portfolio."

1600 Commerce St.

5001 Arapahoe Ave.

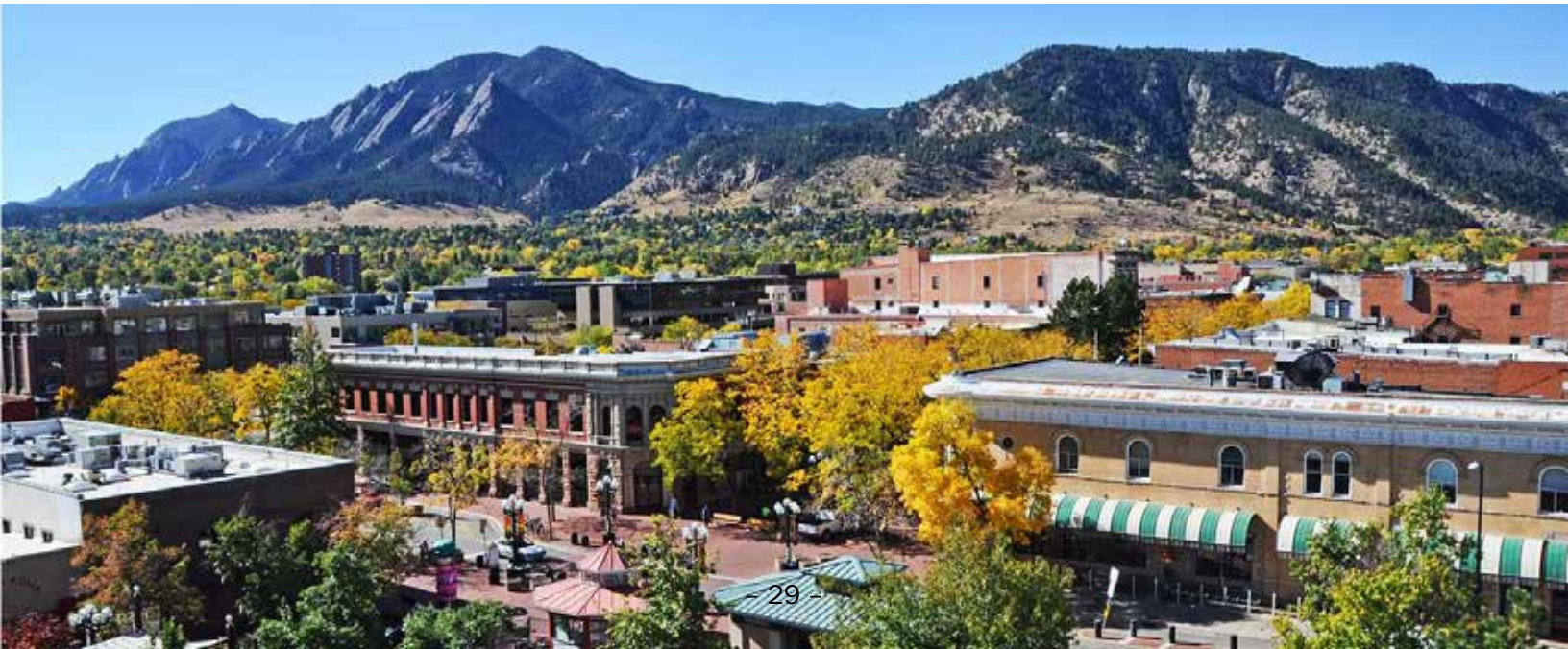
How Does Boulder Compare?

Boulder is one of the smallest cities implementing a rating and reporting requirement, which allows staff the opportunity to provide substantial compliance assistance to building owners and property managers. This assistance, combined with significant outreach efforts, resulted in 100 percent compliance in the program's first year – making Boulder the first city to achieve 100 percent compliance. (See Table 3).

TABLE 3. FIRST YEAR COMPLIANCE COMPARISON

City	Total Square Footage Affected	Number of Buildings Affected	Compliance Rate (First Year)
Boulder	**16.8 million**	**165**	**100% (2016)**
Seattle	281 million	3,216	99% (2013)
Cambridge	72.5 million	980	95% (2015)
Chicago	214.8 million*	277	92% (2014)
Philadelphia	250 million	1,700	86% (2013)
Boston	189 million	984	84% (2014)
Portland	55 million*	413	82% (2015)
New York City	2.6 billion	24,000	75% (2012)

* Represents square footage included in analysis; not total square footage affected.



Despite the differences in square footage represented in Boulder compared to many other reporting cities, Boulder's largest building stock is performing similarly to these other cities.

Boulder's largest buildings, though a bit less efficient than national values, has a lower overall median EUI and higher overall median ENERGY STAR® score than other reporting cities based on most recently reported performance data.

TABLE 4. MEDIAN METRIC COMPARISON

City	Median Site EUI (kBTU/sf)	Median ENERGY STAR® Score	Most Recent Report Year
Boulder	**83**	**70**	**2016**
Cambridge	88	61	2015
Portland	-	67	2015
Chicago	85	59	2016
Philadelphia	100*	59	2015
Seattle	-	68	2013
National	80**	75****	2012***

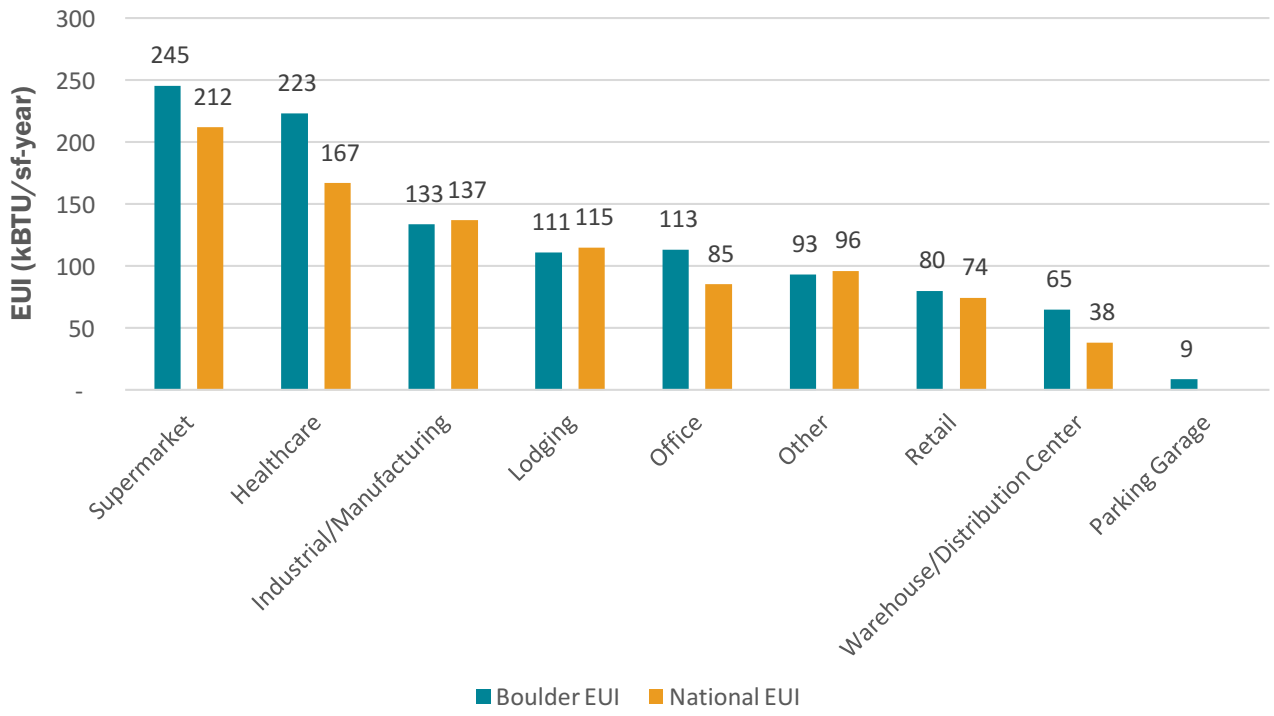
* Weather-normalized site EUI.
** Average EUI (sum of major fuel consumption per total square foot) in kBTU (2012 CBECS, Table C4).
*** 2012 Commercial Buildings Energy Consumption Survey: Energy Usage Summary.
**** The national median value is expected to be higher than results from mandatory city reporting because the national data source is based on voluntary reported data, which largely represents high-performing buildings.

To better understand how Boulder buildings are performing, the overall EUI by building type[15] was compared to the most recently calculated national EUI by building type, for the Boulder climate region. These national EUIs were calculated by the Commercial Buildings Energy Consumption Survey (CBECS)[16] , which is a national sample survey that collects information on the U.S. commercial building stock.

[15] EUI by building type was calculated by summing all energy consumed by each building type and dividing by the summed square footage of that building type.
[16] Table C10. "Consumption and gross energy intensity by climate region for sum of major fuels, 2012." Released May 2016. Column: "Energy intensity for sum of major fuels (thousand Btu/square foot)." Region: "Very cold/cold." https://www.eia.gov/consumption/commercial/reports/2012/energyusage/

As shown in Figure 12, Boulder's largest buildings are performing less efficiently than national EUIs for building types supermarket, healthcare, office, retail and warehouse/distribution center. However, the building types of industrial/manufacturing, lodging and other are performing slightly more efficiently than national.

FIGURE 12. BOULDER AND NATIONAL EUI COMPARISON BY BUILDING TYPE[17]



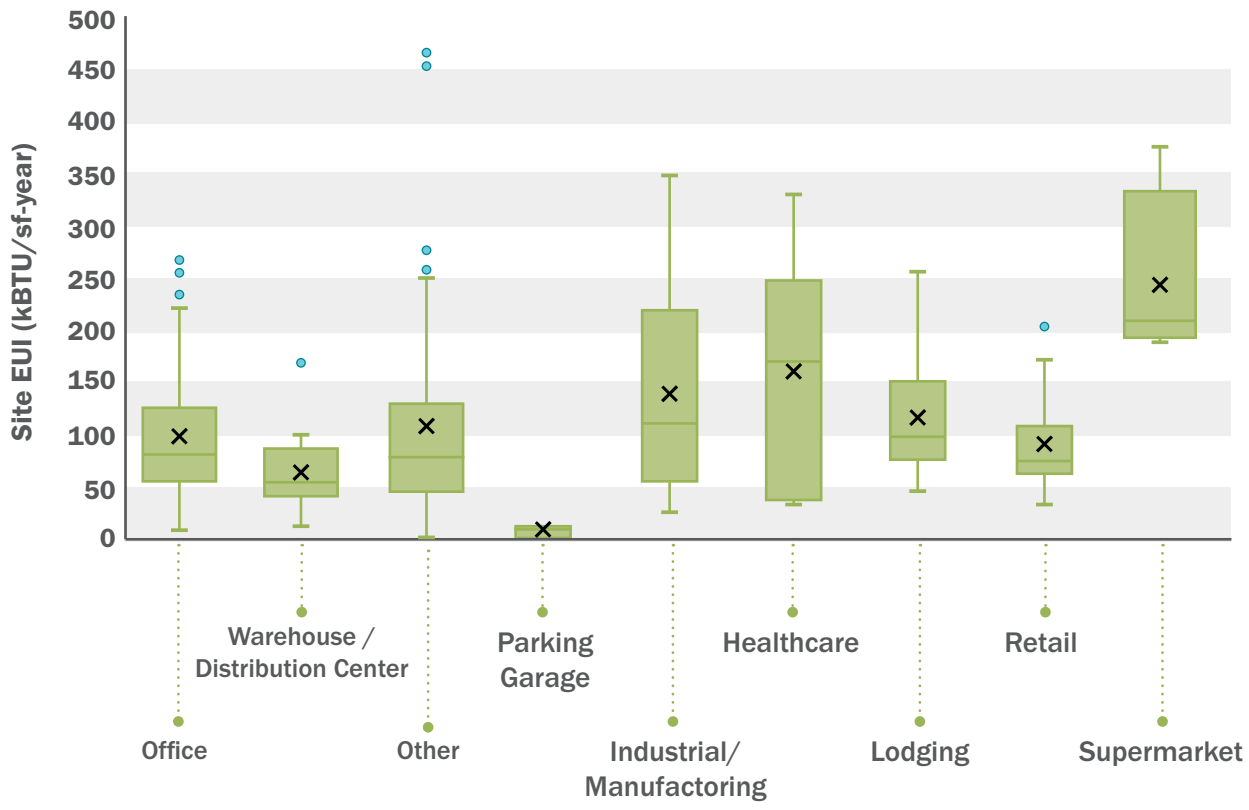
[17] National comparison is not provided for Parking Garage space type as no equivalent data set was available.

Savings Potential

Commercial buildings waste an average of 30 percent of the energy consumed, according to ENERGY STAR® findings. Rating and reporting results can help identify and size that potential energy savings for the City of Boulder.

Analysis of the reported 2015 energy data shows a wide range of energy intensities. The highest EUIs range from 2 to 23 times higher compared to the lowest intensity buildings by type within the city. These ranges are evident in Figure 13.

FIGURE 13. SITE EUI RANGES BY BUILDING TYPE



X = average EUI

Buildings that reported an EUI below the building type median or an ENERGY STAR® score lower than the national median of 50 are likely to have the greatest opportunities to improve energy performance.

Figure 13 shows the EUI range, including the four quartiles, the median, and the average EUI for each building type. Based on analysis, a potential savings opportunity of 467,000 MMBTU was identified, if the building EUIs in the lowest quartiles could achieve a median rating.

Capturing these savings represents approximately $25 million in energy efficiency investments, and could result in $10 million in energy cost savings annually, a reduction of 94,000 MT CO2e and creation of over 120 jobs.

CAPTURING ENERGY EFFICIENCY

How can these potential energy savings opportunities be captured? Property owners, manager, tenants, and even real estate professionals can all play a role by implementing the following recommendations and best practices.

Property Owners & Managers

- Create an energy team or designate an energy champion that is responsible for developing and implementing energy conservation measures.
- Engage with tenants through energy transparency such as providing an energy dashboard in the building to show real-time energy use.
- Educate tenants about good energy conservation habits (turning off computer at night, turning off switchable lights when not in use, etc.).

Facility Managers

- Perform energy assessments and retro-commissioning studies and implement recommended energy conservation measures.
- Ensure operation and maintenance protocols and practices fully optimize building systems.
- Confirm all sensors are calibrated.
- Identify rebate offerings and tax incentives.

Tenants

- Work with property owners and managers on tenant build-out guidelines that involve energy conservation measures.
- Collaborate with property management on green leases opportunities.
- Review energy performance with the property manager.
- Encourage good energy habits by employees.

Real Estate Professionals

- Educate clients on the value of energy efficiency.
- Review tenant energy consumption and building consumption at the time of lease renewal and building sales.
- Encourage use of green leases.

V. NEXT STEPS

Building Report Cards

Following completion of data quality control and analysis, the City of Boulder issued customized report cards to all building owners. These report cards included a comparison of building EUI to the average City of Boulder EUI and the local building type EUI as well as energy costs and financial savings potential. The report cards also included the ENERGY STAR® score, next steps, and a list of resources.

Data Publication

Concurrent with this report, the City of Boulder is launching an online compliance that provides building-specific compliance and energy information, available on BoulderBuildingPerformance.com. Because the City of Boulder has elected to publicly disclose building-specific energy metrics following a two-year grace period, the energy data reported by affected buildings will not be publicly disclosed until 2018 reporting. However, the city is currently disclosing building-specific metrics for all municipal facilities as well as compliance status for all affected buildings within the compliance map.

Reporting Timeline

Rating and reporting is an annual requirement. All buildings that reported in 2016 will be required to continue reporting calendar year energy use each year moving forward. Every two years, the next group of commercial and industrial buildings will begin this compliance schedule, starting with rating and reporting for buildings 30,000 sf to 50,000 sf in 2018 and for buildings 20,000 sf to 30,000 sf in 2020.

In addition, these buildings must follow a compliance schedule where an efficiency requirement must be met every two or three years following the start of rating and reporting.

COMPLIANCE SCHEDULE

2016

Buildings > **50,000** sf

New Buildings > **10,000** sf

City Buildings > **5,000** sf

Large Industrial Campuses

2018

Buildings > **30,000** sf

2020

Buildings > **20,000** sf

Rating & Reporting

↓ 3 yrs

Energy Assessments

↓ 2 yrs

Lighting and RCx

↓ 2 yrs

Implement Cost Effective RCx Measures

VI. ACKNOWLEDGMENTS

The City of Boulder thanks the property owners and managers, partner organizations, utility and supporting individuals that have helped successfully develop and implement the Boulder Building Performance Ordinance.

To the building owners, property managers, tenants, service providers and other stakeholders who collected data, set up accounts, reported usage and complied this year – thank you for your collaboration and efforts. The city appreciates your partnership in achieving our community energy and climate goals.

The Building Performance Program's success would not be possible without the Boulder County Partners for a Clean Environment (PACE) team, who provided significant outreach and assistance to building owners and supported help desk efforts.

Special thanks to Xcel Energy and its Energy Benchmarking services team for making aggregated building energy data accessible and facilitating their customer's rating and reporting efforts.

The City of Boulder thanks the U.S. Environmental Protection Agency for its ongoing, critical support for the ENERGY STAR® Portfolio Manager tool, as well as the support for customized energy tracking, training and rating and reporting support.

The Boulder Building Performance Program Report was created with input, analysis and other support from the following:

- Boulder County Partners for a Clean Environment (PACE)
- Xcel Energy
- Southwest Energy Efficiency Project - Colorado Industrial Energy Challenge
- NORESCO
- Nexant
- U.S. Environmental Protection Agency
- Institute for Market Transformation
- Urban Sustainability Directors Network (USDN)
- Building Performance Ordinance Working Groups
- City of Boulder Environmental Advisory Board

City Staff

Jane S. Brautigam,
City Manager

David Gehr,
Interim Executive Director of Planning, Housing + Sustainability

Tom Carr,
City Attorney

Carey Markel,
Senior Assistant City Attorney

Sarah Huntley,
Deputy Director of Communications

Kendra Tupper,
Energy Services Manager

Elizabeth Vasatka,
Sustainability Coordinator

Kimberlee Rankin,
Sustainability Coordinator

Alexis Bullen,
Sustainability Communications Specialist II

Emily Sandoval,
Communication Coordinator

Dylan Greenleaf,
Sustainability Data Analyst

For more information about the Building Performance Ordinance, please visit BoulderBuildingPerformance.com

April 2017

VII. GLOSSARY

Disclosure: The process of disseminating the reported energy use information to the public.

ENERGY STAR® Score: A 1 to 100 rating calculated by Portfolio Manager to assess a property's overall energy performance, based on national data to control for differences among building uses and operations. Twenty-one property types are currently eligible for an ENERGY STAR® score. A score of 50 represents the national median, while 100 represents a top performer; a score of at least 75 may make buildings eligible for ENERGY STAR® Certification.

ENERGY STAR® Portfolio Manager (ESPM): Free, online software developed by the U.S. EPA to help buildings benchmark, verify and report energy use and property information (www.EnergyStar.gov/PortfolioManager).

Energy Use Intensity (EUI): The total annual energy used per square foot of gross floor area. It is expressed in units of kBTUs (thousand British thermal units) per square foot per year.

Greenhouse Gas (GHG) Emissions: Carbon dioxide (CO2) and other gases released as a result of energy generation, transmission, and consumption. GHG emissions contribute to climate change and are expressed in metric tons of carbon dioxide equivalent (CO2e). GHG emissions are also released due to other activities in buildings, such as refrigeration and cooling, but those emissions are not calculated from energy benchmarking.

Gross Floor Area (GFA): Total interior floor space between the outside surfaces of a building's enclosing walls, expressed in square feet. This includes tenant space, common areas, stairwells, basements, storage and interior parking.

International Energy Conservation Code (IECC): This comprehensive energy conservation code establishes minimum regulations for energy-efficient buildings using prescriptive and performance-related provisions.

Median EUI: The median EUI is the middle of the population – half of buildings use more energy, half use less. The median works better than the mean (arithmetic average) for comparing relative energy performance, because it more accurately reflects the midpoint of energy use for most property types.

Rating: (also known as benchmarking) is the process of measuring and comparing energy performance metrics (such as the normalized energy use of a building) to other similar buildings.

Reporting: providing the energy use and associated metrics and ratings to the parties required by the proposed ordinance (e.g. the city and tenants of the building).

Retro-commissioning (RCx): A process that improves a building's operations and maintenance (O&M) procedures to enhance overall building performance. Retro-commissioning is designed to improve the efficiency of existing building operations by "tuning up" and calibrating existing functional systems to run as efficiently as possible through low- or no-cost improvements.

Site Energy Use: Energy consumed on-site at a building, as measured by utility bills, and expressed in kBTU.

Source Energy Use: Energy required to operate a property, including on-site consumption, as well as energy used for energy generation, transmission and distribution; expressed in kBTU.

APPENDIX A

The analysis presented in this report is based on data submitted as of Oct. 14, 2016. As of this date, the city received 146 unique energy reports ("buildings"). 143 buildings are included in this analysis after conducting quality control on submitted energy reports. The quality control methodology implemented was as follows:

Sampling Criteria

- Review all submitted entries to identify outliers.
- Sample 10 percent of the population of buildings.
- Select unreasonably high and low ENERY STAR® scores
- Include highest and lowest EUI properties.
- Categorize by building type. Sample should have at least five different building types.

QC Criteria

- Does the EUI appear to be reasonable for the building type? What could be causing it to be extremely high (or low)?
- Review natural gas units – is reported usage reasonable or may there be a conversion error?
- Confirm gas and electricity usage per building area are reasonable for that building type.
- Review high and low ENERGY STAR® scores – is the reported data reasonable to support those scores?
- Are the operating hours appropriate for the building and space types?
- Do gas and electricity units appear to be correct?
- Is metering for the whole building, or are there separate meters?
- Is the building categorized correctly?
- Does occupancy seem reasonable for the building type? Could some be part-time?
- Is there a data center, restaurant or other special use that could be input incorrectly (or not at all? Confirm input areas and operating hours for these types of areas.
- Are there any alerts noted? Was the data quality checker run without errors?
- Is there on-site electricity generation that could be affecting the EUI?
- Is there varied use in the building (such as a strip mall) that could be affecting the score?
- Review CBECs data (EUI) for that type of building for comparison and evaluation. The "National Median" and/or the "percent Difference from National Median" columns in the data set supplement review here.

All potential quality control issues found in the sampled buildings were then taken to the property owners to verify and/or correct. Any outstanding issues that could not be verified resulted in those buildings removed from analysis, which occurred for three buildings.