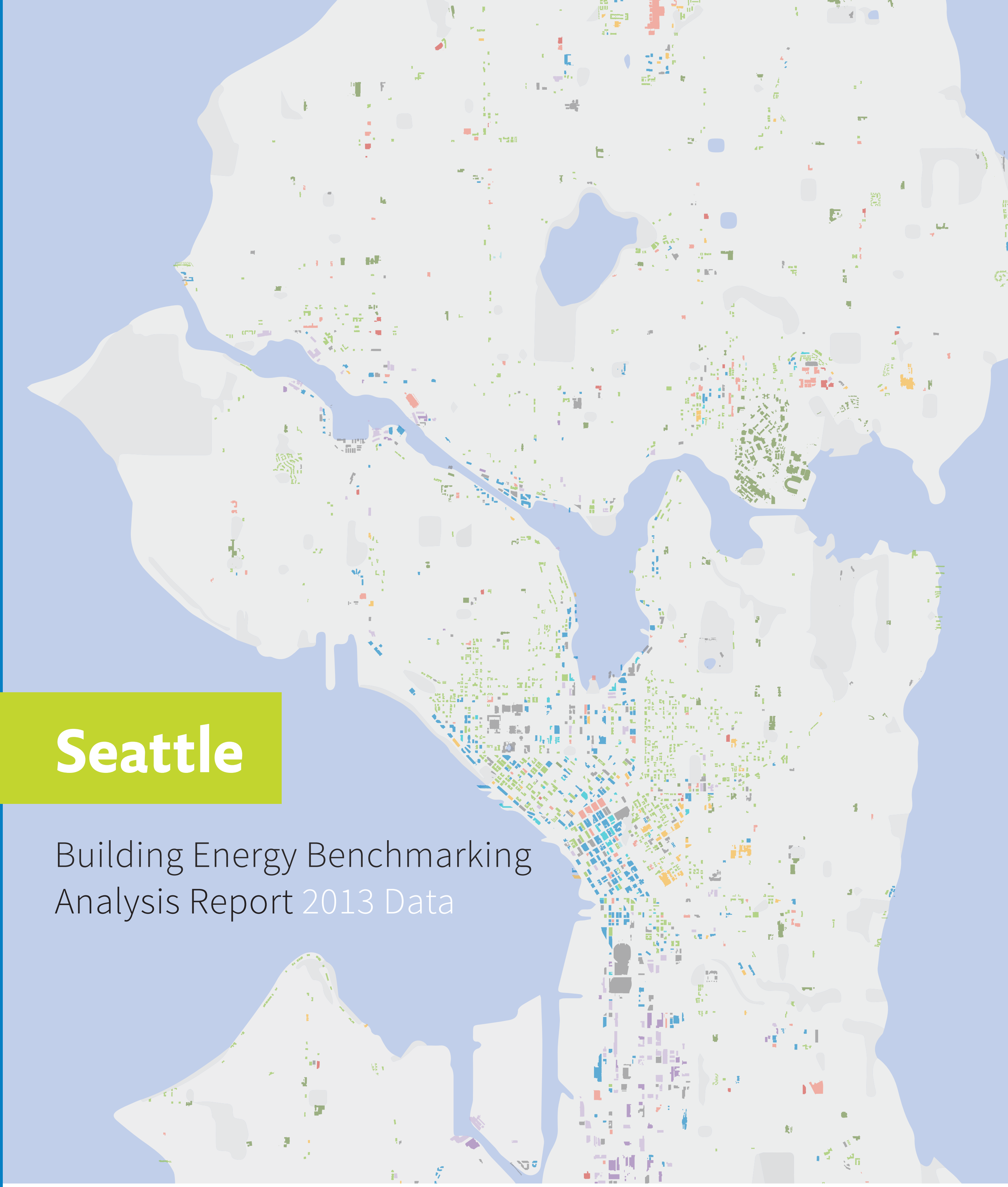


Seattle

Building Energy Benchmarking Analysis Report 2013 Data

Prepared by

SEATTLE OFFICE OF
Sustainability & Environment

September 2015

Acknowledgments

The 2013 City of Seattle Building Energy Benchmarking Analysis Report was prepared by the Office of Sustainability and Environment (OSE) based on the benchmarking results provided by Seattle building owners. Seattle's high compliance rates are the result of extensive outreach, education, collaboration and technical assistance. OSE would like to thank the following organizations for their continued support:

Institute for Market Transformation (IMT)
Northwest Energy Efficiency Alliance (NEEA)
Northwest Energy Efficiency Council (NEEC)
Puget Sound Energy (PSE)
Rental Housing Association (RHA) of Puget Sound
Seattle 2030 District
Seattle Chapter of the Building Owners and Managers Association (BOMA)
Seattle Chapter of the International Facility Management Association (IFMA)
Seattle City Light (SCL)
Enwave (formerly Seattle Steam)
U.S. Environmental Protection Agency (EPA)

Image Credits

Images not directly credited in report are copyright Office of Sustainability and Environment.
Photography by Kristie McLean.

Office of Sustainability and Environment

Jessica Finn Coven, Director

OSE Benchmarking Program

Rebecca Baker, Manager
Nicole Ballinger, Advisor
Angie Bartlett, Coordinator

Benchmarking Help Desk

Brittany Price and Shino Severson, Northwest Energy Efficiency Council (NEEC)

Analysis and Document Preparation

Nate Wilairat, EMI Consulting
Erik Lyon, EMI Consulting
Mark Frankel, New Buildings Institute
Kristina Eastham, EMI Consulting

Executive Summary

This report presents results, accomplishments, trends, and recommendations from analysis of Seattle's building energy benchmarking data for the 2013 calendar year, the third year of energy performance data reported to the City of Seattle. Seattle was one of the first cities in the country to enact and implement a building energy benchmarking disclosure policy requiring private building owners to report energy performance. The benchmarking policy is a part of a suite of policies and programs, recommended in Seattle's Climate Action Plan, aimed at improving energy performance and efficiency among existing buildings. Key findings from this study included:

NATION'S HIGHEST COMPLIANCE RATE

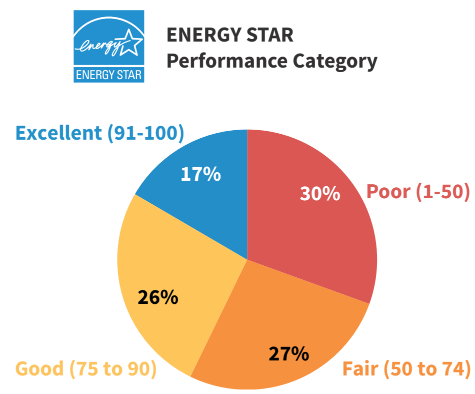
Seattle continues to raise the bar nationally with a 99% compliance rate for reporting of 2013 data. This improves upon the 93% compliance rate in 2012 and attests to effectiveness of the City's implementation strategies, notably the Benchmarking Help Desk. High compliance also signifies building owners' increased awareness of and interest in benchmarking.

DATA QUALITY IS IMPROVING

The upgrade to Portfolio Manager in July 2013 resulted in the availability of more detailed information, covering electric and gas use and additional building categories and space use types. Building owners are improving the precision of the data they enter with the support of the City's instructions and free help desk. This analysis identified a few specific areas where data quality can be improved, such as verifying meters and updating multifamily housing characteristics.

POSITIVE ENERGY PERFORMANCE TRENDS

Overall, Seattle buildings are performing better than the national average for many building types, including offices and multifamily. Office building ENERGY STAR® scores are better on average for buildings constructed in each decade since the 1970s moving from a median ENERGY STAR score of 67 to an 81 for buildings constructed in 2000 or later. Older LEED EB-certified buildings; however, perform as well or better than non-certified newer buildings, underscoring the importance of continued management for achieving and maintaining high efficiency. Preliminary analysis also suggests that year-to-year building energy performance is stable or trending positively, with an overall decrease of 0.6% in total energy use from 2012 to 2013.



SEATTLE'S MULTIFAMILY BUILDING SECTOR IS AN EARLY ADOPTER OF ENERGY STAR CERTIFICATION

When the ENERGY STAR score for multifamily housing was launched in September 2014, nine Seattle buildings achieved ENERGY STAR certification, the highest number in the country. Additionally, in advance of the new score release, a substantial percentage of Seattle's multifamily buildings updated default data with actual building use details to obtain more accurate ratings. These are positive indicators that the market is responding favorably.

GREATER INSIGHT INTO WHAT DRIVES ENERGY USE INTENSITY IN SEATTLE'S MULTIFAMILY SECTOR

Within the 1,500 multifamily buildings benchmarked, two notable trends were observed regarding energy use. Buildings with smaller living units (i.e., a higher density of living units) use more energy per square foot than buildings with larger units. Additionally, taller buildings typically used more energy per square foot than shorter buildings. These findings can help building owners understand the energy performance of a building relative to its unique characteristics.

LARGE OFFICE, MULTIFAMILY AND HOTEL FACILITIES ARE OPPORTUNITIES TO INCREASE EFFICIENCY

Large buildings with a high energy use intensity account for a significant portion of citywide energy use. The distributions of EUI and total energy use for office, hotels, and high-rise multifamily show there is room for improvement in these sectors.

2013 BENCHMARKING HIGHLIGHTS:

3,216
buildings

281
million square feet

68
Median
ENERGY STAR score
(non-residential buildings)

99%
Compliance Rate

Contents

1. Introduction

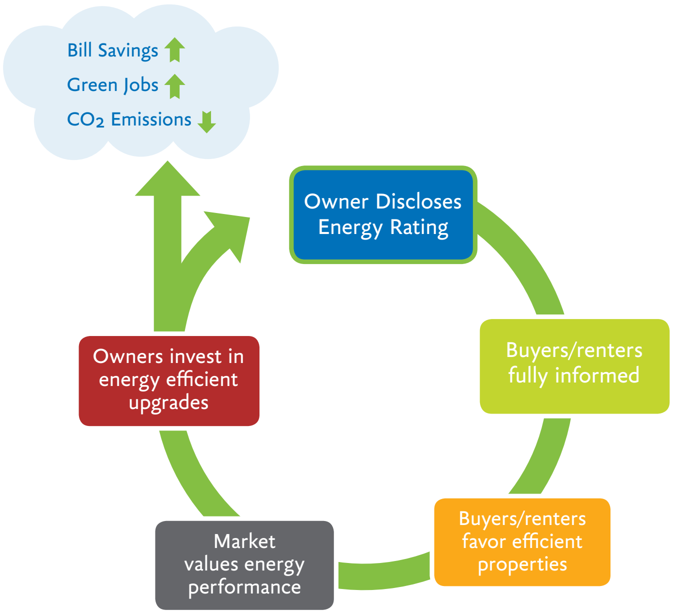
In 2010, Seattle was one of the first cities to enact and implement a building energy benchmarking policy and is now one of 14 cities with a benchmarking requirement (as of August 2015). Benchmarking policies cover 6.1 billion square feet of floor space in the country's major real estate markets and are part of larger movement to encourage transparency and data-driven decision-making in energy management.[1]

Seattle's Building Energy Benchmarking and Reporting Program attained a 99% compliance rate for the 2013 calendar year. The resulting dataset represents a near census of Seattle's non-residential and multifamily buildings 20,000 square feet or larger. It is estimated that Seattle's benchmarked buildings represent about two-thirds of citywide commercial and industrial square footage. Benchmarking data provides a robust means of tracking and motivating progress towards the City's Climate Action Plan building energy goals. Seattle's building performance dataset allows for unprecedented comparisons among similar buildings locally. Benchmarking results let building owners know what performance level may be possible for their building type.

Building benchmarking is a first step toward understanding and managing energy use. Benchmarking helps owners identify opportunities to increase profitability by lowering energy and operating costs.

These data also allow for a deep understanding of building energy trends. Buildings can be compared by type, age, location, size, types of environmental certifications, and even secondary space uses. The ability to segment Seattle's buildings allows planners and utilities to better understand market segments that could benefit from energy efficiency improvements.

The benchmarking policy facilitates the tracking of energy performance trends across time. While only two to three years of data have been collected for buildings thus far, the benchmarking dataset will allow policymakers to track the long-term energy performance of Seattle's buildings and encourage building owners to monitor and manage building energy use.



NEEP (Northeast Energy Efficiency Partners)

[1] *Visit www.buildingrating.org to learn more about benchmarking and transparency policies.*

Policy Background

Seattle's Energy Benchmarking and Reporting policy (see Seattle Municipal Code Chapter 22.920 Energy Use Benchmarking[2]) requires non-residential and multifamily building owners of facilities 20,000 square feet or larger to benchmark building energy performance through the U.S. Environmental Protection Agency's (EPA) ENERGY STAR Portfolio Manager and report the results annually to the City of Seattle by April 1st. Additionally, the ordinance requires building owners to disclose, upon request, a Statement of Energy Performance (SEP) to any current or prospective tenant, buyer, or lender.

Benchmarking and transparency of buildings' energy use allows owners and occupants to understand their building's relative energy performance and helps identify opportunities to cut energy waste. Sharing building performance data allows the market to recognize and reward energy efficiency and create a continuous cycle of improvement and demand for high-performing buildings. Learn more about the benefits of benchmarking by visiting www.IMT.org/resources.

The benchmarking policy is a part of a suite of initiatives recommended in the Seattle Climate Action Plan[3] to reduce energy consumption in Seattle's existing building portfolio. The 2013 Climate Action Plan established goals for 2030 to reduce energy use in commercial buildings by 10%, energy use in residential buildings (including multifamily) by 20%, and reduce the Greenhouse Gas (GHG) intensity of all fuels by 25%.

2 http://www.municode.com/library/wa/seattle/

3 Visit http://www.seattle.gov/environment/climate-change/climate-action-plan to download the plan.

2. Accomplishments

Compliance Rates

Seattle's benchmarking ordinance has achieved a high compliance rate each year of implementation. About 3,240 non-residential and multifamily buildings 20,000 square feet or larger (about 282 million square feet total) were required to report 2013 energy data. This includes about 50 newly constructed or renovated buildings required to report for the first time. About half of all buildings in the dataset are multifamily housing.

As of December 2014, 99% of these buildings had 2013 energy performance data reported by a manager, owner or vendor to the City. This represents 99.4% of the total square footage subject to the requirement. The 2012 calendar year was the first year that all buildings 20,000 square feet or larger were required to report data. The overall compliance rate of 99% in 2013 improved over the already high rate of 93% in 2012, due largely to higher reporting by non-residential buildings.

Table 1: **2013 Annual Benchmarking Reporting Compliance Rates**

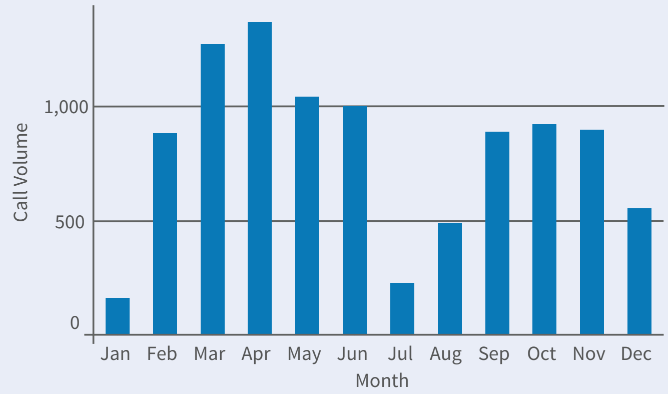
	2013 Data ≥20,000 SF *as of December 2, 2014*			
	Buildings	**% of buildings compliant**	**Area** *million sf*	**% of building sf compliant**
Non-Residential	1,651	99.0%	178.6	99.2%
Multifamily	1,565	99.5%	102.4	99.7%
Total	**3,216**	**99.2%**	**281.0**	**99.4%**

Help Desk: Free Technical Assistance for Benchmarking

To help building owners meet the annual benchmarking and reporting requirement, Seattle provides free technical assistance available weekdays during business hours (8am–5pm, M–F) for telephone and email questions. In 2014, Resource Media conducted an assessment of Seattle's help desk to capture the impact of this investment. The study found an ongoing need for assistance

SEATTLE HELP DESK IN 2013

- Help desk responded to 9,695 calls and emails.
- 64% of owners and managers required to report received assistance.
- 98% of inquiries responded to in 3 days or less.



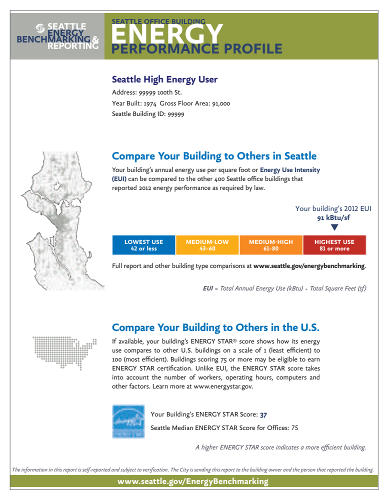
and a progression from basic compliance help to more advanced inquiries from those interested in learning about their building's performance and how they can improve it.[4]

> *"It's going to be my roadmap for how we plan and finance green retrofits and help me prioritize. Out of the 30 buildings, I have a dozen that need help. That's what (Seattle's benchmarking program) told me three years ago, that they are trying to encourage existing buildings to be more efficient. But without the knowledge, you don't know where to start."*
>
> *- Benchmarking Focus Group Attendee (name withheld)*

Training Workshops

To respond to changing needs, the help desk has developed an advanced workshop which includes: a benchmarking account "tune-up" to correct mistakes, steps to update building use information to improve ENERGY STAR score accuracy, methods to access reports and compare data in their Portfolio Manager account, top ten energy saving opportunities, and free local energy efficiency resources. In partnership with local utilities, briefings on incentive programs were also provided to building owners and managers. Throughout 2013, 142 owners or their representatives registered for Seattle Benchmarking training workshops and 34 attended in-person help sessions.

Performance Profiles: Applying Benchmarking Data to Encourage Action



In 2013, Seattle piloted benchmarking performance profiles for the office building sector, providing feedback to owners and managers on how their property compared to similar buildings locally and nationally. The Seattle Office Building Energy Performance Profile was customized to highlight each building's 2012 EUI and display if that annual energy use was in the low, medium-low, medium-high, or highest use performance quartile. If available, the ENERGY STAR score was listed relative to the Seattle's median office score. Links to utility incentives were included on the back. Sharing this custom performance data is intended to spur market action and drive improvement in building performance by helping owners and managers understand how their facility performs relative to its peers.

Owners and City Benefit from Automated Data Access

Seattle's benchmarking and reporting process is unique among cities with benchmarking ordinances. Unlike other cities, the City of Seattle and local utilities (Seattle City Light, Puget Sound Energy and Enwave—formerly Seattle Steam) use Portfolio Manager data exchange to establish a secure, web-based connection for automated data uploads and reporting to the City. Benefits include reduced data entry errors, efficient compliance tracking, and the ability to help correct erroneous reports in a timely manner.

---

[4] *Full report available at www.buildingrating.org/file/1517/download*

The benchmarking process begins when the person reporting (typically a manager or vendor) enters details about the property and its operations, including size, year built, number of floors, and uses (retail, office, multifamily, etc.) into Portfolio Manager. Monthly energy meter usage is entered either manually from bills, which is time consuming and can create data entry errors, or by enrolling in utility data exchange. Via data exchange, PSE and City Light offer automated monthly uploads of common area and tenant energy usage that is aggregated into a whole-building "virtual meter." Aggregation protects privacy, reduces the need to obtain tenant release forms,[5] and keeps the building's energy use history up to date.

As a final step in the compliance process, building owners authorize the City of Seattle to download energy performance and building characteristics for the previous calendar year, also using data exchange. The data collected from Portfolio Manager is matched to the City's benchmarking database through a unique building ID.

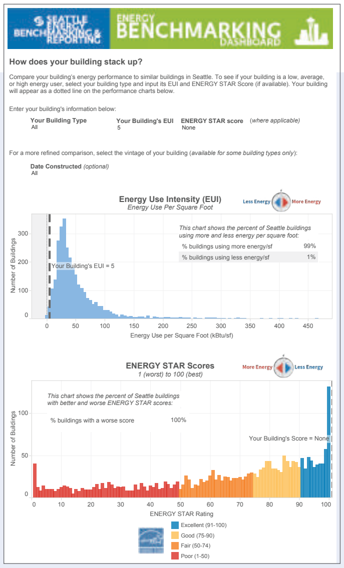
The City and PSE are mentoring other cities and utilities through the Department of Energy's Data Accelerator, a program designed to help utilities make tenant energy data more available to owners and managers seeking to benchmark. The City is also a collaborator on DOE's Standard Energy Efficiency Data Platform (SEED), a tool for cities to manage energy data.

5 PSE (private utility) requires tenant release form if there are four or fewer tenants while Seattle City Light (public utility) requires releases if there is a single tenant.

HOW DOES YOUR BUILDING STACK UP?
NEW SEATTLE ENERGY BENCHMARKING DASHBOARD

For building owners and managers as well as prospective tenants or buyers, EUI and ENERGY STAR score alone may not be enough to understand energy performance.

The most valuable information is seeing how the building's energy use stacks up compared to other buildings in Seattle. The Seattle Office of Sustainability and Environment has made this comparison possible. Users can enter their building type, EUI, and ENERGY STAR score to see how their buildings' energy use compares with other buildings in Seattle, and even compare against buildings of similar age and size. Try it out on the Energy Benchmarking & Reporting website: www.seattle.gov/energybenchmarking.

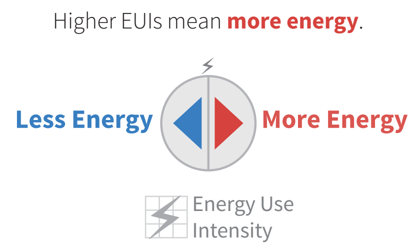


3. Benchmarking Metrics

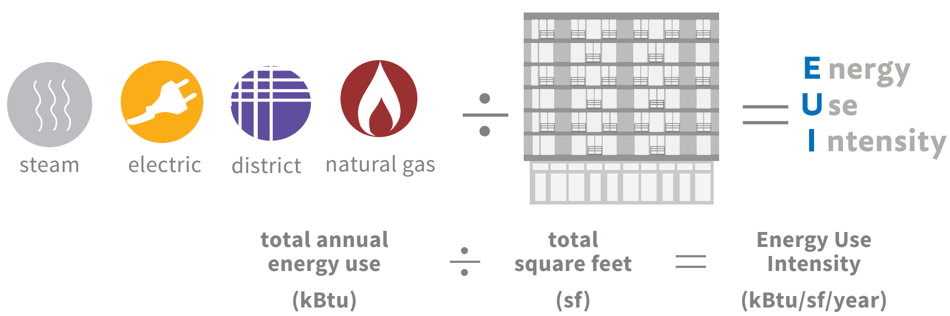
The Seattle benchmarking program relies on the U.S. EPA Portfolio Manager tool[6] to collect building performance information. Portfolio Manager generates two main outputs to measure a building's energy performance: an energy use intensity (EUI) and ENERGY STAR score.

Energy Use Intensity

Energy use intensity (EUI) is a building's total annual energy use (electricity, natural gas & steam) divided by its gross floor area. It is measured in kBtu/sf (one thousand British thermal units per square foot). Since EUI normalizes for size, the energy use of similar building types can be compared. Higher EUIs show greater energy use, whereas lower EUIs indicate more energy efficient buildings.

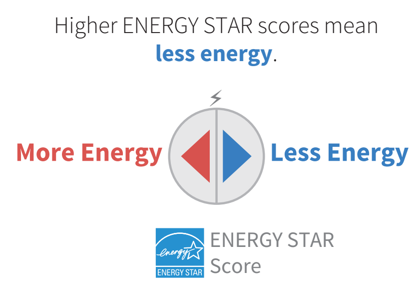


What is an EUI?



ENERGY STAR Score

The Portfolio Manager ENERGY STAR score is available for 21 building types, such as offices, hotels, retail, and multifamily housing.[7] It compares a building's energy use to other U.S. buildings on a scale of 1 (least efficient) to 100 (most efficient). A 50 represents the national median and buildings with 75 or better may be eligible to earn ENERGY STAR certification. The ENERGY STAR score adjusts for operations, such as number of workers, operating hours, bedrooms, and other factors depending on building type.[8]



6 www.energystar.gov/benchmark

7 *The multifamily housing ENERGY STAR score, available for buildings with 20 or more units, was released in September of 2014, after the 2013 reporting deadline. 2013 Multifamily Housing ENERGY STAR metrics are preliminary. To learn more, visit www.energystar.gov/multifamily.*

8 *Learn more about ENERGY STAR certification at www.energystar.gov/buildingcertification.*

Seattle Benchmarking Dataset

The data retained by the City on each building is a subset of the information collected in Portfolio Manager. The data includes energy use by fuel source, floor area (square footage) by space use, EUI (site and source), ENERGY STAR score, and building characteristics such as year built and property use type. All multifamily and non-residential buildings are required to report annually with the exception of buildings with 50% or more industrial and manufacturing uses. Campuses, defined as a group of buildings on a shared meter or central plant (not including hospitals, senior care or K–12 schools) will be required to report 2014 data. Buildings undergoing major renovation, vacant buildings soon to be redeveloped and new construction are temporarily exempt until they are completed and occupied for at least one full calendar year.

Reviewing and assessing Seattle's benchmarking dataset for quality and accuracy were primary objectives of this analysis. Detailed results are presented in the following section on Dataset Accuracy.

BENCHMARKING
Saving Energy & Saving Lives

Fred Hutch
1.6 million sf

At Fred Hutch, physical health goes hand-in-hand with a healthy environment. The Center is one of the most advanced biomedical research facilities in the world, with 1.6 million sf of laboratories, offices, data centers and clinical spaces that serve 600 patients and 4,000 staff every day. It is also one of the world's most energy-efficient.

Over the past 20 years, Fred Hutch has invested more than $9.5 million on 200 conservation projects throughout its 15-acre campus, which are saving the Center $2.2 million annually. The total savings could power more than 2,000 single-family homes in Seattle every year. The projects include:

- On demand ventilation
- Occupancy sensors for HVAC and lighting so they are only in use when people are present
- Heat recovery from server rooms
- Data center utilizes outside air and evaporative cooling
- Automatic adjustment of duct pressures to minimize fan energy
- Reduced water use by 1/3 while campus growth tripled
- Heat recovery from process water
- Reusing process water waste for second process water need

Fred Hutch was recently honored with a Visionary Award in Energy from the Seattle 2030 District for its high-efficiency data center at 1100 Eastlake. The Center also participates in the International Institute for Sustainable Laboratories program (formerly Laboratories for the 21st Century), a joint initiative of the U.S. Environmental Protection Agency and U.S. Department of Energy to improve the energy performance of this energy-intensive building type.

Fred Hutch

"From my perspective, the bottom line drove us. We have limited funds at Fred Hutch and we want to spend every dollar possible on cancer research. Every dollar we save from energy conservation is a dollar we can put towards our research."

- Robert Cowan, Director of Facilities Engineering

4. Data Accuracy

The quality and accuracy of the Seattle benchmarking data is foundational to understanding energy use in Seattle's existing buildings and to the City's efforts to meet its long-term carbon and energy reduction goals. Unreliable data can affect the robustness of analyses and the accuracy of trends and generate individual benchmarking results that are not useful for managing the building.

Three major dataset accuracy tasks were conducted to ensure the validity of the energy benchmarking dataset and to understand potential sources of error. These efforts included initial dataset cleaning, calculation of key data quality indicators, and a survey of multifamily and office buildings with outlier EUIs. Overall, the assessments found data quality to be high, although a few areas for improvement were noted. The appendix includes a detailed discussion of these analyses.

Data Cleaning

The City conducted data cleaning to ensure the analysis dataset removed records with identifiable inaccuracies. Data cleaning steps included removing the following:

- Buildings missing electric or gas consumption.
- Buildings reporting steam use in incorrect units.
- The lowest 1% and highest 1% buildings by EUI for multifamily housing, office, and non-refrigerated warehouses.

These data cleaning steps resulted in a subset of the dataset consisting of 3,016 buildings, used for analysis of energy performance trends. Further data cleaning was conducted for year-to-year comparisons, described later in this report.

Data Quality Indicators

Before the data could be analyzed for trends, data quality indicators were calculated to ensure there were no widespread or systematic errors.

Data quality indicators included the following:

- The proportion of buildings using data exchange web services to automate uploading of electric, gas and/or steam consumption to Portfolio Manager from the utilities.
- A comparison of square footage reported in all Portfolio Manager records to the City's benchmarking database (based on King County Assessor property information) to look for systematic errors, such as over-reporting or under-reporting of square footage.
- The proportion of office and multifamily buildings reporting default values for building use details.

Data Quality Assessment Results

Majority of buildings reported energy use through Utility Data Exchange.
Seattle is fortunate to have data exchange services offered by Seattle City Light, Puget Sound Energy and Enwave. These automated services minimize data entry errors and omissions that can be made when manually entering utility bills, ensure consistency with utility records, and help protect tenant privacy by aggregating uploads to the whole building level. Automated fuel consumption uploads were estimated to be highest for electricity (at least 80%), followed by natural gas (at least 60%), followed by steam (56% or less).

Enrollment of automated uploads for natural gas usage can be increased.
Due to the timing of the launch of PSE's new data exchange service (MyData), many building owners had already reported to the City with manually entered gas data before they were able to enroll in the automated service. We estimated that up to 28% of building owners with gas accounts did not complete the automated process and either manually entered gas usage or omitted it. Of the buildings that did not complete the automated process, 76% manually entered gas data instead. Notably, 111 buildings reported gas in 2013 but not in 2012 while others appeared to have added additional gas meters in 2013. As previously mentioned, buildings identified to have omitted gas in 2013 were excluded from energy trend analysis. Accordingly, there is an opportunity to increase enrollment in PSE's MyData service for 2014 data.

Building square footage reported in Portfolio Manager appears valid.
The square footage values reported in Portfolio Manager were reviewed for systematic errors towards over- or under-reporting. There was no evidence of frequent over-inflation of square footage values, which would lead to a lower EUI. The reported value was compared against King County Assessor records. The analysis found that over half (54%) of the Portfolio Manager reports used a square footage that fell within 1% of King County records. The vast majority of the buildings (88%) with "matching" square footage did not have any parking listed in the King County record, thus using the provided "matching" value was reasonable.

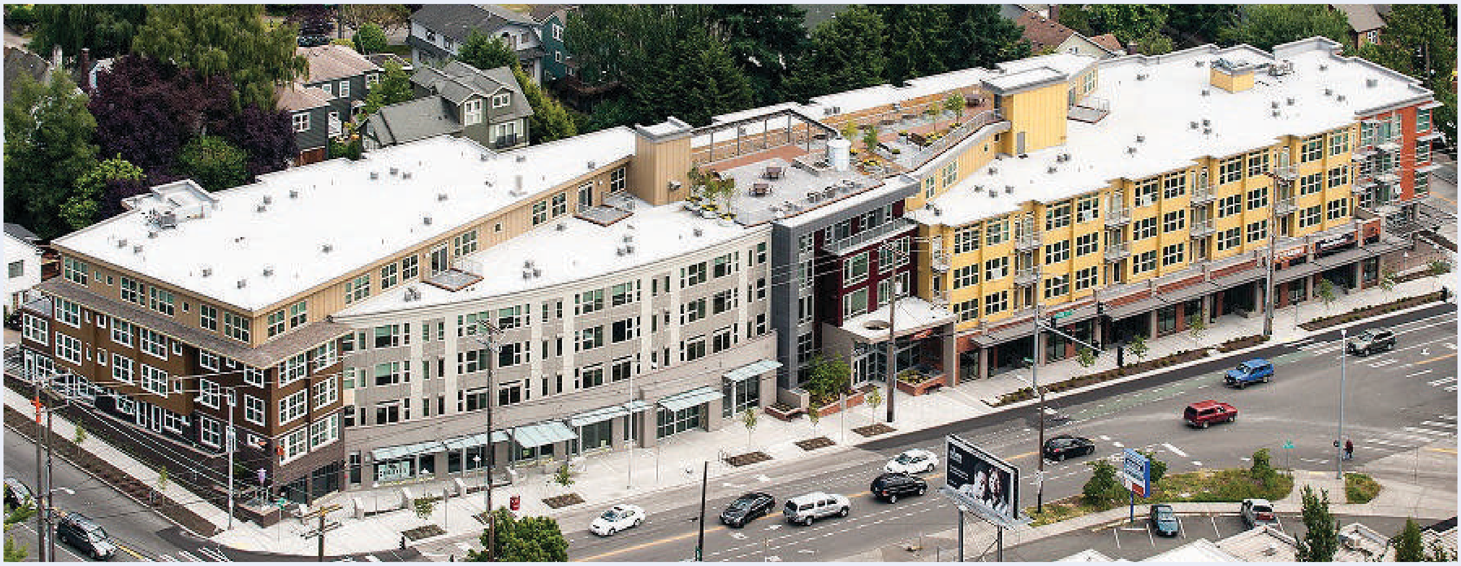
Default values for building characteristics are uncommon for office buildings.

Building ENERGY STAR scores account for characteristics about how the office space is used, such as hours of operation, in addition to EUI, making accurate data important for these values. While building owners might use a Portfolio Manager default value when they cannot obtain the real value, an actual or well-estimated value generally results in a more accurate ENERGY STAR score. Only 11% of office buildings opted to use default values for worker density, and 14% used the default value for operating hours (65 hours per week).

Multifamily market is an early adopter of new ENERGY STAR score.

Even though the Multifamily Housing ENERGY STAR score was not introduced until September 2014 (after the 2013 reporting deadline), many building owners provided actual space use details, such as number of units and bedrooms, rather than using a default value. About half (54%) included number of units, and over one-third (38%) included number of bedrooms. Additionally, over 75% of buildings were correctly categorized as low-, medium-, or high-rise as defined by Portfolio Manager, using King County Assessor data to assess number of stories.[9]

[9] Based on analysis of national data, Portfolio Manager applies a different calculation to generate an ENERGY STAR score for low-rise multifamily and mid and high-rise multifamily buildings. Incorrectly reporting the building's number of floors can result in Portfolio Manager applying the wrong calculation. See "New Multifamily ENERGY STAR Score" on page 29.



Prescott Wallingford Apartments: Jay Dotson Photography courtesy of TIAA-CREF

BENCHMARKING
A Sound Investment

TIAA-CREF

"As one of the world's largest real estate investors, TIAA-CREF has been able to influence the sustainability characteristics of hundreds of properties. By emphasizing long-term value creation, we believe that we can deliver sustainability alongside robust, long-term investment returns."

- Nicholas Stolatis, TIAA-CREF Senior Director and Head of Global Sustainability

Four Seattle apartment buildings owned by investment firm TIAA-CREF all obtained the new ENERGY STAR score for multifamily properties in 2014. Aspira was built in 2009 as the first Four Star Built Green high-rise in Seattle and was already performing well when TIAA-CREF purchased it in 2012. But TIAA-CREF took it to even greater heights by replacing lights with LEDs and providing tenants with energy-saving power strips. Lighting in the parking garage, stairwell, and terrace was also updated.

Similar approaches were used at the other properties, such as efficient lighting and sensors in common areas and programmable apartment thermostats—with easy instructions for optimal efficiency provided to residents. The properties also obtained free energy- and water- efficient fixtures for units through Seattle City Light's Powerful Neighborhoods Program. At Stream Uptown, TIAA-CREF is using the ENERGY STAR Portfolio Manager tool to monitor the building's energy use, helping to ensure that it maintains the LEED Gold certification it achieved in 2012.

Of the 25% incorrectly categorized buildings, the vast majority were high- and mid-rise buildings that were incorrectly classified as low-rise, which is the Portfolio Manager default for building height.

Outlier Survey

Since office and multifamily buildings make up 60% of the energy consumption in the benchmarking dataset, these building types were targeted for a follow-up study to understand high and low outliers by EUI. These were defined as the highest and lowest 3% of multifamily buildings by EUI and highest and lowest 5% of office buildings by EUI. The purpose of the task was to develop hypotheses and test them to understand both sources of error and drivers of high and low energy usage. This systematic follow-up with outliers yielded a number of insights, suggesting that this could be a useful strategy for other jurisdictions to contextualize their data.

To conduct this study, a voluntary online questionnaire was distributed via email to the benchmarking contacts for these buildings. The Benchmarking help desk conducted follow-up calls with the contacts to complete questionnaires and correct any reporting errors uncovered in the process. See Appendix A for additional detail.

High intensity secondary space uses frequently explain high outlier EUIs.

The majority of high EUI office outliers (8 of 10) and a quarter (7 of 26) of high EUI multifamily outliers were explained by high intensity secondary spaces, such as restaurants, supermarkets, and medical offices. In some cases, the secondary space was correctly entered in Portfolio Manager but had a unique use that did not clearly fall under the space type definition, such as a dispatch center classified as a distribution center.

Missing meters were a common cause of low EUI outliers.

Missing meters were the most common explanation for low EUI outliers for office (5 of 8) and multifamily housing (5 of 13). The help desk determined where meters were potentially missing and assisted building owners to add the meters.

Vacancy and special needs housing explained some multifamily outliers.

Special needs housing, which includes commercial kitchens, showers, and clinical services, explained 4 of 26 high EUI multifamily outliers, while vacancy was the most likely explanation for 3 of 13 low EUI multifamily outliers. Spaces such as commercial kitchens and clinical services provided by special needs housing should be reported as secondary space uses.

Some buildings appeared to be simply inefficient.

Respondents noted known inefficiencies in their buildings as an explanation for 5 of 26 high EUI multifamily outliers and 1 of the 10 high office outliers. Additionally, there was no clear explanation for another 7of 26 high EUI multifamily outliers and 1 of 10 high EUI office outliers.

5. Building Characteristics

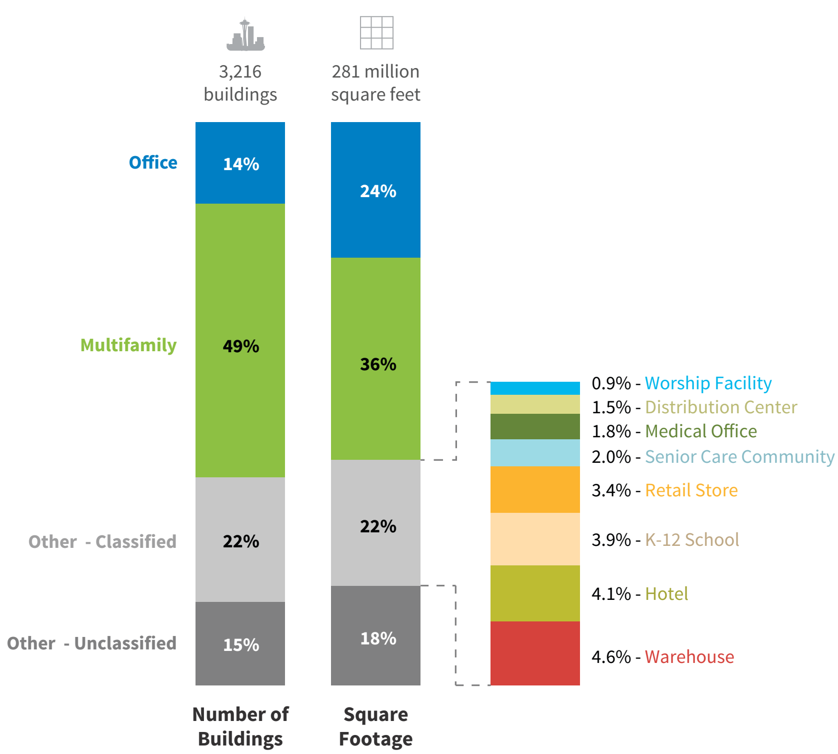
Seattle's benchmarking ordinance and the high rates of compliance allow for an incredibly complete picture and unprecedented understanding of Seattle's commercial and multifamily buildings 20,000 square feet and larger. This chapter presents analysis of the non-energy characteristics—square footage, building type, age, and location—of the 3,216 buildings in the 2013 dataset. Details on fuel consumption mix and greenhouse gas emissions are also included for the "cleaned" dataset of 3,016 buildings.

Building Type

Offices and multifamily housing made up the majority of benchmarked buildings by both number and square footage. Building types are defined by Portfolio Manager as the building's majority space use in square footage (over 50% of the building's floor area). Portfolio Manager includes more than 80 different space uses to choose from. Mixed-use buildings with no majority space use and buildings not falling into a defined category are classified as "other."

Although multifamily housing made up 49% of the buildings, they comprised only 37% of the total square footage, since they are smaller on average by square footage relative to other building types (Figure 1). Conversely, offices comprised only 14% of the buildings, but 24% of square footage. Warehouses, hotels, K–12 schools, retail, and senior care communities made up the highest percentage of square footage outside of multifamily and office (Figure 2). The percentage of "other" buildings has increased since the 2012 analysis due to increased compliance of these types of buildings in 2013.

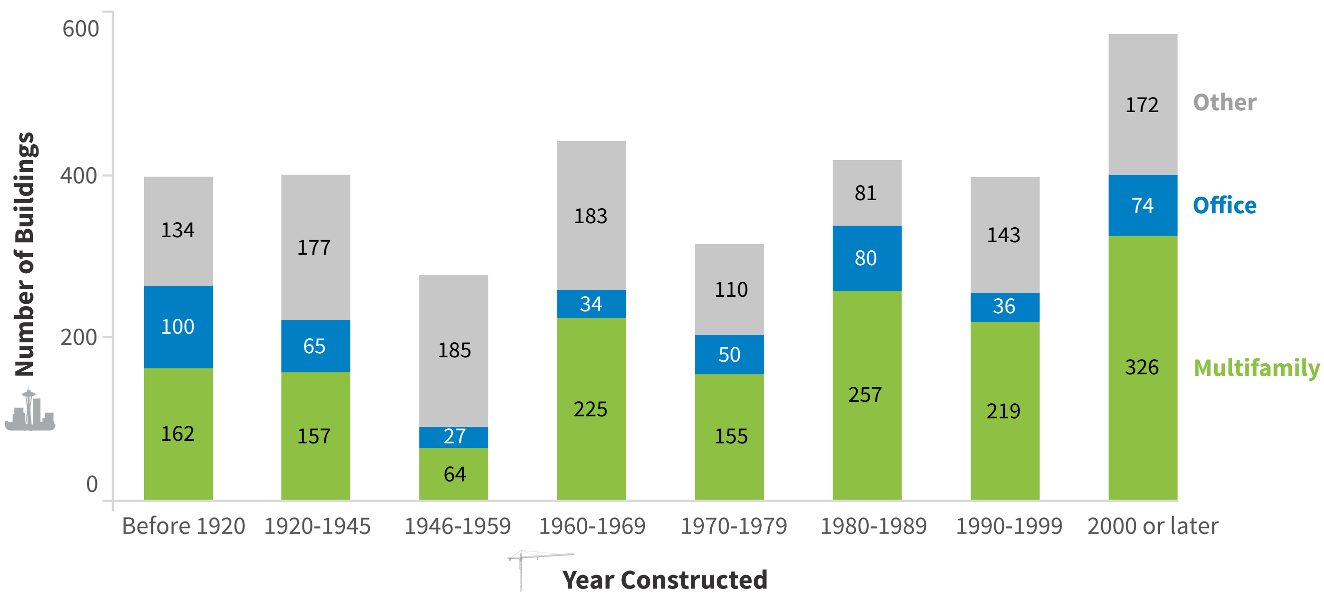
Figure 1: **Percentage of Buildings and Square Footage by Building Type**



Building Age

Seattle's buildings reflect a number of growth periods in the city's history. Overall, Seattle's buildings are relatively young, with the majority of buildings constructed since 1970 and slightly less than a quarter built before 1946 (Figure 2). However, over 20% of office buildings and 10% of multifamily buildings were constructed before 1920. The mix of buildings by age continues to evolve as the city's largest building boom to date (for buildings over 20,000 square feet) occurred in the 2000s, with 501 buildings constructed from 2000 to 2009. This boom is still ongoing— the dataset now contains 71 buildings constructed in 2010 or later.

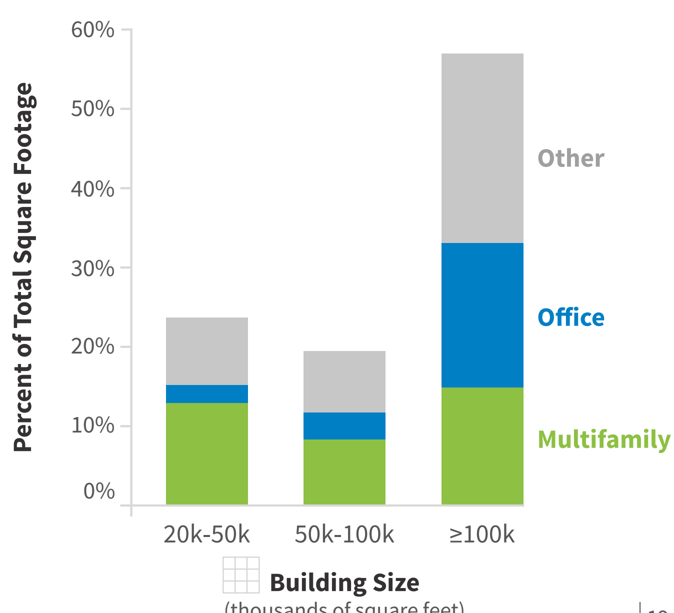
Figure 2: **Building Construction by Time Period**



Square Footage Distribution

Seattle's largest buildings account for a disproportionate share of square footage and energy use. Buildings less than 50,000 square feet made up 60% of Seattle's 2013 benchmarked buildings by number, but accounted for less than a quarter of total square footage (Figure 3). In contrast, buildings of 100,000 square feet or more comprised only 18% of the number of buildings, but made up over half of the total square footage. Accordingly, large buildings (100,000 sf or greater) also made up the majority of the total energy consumption (64%), underscoring the importance of energy management in large buildings. The largest benchmarked building was 1.76 million square feet, 88 times larger than the smallest benchmarked buildings at 20,000 square feet.

Figure 3: **Square Footage Distribution**



Mixed-use Buildings

In recent decades, mixed-use buildings have become increasingly common in Seattle's buildings as patterns of growth and zoning have increasingly favored dense development (Figure 4). Building space dedicated to secondary uses (such as retail and restaurants) has increased markedly since the early 1980's for multifamily and late 1990's for office. Over 5% of multifamily housing building space constructed in 2000 or later is dedicated to secondary space uses compared to 1-2% of floor area in buildings built from 1920 to 1979. Similarly, nearly 7% of space in office buildings built in 2000 is made up by secondary space uses, compared with less than 3% in the two previous decades.

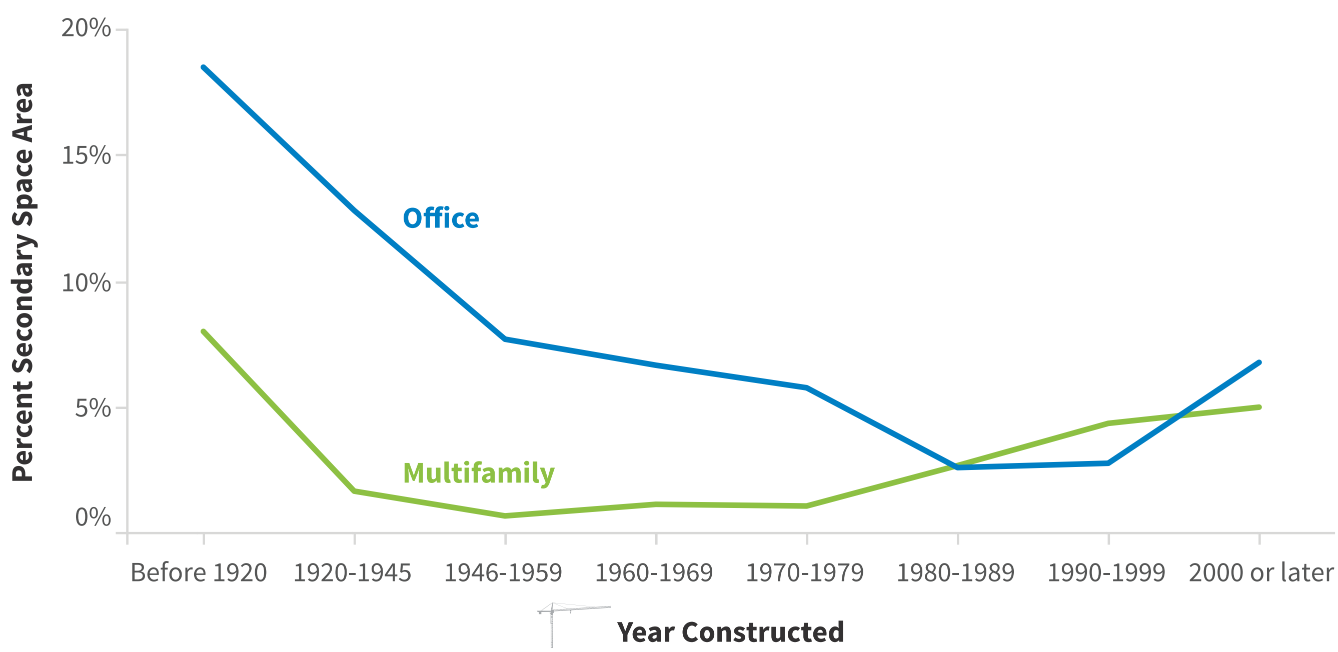
Table 2: **Secondary Spaces in Office and Multifamily Buildings (% of total square footage)**

	Building Type	
Secondary Space	**Office**	**Multifamily**
Retail	2.5%	2%
Other	1.6%	
Non-refrigerated Warehouse	1.3%	0.2%
Financial Office	1.1%	
Restaurant	0.6%	0.3%
Data Center	0.4%	
Office	NA	1.6%
Hotel		0.3%
Supermarket		0.2%

Notably, the proportion of secondary spaces for both multifamily and office buildings is highest in Seattle's oldest buildings. This may reflect the fact that early development in Seattle was often dense, public transit-centric, and walkable. This finding may also suggest that these spaces in older buildings and historic neighborhood centers are appealing for contemporary uses, such as restaurant and retail.

The type of secondary space in a building can noticeably affect its overall energy intensity (see page 37 and 40). The top six secondary space types, by percent of total square footage, are presented in Table 2 for office and multifamily buildings. Retail, non-refrigerated warehouse, and restaurant are top categories for both building types. Office was also the second highest secondary space type among multifamily buildings.

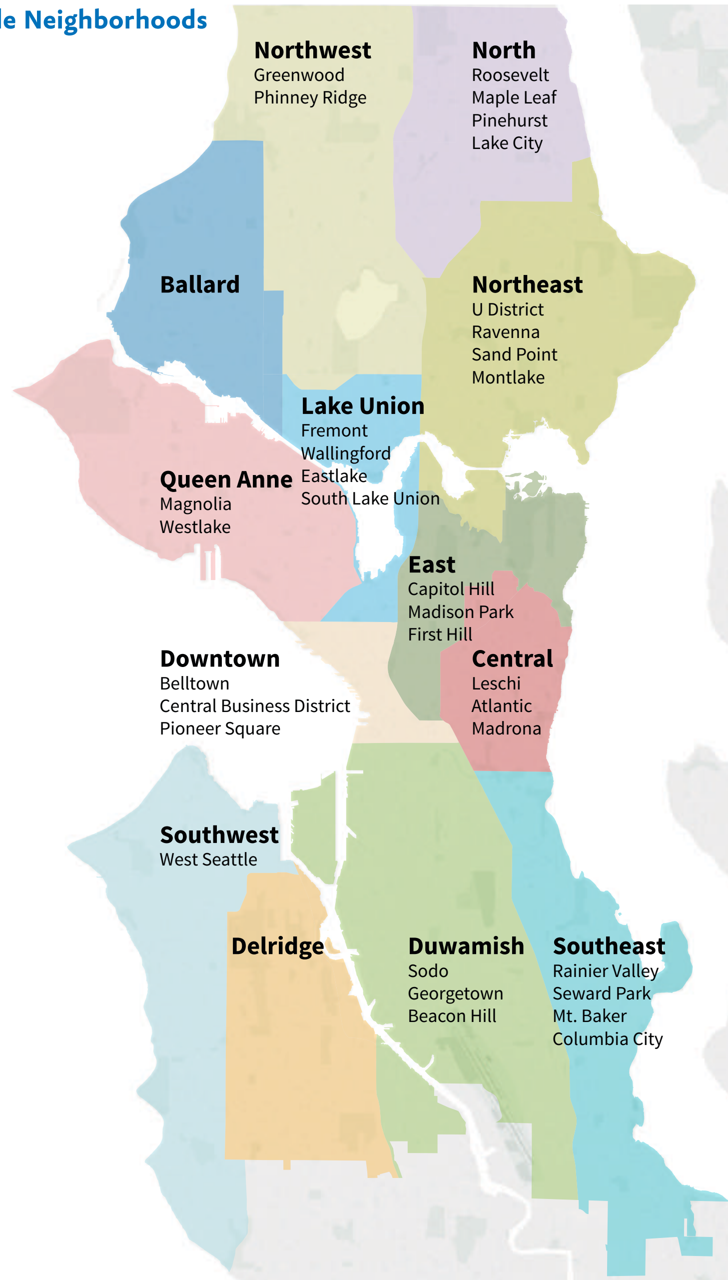
Figure 4: **Percent of Secondary Area by Date Constructed**



The Neighborhoods of Seattle

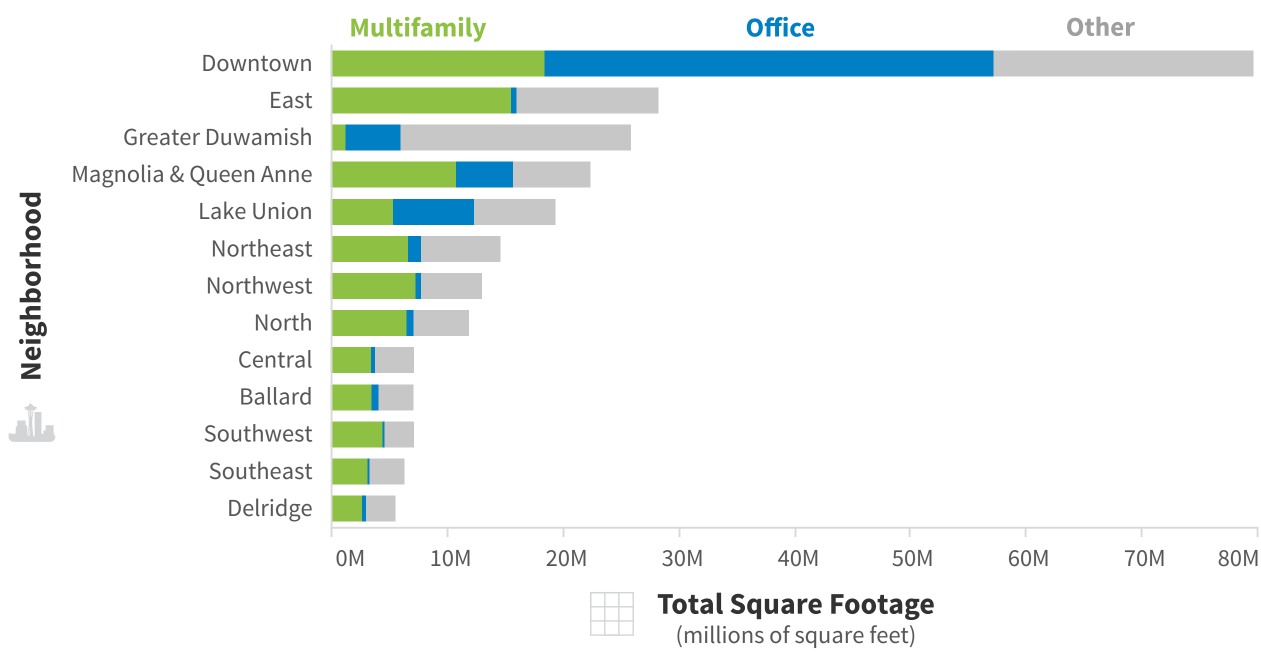
The composition of buildings in Seattle's neighborhoods by floor area reflects the geographic concentration of building types, such as offices and warehouses. Buildings in Seattle were classified into the neighborhoods used by the Department of Neighborhoods for planning and outreach purposes, as shown in Figure 5.

Figure 5: **Seattle Neighborhoods**



As shown in Figure 6, the three largest concentrations of buildings by floor area—Downtown, East, and Greater Duwamish—each reflect a very different building mix. Buildings in downtown make up nearly one-third (32%) of Seattle's benchmarked square footage. Not only does Downtown have the greatest square footage of multifamily housing buildings, but its office buildings account for more floor area than all other neighborhoods' office buildings combined. East, which includes Capitol Hill, is largely residential but also contains the large hospitals and medical offices of First Hill, which make up nearly one quarter (24%) of the neighborhood's floor area (shown in gray as "other" on Figure 6). The industrial area of Greater Duwamish has the lowest proportion of multifamily housing of any neighborhood; instead warehouses and distribution centers make up a combined 40% of the total building floor area. Another one-tenth of this neighborhood's building space is made up of entertainment and public assembly buildings, which include the home of the Seahawks and Sounders (CenturyLink Field) and the home of the Mariners (Safeco Field).

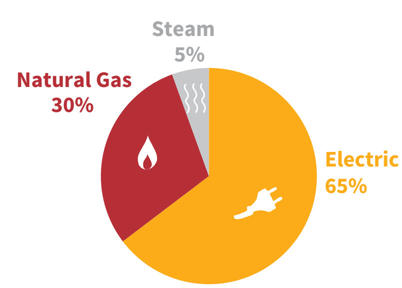
Figure 6: **Floor Area of Buildings by Type & Neighborhood**



Total Energy Consumption Mix

Seattle's 3,016 benchmarked buildings in the cleaned dataset consumed a total of 15.7 billion kBtu of electricity, natural gas, and steam energy in 2013. Portfolio Manager provided the total energy consumption for each building by energy source,[10] allowing a breakdown of all benchmarked buildings' energy use. Electricity accounted for nearly two-thirds (65%) of total energy consumption, and natural gas made up nearly one-third (30%). Steam made up slightly over 5%.[11]

Figure 7: **Energy Consumption Mix**



10 Energy consumption by source was estimated using weather-normalized consumption. Total weather-normalized steam consumption was not provided, so the non-normalized value was used to estimate the relative proportion of steam to total energy consumption. Overall, the difference between normalized and non-normalized energy consumption was less than one-half of one percent (<0.5%).

11 Portfolio Manager made energy consumption by fuel source available via web services starting in 2013, allowing for a more accurate analysis of energy sources. In 2012, energy consumption by source was estimated by a statistical sample of buildings ≥ 50,000 sf. In 2012, steam was estimated to be <1% of total, and natural gas was estimated to be 17% of total.

Greenhouse Gas Emissions

In total, the 3,016 buildings analyzed in this report emitted 343 thousand metric tons of greenhouse gases in 2013 (CO_2e, or "carbon dioxide equivalent").[12] Seattle's high usage of carbon-neutral hydropower makes electricity a comparatively small contributor to greenhouse gas emissions. While electricity made up nearly two-thirds of energy consumption, it was the source of only 10% of emissions. In contrast, natural gas accounted for only 30% of energy consumption, but was the source of over 70% of greenhouse gas emissions.

12 GHG emissions reported are "site" emissions. Calculations used the following emissions factors, with unit conversions where necessary: electricity, 25.62 lbs CO2e/MWh; natural gas, 53.02 kg CO2e/mmBtu; steam, 182.85 lbs CO2e/kLb.

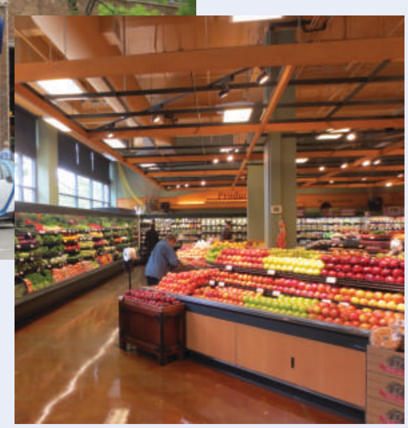
BENCHMARKING
Serving up energy savings

QFC: Broadway Market
64,000 sf

The Kroger company, which owns 50 QFC grocery stores in the Seattle area, is as serious about saving energy as it is about food. Since 2000, the company has reduced energy use across all of its 2,640 U.S. grocery stores by 34.6%. At its Broadway Market QFC location, a variety of energy-saving improvements have been made over the past decade, such as:

- All refrigerated cases have LEDs and temperature controls
- Waste heat from refrigeration system is used to heat hot water
- Refrigerator coils are automated to defrost only when necessary
- Store lighting and HVAC is controlled for occupancy
- Upgraded to more energy efficient equipment throughout the store

Image credit: QFC



Seattle City Light developed custom rebate programs for some of the store's unique energy-saving methods, in addition to providing prescriptive rebates. Since 2007, the store has saved 7.4% on electricity, 37% on natural gas and 14.1% on water. The building earned an ENERGY STAR certification in 2013.

In addition to its energy-saving efforts, Kroger has set a goal to reduce water use across its U.S. stores by 25 percent over the next 5 years, and participates in the EPA Green Chill program to reduce refrigeration leaks, which are harmful to the ozone layer.

"From a business perspective, to stay competitive in the market you have to reduce your utility costs. As a grocery store, which have narrow profit margins, every little bit counts."

- Aaron Sprague, QFC Facility Energy Engineer

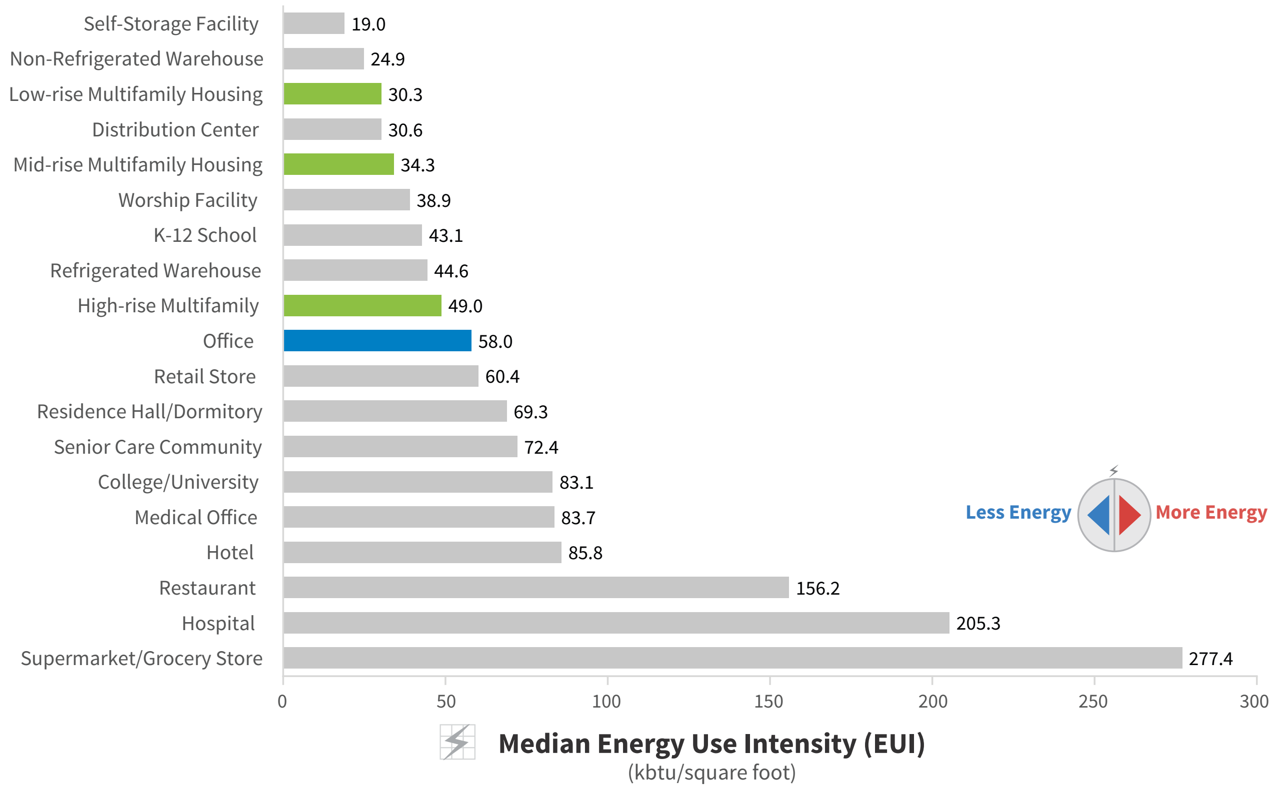
6. Energy Performance Results

This section provides performance results for 3,016 benchmarked buildings using weather-normalized site energy use intensity (EUI), total energy consumption, and ENERGY STAR scores, primarily provided by building type. This chapter also discusses the potential for energy savings by sectors and subsectors. "Source EUI," a metric for building performance that includes the impacts of energy source, is discussed in Appendix B.

2013 EUIs by Building Type

As found in the 2012 analysis, median site EUIs exhibited large variation between building types (Figure 8). A range of median EUIs among building types is expected, because some building types, such as supermarkets and hospitals, require energy-intensive equipment, while others, such as non-refrigerated warehouses, do not.

Figure 8: **Median Seattle 2013 Site EUI by Building Type**



Performance Ranges by Building Type

While median EUI is an important metric for comparing the relative energy intensity of different building types, some variation within building types is expected. To better understand the reasonable range of site EUIs, each building type was broken into four energy use categories:

lowest, medium-low, medium-high, and highest. These categories represent the four "quartiles" within the data for each building type. The first quartile represents the 25% of buildings with the lowest EUIs of that building type. The second quartile represents the range of EUIs for the next lowest 25%, and so on. A low-rise Seattle multifamily housing building with an EUI of 40, for example, would place it in the highest EUI quartile, with 75% of buildings performing better. Building owners and managers can use the table to determine the energy use category for their building and assess its energy efficiency relative to similar buildings. A high EUI, relative to others in Seattle, can indicate opportunity for reducing energy use and operating costs. Because this information is available upon request by existing or prospective tenants, buyers or lenders, a building's EUI can also be used to predict operating costs when leasing, buying, or financing a property.

Table 3: **2013 Energy Performance Ranges for Seattle Buildings by Building Type**

	2013 Annual Energy Use Intensity *(Site EUI in kBtu/sf)*								
Type of Building	**Median**	**Lowest Use** *(1st Quartile)*	**Medium-Low** *(2nd Quartile)*	**Medium-High** *(3rd Quartile)*	**Highest Use** *(4th Quartile)*	Number of Buildings	Year Built *(median)*	Size *(median sf)*	**EPA ENERGY STAR** *(median)*[1]
Low -Rise Multifamily[2]	30.3	≤24	25-30	31-38	≥39	918	1987	29,652	77*
Mid-Rise Multifamily[2]	34.3	≤27	28-34	35-45	≥46	445	1995	52,020	85*
High-Rise Multifamily[2]	49.0	≤42	43-49	50-63	≥64	88	1980	139,684	47*
Office	58.0	≤43	44-58	59-72	≥73	431	1970	55,632	75
Warehouse	24.9	≤14	15-25	26-48	≥49	187	1964	39,984	60
Distribution Center	30.6	≤20	21-31	32-43	≥44	54	1967	46,355	48
Self-Storage Facility	19.0	≤11	12-19	20-30	≥31	23	1956	38,959	NA
Refrigerated Warehouse	44.6	≤34	35-45	46-91	≥92	11	1955	27,200	57
K-12 School[3]	43.1	≤35	36-43	44-56	≥57	125	1960	54,986	83
Retail Store	60.4	≤43	44-60	61-93	≥94	99	1966	41,615	68
Hotel/Motel	85.8	≤55	56-86	87-106	≥107	67	1977	88,592	53
Worship Facility	38.9	≤26	27-39	40-52	≥53	65	1952	26,210	60
Medical Office	83.7	≤67	68-84	85-115	≥116	39	1984	63,909	49
Senior Care Community	72.4	≤51	52-72	73-111	≥112	39	1974	90,383	58
Hospital	205.3	≤170	171-205	206-229	≥230	9	1959	607,780	46
Supermarket	277.4	≤221	222-277	278-299	≥300	35	1996	41,447	41
Restaurant	156.2	≤88	89-156	157-186	≥187	11	1919	33,600	NA
Residence Hall	69.3	≤42	43-69	70-85	≥86	16	1958	31,622	63
University[4]	83.1	≤57	58-83	84-94	≥95	14	1958	58,706	74
Other	62.2	≤36	37-62	63-113	≥114	216	1962	42,750	NA

[1] *ENERGY STAR median only includes buildings that had a score available and therefore may not include all buildings with an EUI.*

[2] *Low-rise multifamily defined as 1 to 4 floors, mid-rise multifamily defined as 5 to 9 floors, and high-rise multifamily defined as 10 floors or greater.*

[3] *Seattle Public Schools are reporting the academic year of September 2012 – August 2013.*

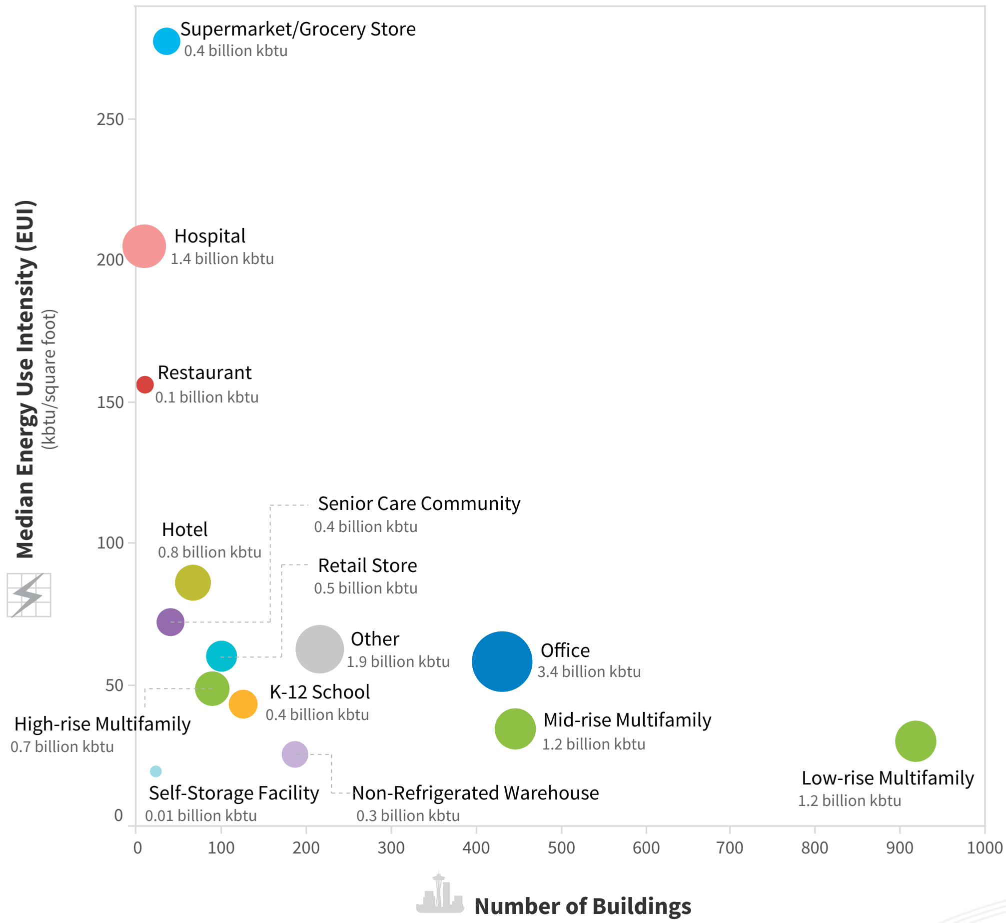
[4] *2013 university buildings only represent facilities that are separately metered and benchmarked as individual buildings. The majority of university buildings will be reported under the campus definition in 2014, the first year campuses are required to report to the City of Seattle.*

[*] *Multifamily ENERGY STAR scores are preliminary. Buildings with default unit density or incorrect building size classification have been excluded from the median ENERGY STAR score calculation.*

A building's EUI can be supplemented with its ENERGY STAR score, which adjusts for details of a building's use, such as the number of workers in the building, or number of bedrooms. The ENERGY STAR score provides a national reference (see page 29 for more details) and can also be compared against the Seattle median in the table on page 25.

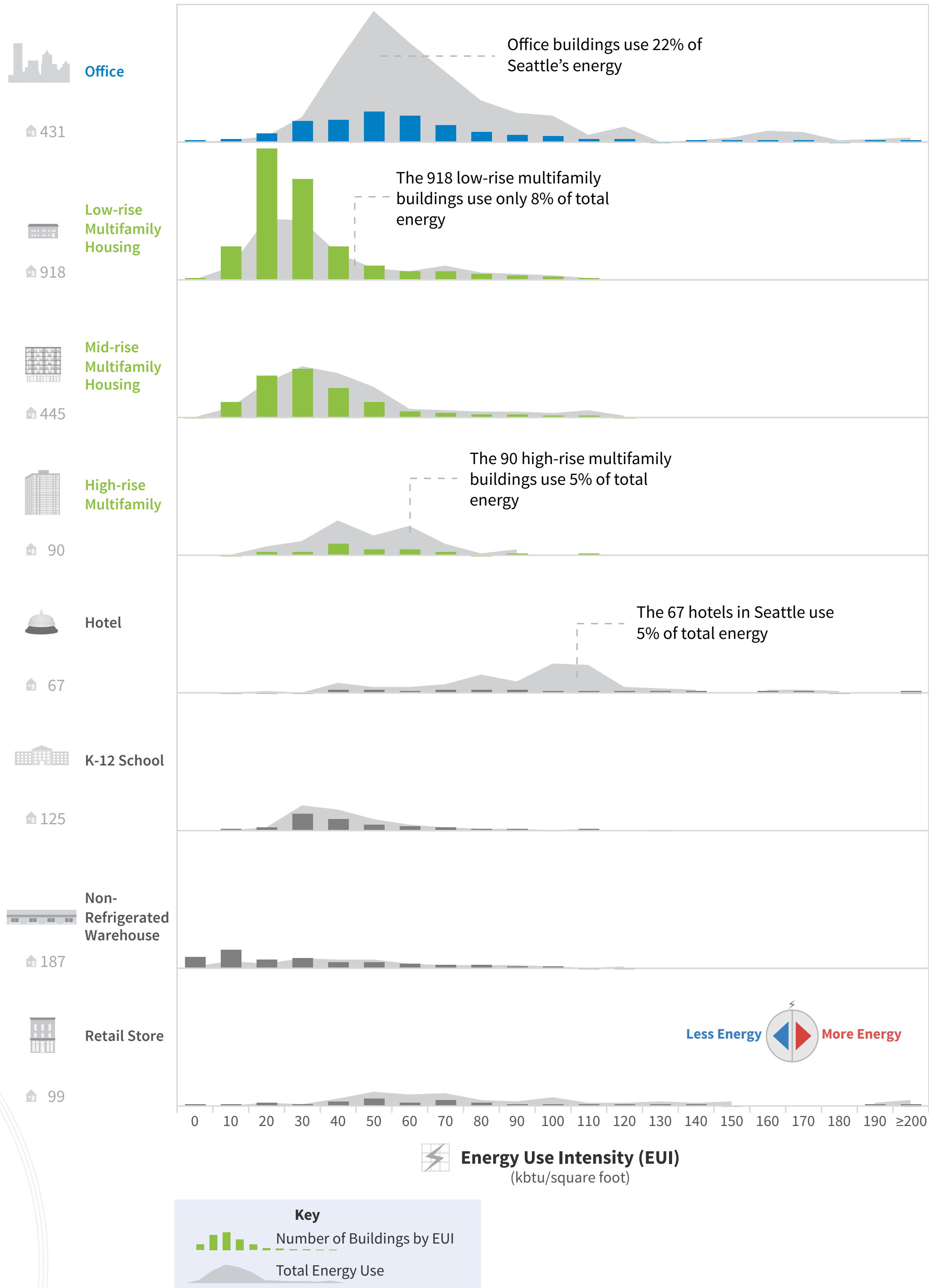
In addition to energy intensity, overall energy consumption by building type is key to understanding opportunities for understanding energy savings opportunities across the portfolio. Figure 9 shows the number of buildings (x-axis), the median EUI (y-axis), and total energy consumption (the size of the "bubble").

Figure 9: **Median 2013 Site EUI by Number of Buildings**



The building types that contribute the most to Seattle's overall energy use tend to have a high number of buildings (e.g. low-rise multifamily), a high EUI (e.g. hospital), or both (e.g. office). Office buildings used the most energy of any building type, with 431 buildings that used 3.4 billion kBtu of energy. Multifamily buildings, with their relatively low energy intensity used less total energy (3.1 billion kBtu) than offices, despite having more than three times as many buildings and over 50% more total floor area. Another example of a disproportionate energy impact is the large, high-intensity hospitals in the dataset, which consumed more energy than the 918 low-rise multifamily buildings.

Figure 10: **Total Energy Use by Site EUI & Building Type**



At the individual building level, large buildings with a high energy intensity contribute greatly to Seattle's total energy consumption. Figure 10 shows the number of buildings by EUI for common building types (vertical bars) and the total energy consumption for these buildings, indicated by the gray shaded area. This figure demonstrates many of the findings from Figure 9 in greater detail, such as the large amount of energy used by the relatively small number of highly energy intensive office buildings (EUI ≥90). High-rise multifamily buildings showed a similar pattern of high energy consumption relative to the number of buildings, driven both by the high energy intensity and square footage of these buildings. In contrast, low- and medium-rise multifamily buildings consumed relatively little energy compared to the number of buildings.

Hotels also have a high energy impact for the number of buildings—just 67 hotels use 5% of overall energy in Seattle. The large gray bumps in the figure show opportunities for energy savings that would have a sizable impact on Seattle's total energy use. Hotels also have a relatively wide distribution of energy use intensity, suggesting variability in operations or building style. This may represent an opportunity for improved performance in some of the high energy users.

"Benchmarking through ENERGY STAR Portfolio Manager allowed us to look at our energy use across the board. The data are very powerful because they tell all of us in the church: here is where your costs are going, and if you make some changes, you will see your costs go down dramatically. It's a very powerful story."

— Roger Seeman, Church Facilities Group Leader

BENCHMARKING
Seeing the Light

Magnolia United Church of Christ
22,600 sf

For the congregation at Magnolia United Church of Christ, saving energy is a higher calling. The church is one of only a few dozen houses of worship in the U.S. that has earned ENERGY STAR certification. Improving efficiency is an ongoing commitment, demonstrated by its score that improved from 75 to 86 in just one year. Better yet, the congregation saved money and then was able to boost support for programs and staff. Energy-saving updates include:

- Insulated attics
- Upgraded florescent lighting to high efficiency T8
- Replaced all toilets with low-flush, water efficient toilets
- Installed programmable thermostats to replace obsolete thermostats
- Installed LED exit lights
- Shut down boiler in summer
- Installed motion & occupancy sensors for external and internal lights
- Installed an efficient air return system in the main meeting hall

ENERGY STAR Performance Results

Of the 1,565 non-residential buildings included in this analysis, 1,071 (68%) reported a 2013 ENERGY STAR score by being a ratable building type and providing all required energy consumption and building characteristic fields, such as occupancy and hours of operation. Buildings classified as “other” are currently not eligible for ENERGY STAR scores. Multifamily ENERGY STAR scores were released in September of 2014, after the 2013 reporting deadline, so only preliminary results for multifamily are reported.

Of the nearly 1,500 multifamily buildings reported in Seattle, 1,190 received the new ENERGY STAR score. Those without a score typically had fewer than 20 units or other uses that prevented a score from being calculated. When EPA Portfolio Manager released the score, “default” values were assigned for the number of units, floors, and bedrooms if they had not already been entered. As noted on page 16, many reports had already been updated to actual values, indicating an early market interest.

To help our local market understand the score, we’ve included preliminary median ENERGY STAR scores in Figure 11 and in the summary table on page 25. For the multifamily buildings in the table, we used the height categories that Portfolio Manager prompts users to enter to define their buildings as low-rise (1-4 floors), mid-rise (5-9 floors), or high-rise (10 or more floors). Since users are asked to categorize their building as such, it is a good reference point for the market. (For an analysis of the influence of building height on EUI, see page 33). These provisional ENERGY STAR scores exclude reports that used “default” unit density or height classification, since the ENERGY STAR metric accuracy is highly dependent on these values. A major focus of benchmarking outreach, education and technical support has been helping managers and owners update their Portfolio Manager accounts with accurate values. Thus, we expect that future analysis of this new multifamily score will be more robust. Furthermore, nine Seattle apartment properties have earned 2014 ENERGY STAR certification—the highest number of any US city to date (see case study on page 29), and two recent multifamily workshops nearly sold out—strong indicators of local interest in this new market differentiator.

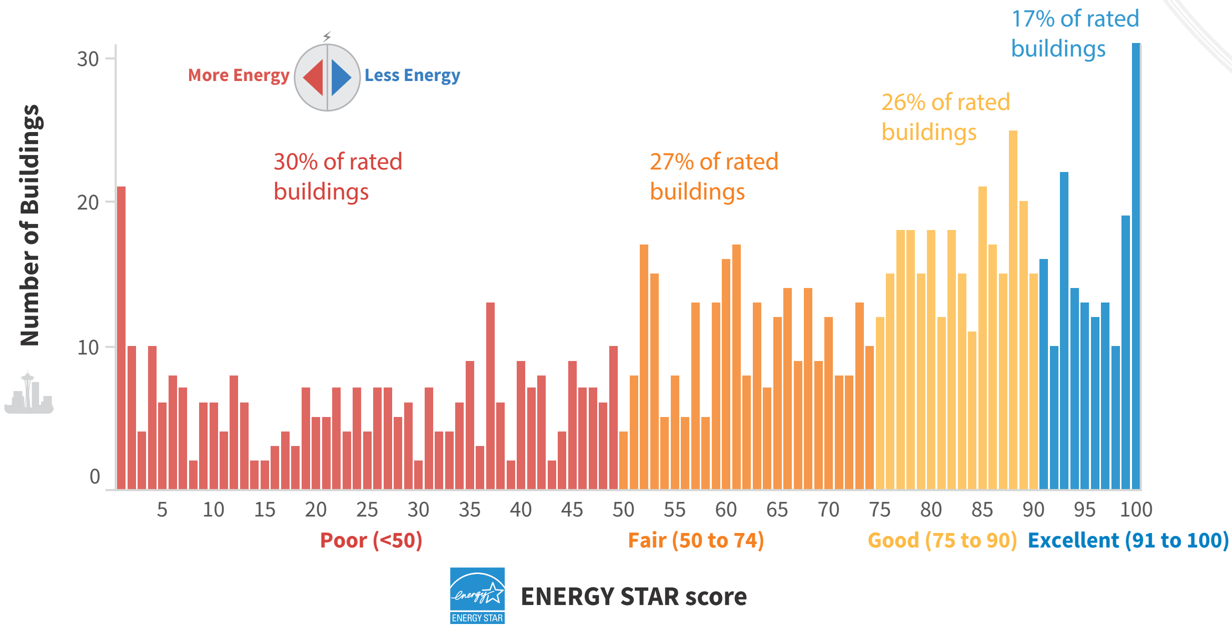
EUI performance categories provide a comparison of a building’s performance relative to other Seattle buildings whereas ENERGY STAR scores can be compared to national distributions. On a scale of 1 to 100, an ENERGY STAR score of 50 represents median building performance for that building type nationally based on a statistically robust national dataset. One of the most common surveys used by the EPA is the Commercial Building Energy Consumption Survey (CBECS).

NEW MULTIFAMILY ENERGY STAR SCORE

In September 2014, the U.S. EPA released a new multifamily ENERGY STAR score for apartments and condominium buildings with 20 or more residential units. The score analytics are based on a nationwide industry survey conducted by the Federal National Mortgage Association (“Fannie Mae”). Although the EPA reviewed many variables that may affect energy performance, they ultimately used the following adjustments for calculating the score: number of units, bedrooms per unit, and percent of units in a low-rise building (1-4 stories). Like all other ENERGY STAR scores, weather and climate are also factored into the score.

For more information, the Technical Reference document can be found here:
http://www.energystar.gov/sites/default/files/tools/Multifamily.pdf

Figure 11: **Number of Non-Residential Buildings Receiving ENERGY STAR Scores from 1 to 100 (2013)**



To learn more about ENERGY STAR scores, consult the technical reference document for ENERGY STAR scores.

Seattle's benchmarked building stock generally outperformed the national median ENERGY STAR score, with 70% of buildings receiving a score of 50 or above (Figure 11). Forty-three percent of buildings received a score of 75 or above, and 17% received a score of 91 or above. The median ENERGY STAR score was 68 for non-residential buildings. The unexpectedly high number of buildings with scores of 100 and 1 were explored in the outlier analysis (page 17) and reflect poor- and high-performing buildings as well as some buildings with incomplete energy data or use characteristics.

While most buildings were above the national median score, 30% were poor performers below the national median. These scores indicate substantial room for improvement in energy performance .

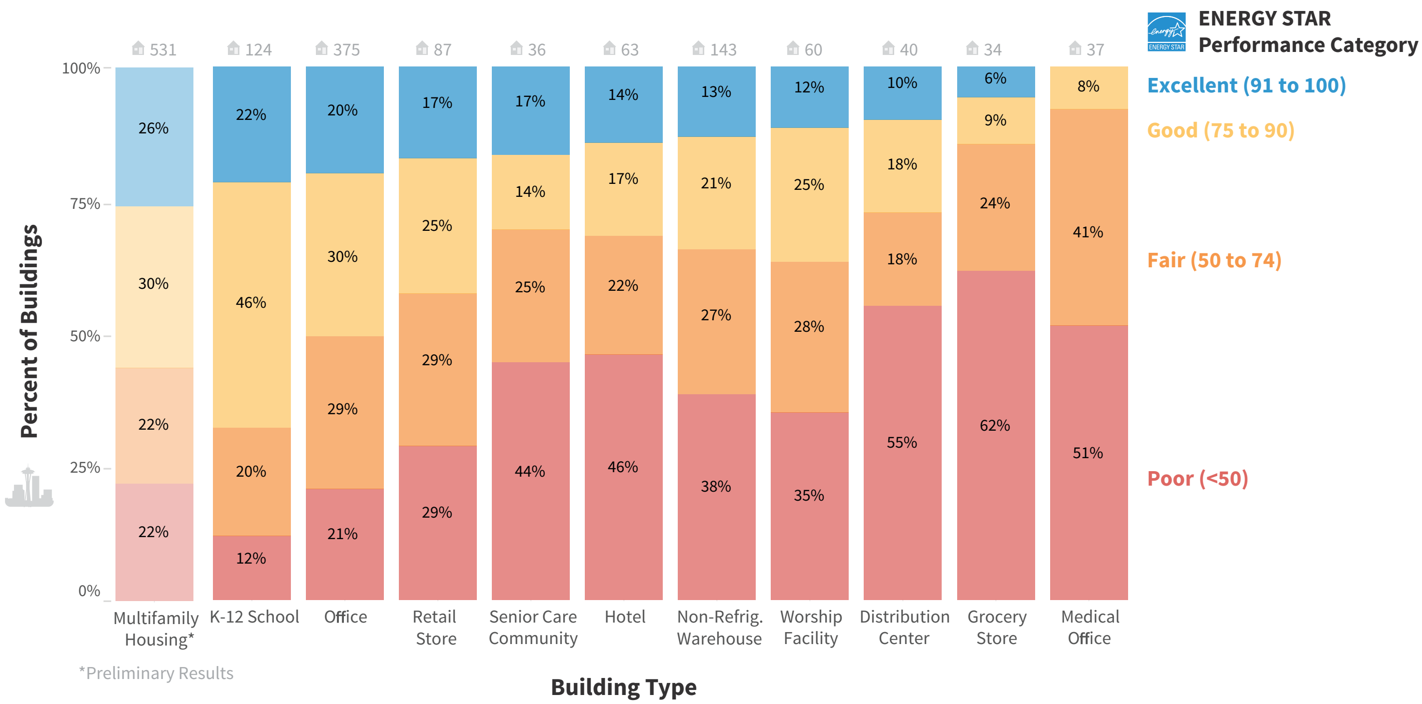
Office buildings made up one-third (35%) of non-residential ENERGY STAR rated buildings, followed by non-refrigerated warehouses (13%) and K-12 schools (12%). K-12 schools had the highest median rating (83) , followed by offices (75), and retail stores (68) (See Table 3 on page 25). Accordingly, these three building types also had the highest proportion of buildings classified as good or excellent (Figure 12). Grocery stores had the lowest median rating (41), followed by hospital (46), distribution center (48), and medical office (49).

Buildings that receive a rating of 75 or above (blue and yellow in Figures 11 and 12) are eligible to apply for ENERGY STAR certification on an annual basis (EPA requires a professional engineer or registered architect to verify the accuracy of data). Of the 454 benchmarked non-residential buildings reported to the City of Seattle with a score of 75 or higher, only 29 (6%) were ENERGY STAR certified in 2013.

Preliminary data suggest multifamily buildings are performing well overall. Including only the 531 buildings with the most complete and accurate data (non-default inputs), the median ENERGY STAR score was 79, with the highest proportion —over one-quarter—in the “excellent” performance category. However before these results can be verified, complete data from a greater number of multifamily buildings needs to be collected.

Although the ENERGY STAR score for multifamily is new, early results show the label is quickly gaining in popularity. By 2014, Seattle already had nine ENERGY STAR certified multifamily buildings—the highest number in the country. This indicates a growing market awareness of the value of certification. As the number of owners seeking and promoting their ENERGY STAR certification increases, energy efficiency will also increase in competitive value in the market.

Figure 12: **Percent of Buildings in Each ENERGY STAR Performance Category (2013)**



7. Multifamily Trends

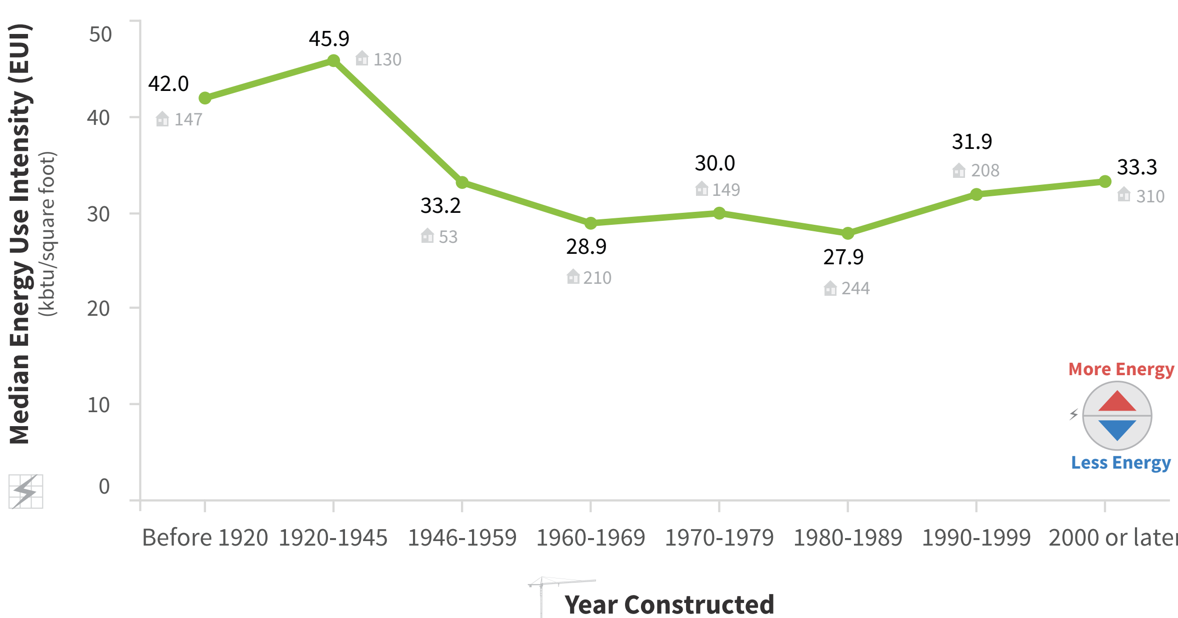
This chapter details energy performance trends for the nearly 1,500 multifamily buildings reported, by age, size, and other characteristics. The trend analyses explore factors that drive energy use to allow for targeted actions and better understanding of benchmarking results.

Building Age and EUI

As discussed in the 2011-2012 benchmarking analysis report, the oldest multifamily buildings (constructed 1887 to 1945) had the highest median EUIs in 2013 (Figure 13).[13] Building constructed since 1945, however, have similar EUIs by age, even when breaking out results by low, mid, and high-rise or by multifamily-only and mixed-use. Applying a statistical test to the data also found no significant EUI change from 1945 to present.

Although additional research is necessary to understand this flat trend, other factors may help explain it. For example, while newer building materials may have greater efficiency (such as windows and insulation), building amenities have also increased. New apartments often provide in-unit washers and dryers and extensive common areas. Unit density, however, is not an explanation—our data indicated that newer buildings are not necessarily denser by unit count than older buildings.

Figure 13: **Multifamily Housing Median Site EUI by Year Constructed**



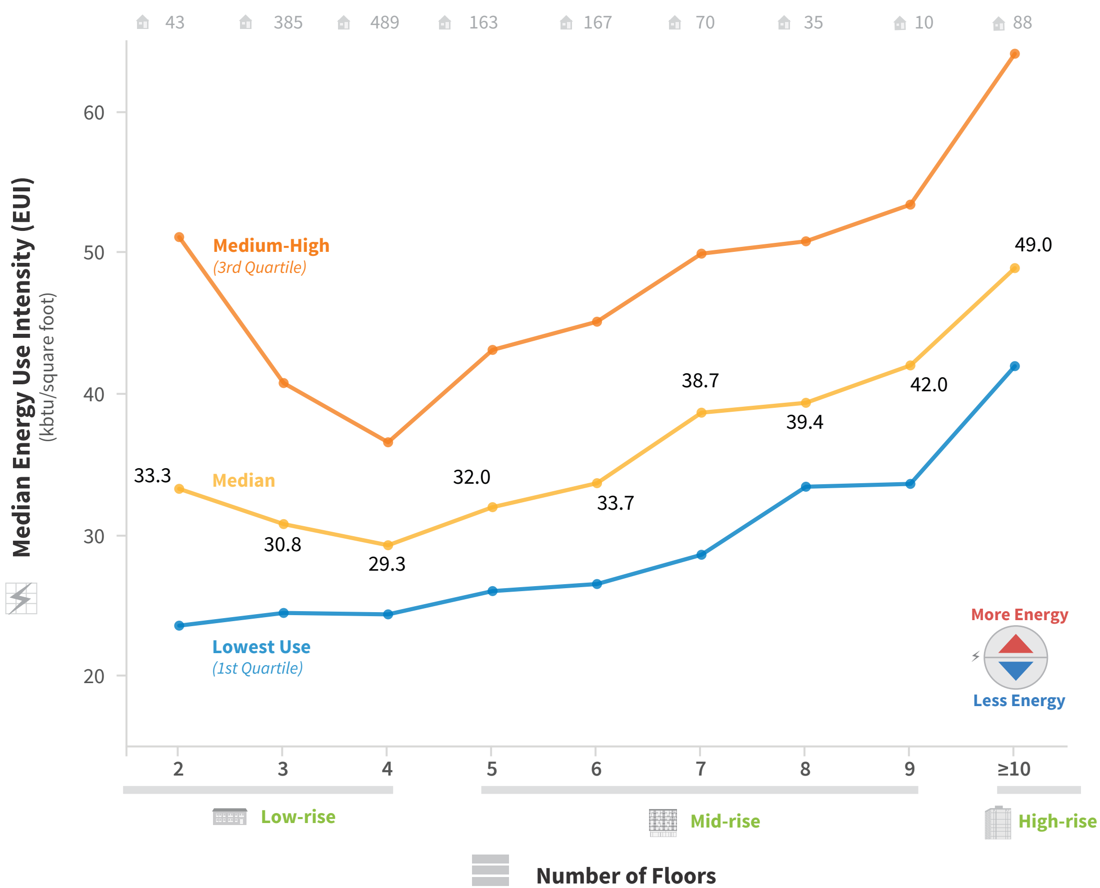
13 While the overall trend remains consistent, some of the data points have changed between 2012 and 2013 (e.g., the 1920-1945 group). This is a result of corrected data in 2013, such as inclusion of gas meters (see Dataset Accuracy on page 14).

Building Height and EUI

Building height by number of floors has a strong relationship to multifamily building EUI. Our 2013 data analysis showed that median EUI increased as building height increased. Figure 14 shows this trend by number of floors with median EUIs (yellow line) and energy use quartiles (blue and orange lines). The smoother blue trend line for the lowest use buildings (1st quartile) from one to seven floors indicates that buildings of these heights had similar energy intensities. For these buildings, there did not appear to be a large jump in energy intensity between four and five floors (the cutoff between low and mid-rise) as there was for more energy intensive buildings (orange line) in the 3rd quartile.

For the EUIs in the Energy Performance Results chapter (page 24), we used the height categories that Portfolio Manager prompts users to enter to define their buildings as low-rise (1-4 floors), mid-rise (5-9 floors), or high-rise (10 or more floors). Since users are asked to categorize their building as such, these categories provide a good reference point for the market. Using this categorization, low-rise buildings had the lowest median EUI (30 kBtu/sf), before increasing somewhat for mid-rise buildings (34 kBtu/sf), and sharply from mid-rise to high-rise (49 kBtu/sf) (see Table 3 on page 25). Low-rise buildings used less energy per square foot, which may be attributed to less common area and fewer amenities as compared with mid- and high-rise buildings. For other analyses, however, a different categorization may be appropriate to capture differences in building codes or construction type between buildings of various heights.

Figure 14: **Site EUI by Number of Floors for Multifamily Housing**



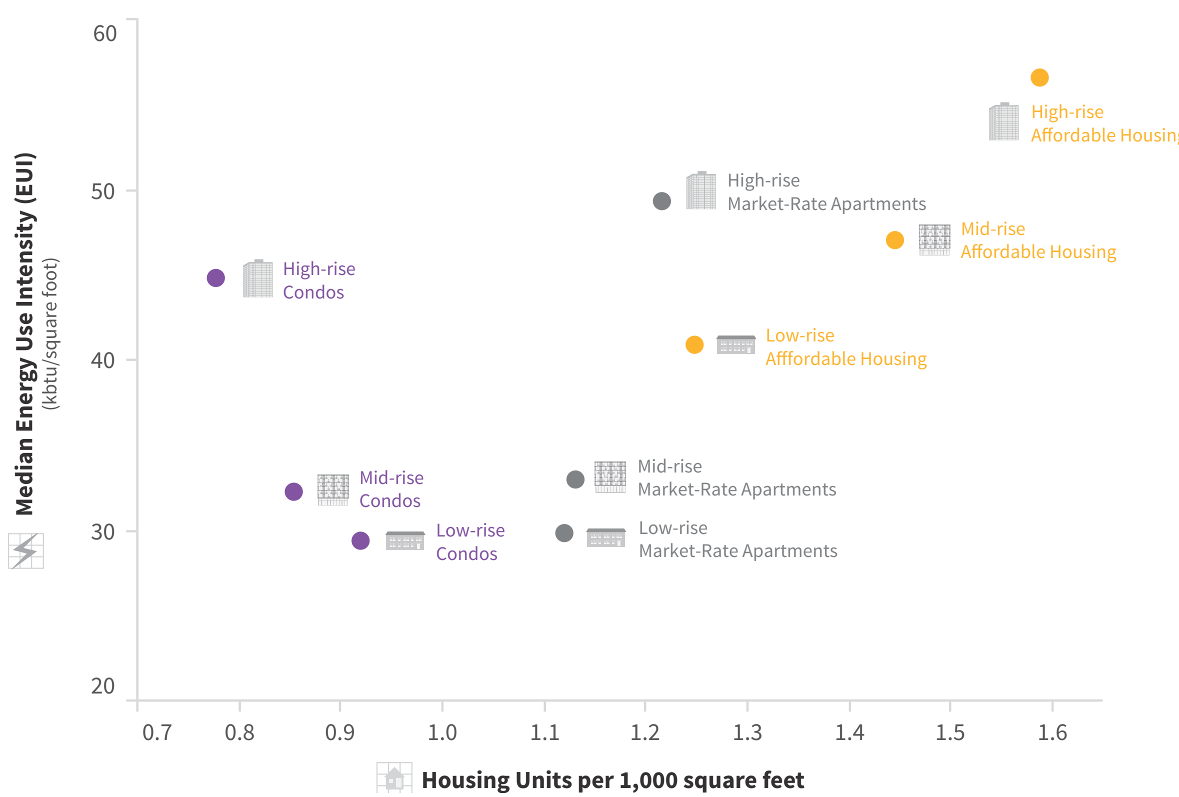
Unit Density, Condominiums, and Affordable Housing

Living unit density, defined as the average number of apartments or condominiums for every 1,000 square feet of building space, emerged during analysis as a major driver of energy use of multifamily buildings. Living unit density can also be thought of as the size of units (low density relates to large units and high density relates to small units) and can have a substantial effect on energy use because more units is correlated with more people using energy in a building. Each unit includes appliances such as refrigerators and stoves, and often other devices like TVs, computers, and game consoles that use electricity and increase "plug load."

Analysis of multifamily buildings revealed three distinct multifamily housing types: market-rate apartments, market-rate condominiums, and affordable or low-income housing. These multifamily housing types were distinguished by unit density and EUI. When accounting for height, affordable housing buildings had the highest median living unit density and EUI; condominiums had the lowest.

As shown in Figure 15, greater unit density (i.e. smaller units) was associated with higher overall building energy intensity. However, because these buildings have more households—and presumably more people—for a given size, they may perform comparably or even better on a *per household* basis.

Figure 15: **Unit Density & EUI for Housing Types, Including Condominiums & Affordable Housing**



BENCHMARKING
Luxury Meets Energy Savings

Escala
816,000 sf

Built in 2009, this 31-story luxury high-rise condominium has 270 units outfitted with high-end fixtures and appliances. Between 2013 and 2014, the building's energy use remained stable, even as the number of people living there increased. Currently, the building has an ENERGY STAR score of 80 and is considering applying for certification. Its energy use per square foot is also lower than many other high-rise condos in Seattle.

What kept Escala's energy costs in check? In 2012 and 2014, Escala:

- Replaced 1,500 outdated lights in the building's common areas with new CFL and LED technologies.
- Installed occupancy sensors in the corridors and parking garage.

With Seattle City Light rebates for the energy efficient equipment they selected, Escala will recoup their investment in just 1.6 years. The upgrades are saving $32,282 per year, which is being passed on to residents. Building managers are now actively pursuing other lighting upgrades and are engaged in other sustainability efforts such as advanced recycling (i.e. batteries and Styrofoam).

> *"Residents welcomed the installation of occupancy sensor controls, both in the common areas above ground, and below ground in the parking structure. But they were especially pleased with the 17% savings in energy usage we were able to pass on through lower building operation costs."*
>
> *— Bruce Jarrard, Escala Facilities Manager*

Escala

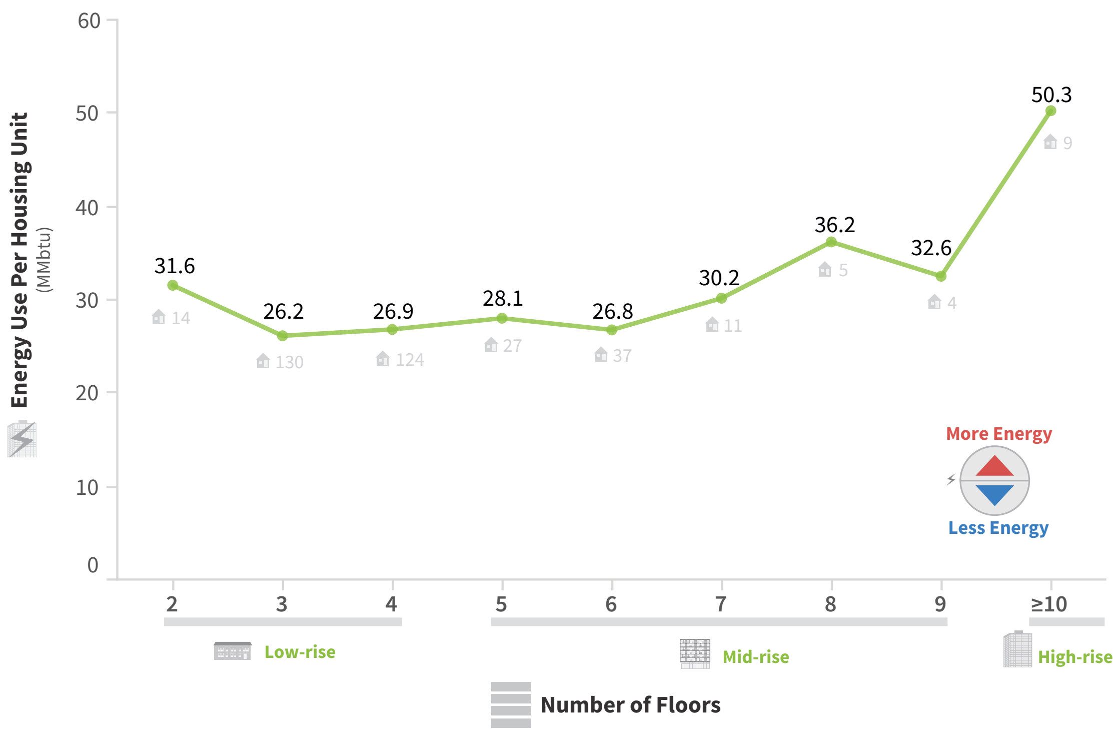
Living Unit Energy Intensity

Because the most energy-intensive multifamily buildings were also the densest, living unit energy intensity—annual energy use per housing unit—was also calculated to better understand building consumption on a per household basis.[14] On average, living unit energy intensity was markedly higher for high-rise buildings. Figure 16 depicts only market-rate apartments to illustrate the trend. High-rise multifamily developments concentrate residents on a per square mile basis and encourage public transportation and walkable neighborhoods; however, they use more energy per square foot and per living unit than low and mid-rise housing.

High-rise multifamily buildings present both an opportunity and challenge for energy efficiency. These buildings clearly use substantially more energy than low- and mid-rise multifamily buildings. High-rise buildings tend to require more complex heating, cooling, and ventilation systems and have higher glazing levels (i.e. more windows), but may also have thermodynamic advantages such as low surface-area-to-volume ratio. While some high-rise multifamily buildings have achieved similar energy efficiency to smaller buildings, this is not typically the case. As previously discussed (see Figure 9), Seattle's largest and most prominent apartments and condominiums have a substantial impact on the city's overall energy use and thus could be targeted to lead the way on multifamily energy efficiency.

[14] *This metric is calculated by the building's total energy consumption divided by the number of units for single-use buildings only. Energy use associated with common areas could therefore not be separated.*

Figure 16: **Energy Use Per Housing Unit by Number of Floors (Single Use Market-Rate Apartments Only)**

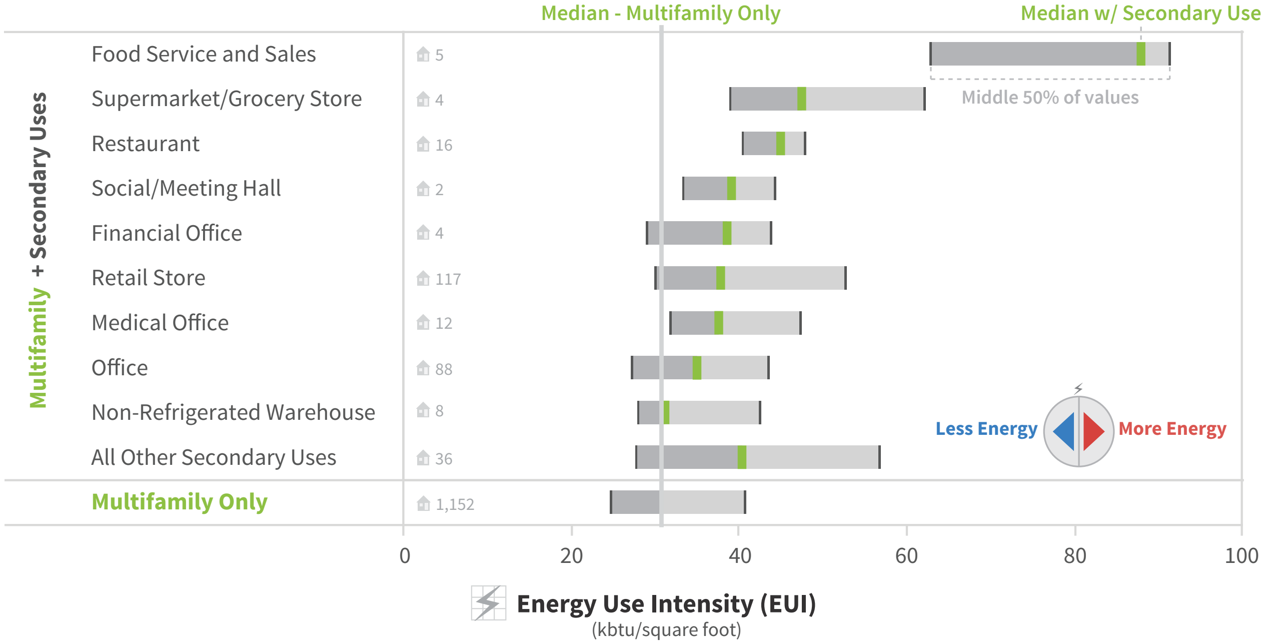


Secondary Uses

In addition to height and unit density, secondary uses in multifamily housing appear to be strong drivers of increased energy use. As shown in Figure 17, secondary uses across the board were associated with higher energy intensities than single-use multifamily buildings, with the exception of space classified as non-refrigerated warehouse. The figure groups multifamily buildings by those with secondary uses, based on the largest use in the building after multifamily housing (some buildings may have additional uses).

Uses such as food service (bakeries, restaurants, cafés) and food sales (supermarkets, specialty food shops) had some of the largest effects on whole building energy use. Buildings with retail, medical office, and office spaces also showed noticeably higher EUIs than multifamily-only buildings. This finding underscores the importance of accurately identifying secondary uses of a building when benchmarking.

Figure 17: **EUIs for Multifamily Housing Buildings with Common Secondary Uses**



8. Office Trends

This chapter documents detailed trends for the 431 office buildings reported, which consume more total energy as a group than any other benchmarked building type in Seattle. Understanding what drives energy use in office buildings is therefore critical for any effort to improve energy performance city-wide.

Building Age and Energy Performance

Analysis of office energy intensity by date of construction shows that, unlike for multifamily housing, the oldest office buildings tend to have relatively low EUIs (Figure 18). Energy intensity increased for buildings constructed after 1945, peaking in the 1970s before declining and remaining somewhat stable since the 1980s.

Median ENERGY STAR scores for office buildings across the same time periods reveal a more complete picture of energy performance trends (Figure 19). Similar observations can be made about Seattle's oldest office buildings, which again appear to be relatively high performing, versus those constructed in the 1970s, which have the lowest median ENERGY STAR score and thus poorer energy performance.

However, a different trend emerges for newer office buildings, which show an improvement in median ENERGY STAR score in each decade since the 1970s. This trend may indicate that despite changes in the characteristics of office buildings, Seattle's efforts to improve energy performance in new construction for office buildings, such as codes and incentive programs, have had a positive effect.

Figure 18: **Office Median Site EUI by Year Constructed**

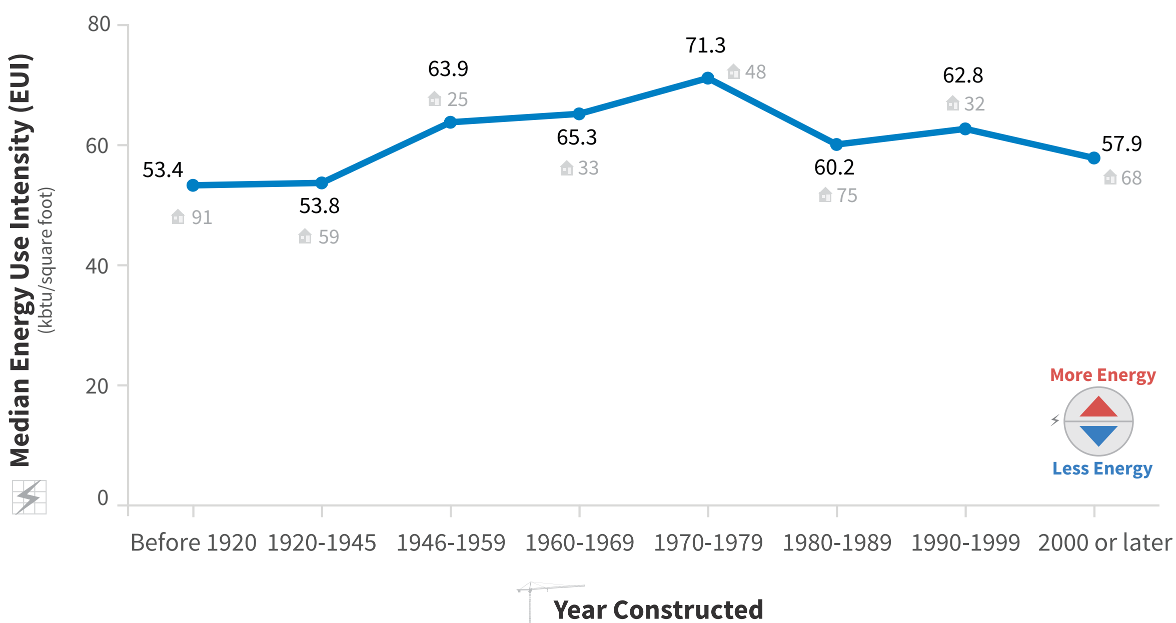
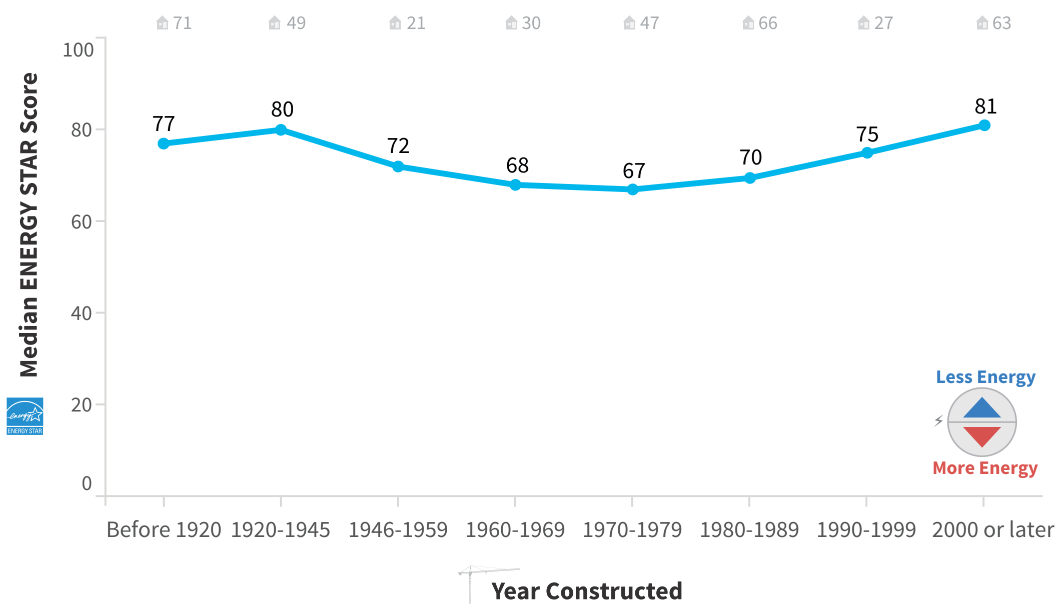


Figure 19: **Median Office ENERGY STAR Score by Year Constructed**



BENCHMARKING

New Owner Strives for ENERGY STAR

Fremont Lake View
111,580 sf

Kilroy Realty Corporation has a knack for transforming its buildings into energy-saving all-stars. More than half of its commercial portfolio in the U.S. is ENERGY STAR certified, and 45% is LEED certified. By the end of 2015, the company projects that it will reduce energy use across its portfolio by 10% from 2010 levels. The company has also received numerous awards for its sustainability efforts, including ENERGY STAR Partner of the Year (2014 & 2015), 2014 Green Lease Leader, and is ranked #1 by the Global Real Estate Sustainability Benchmark..

Kilroy bought the Fremont Lake View building in 2012 with these goals in mind, and quickly started improving the building's energy efficiency. Energy-saving improvements to date include:

- Retrofitted garage with LEDs & occupancy sensors
- Upgraded heating and cooling (HVAC) controls
- Financed LED lighting upgrades for tenants
- Installed LEDs in common areas

"Kilroy is passionate about sustainability and energy efficiency. We don't hold back on our properties. Working with tenants to reduce energy use is a win-win because it saves money and improves tenant satisfaction"

— Shanna Braga, Property Manager, Kilroy Realty Corporation

These improvements will save both Kilroy and its tenants – many of which are high-tech companies with big energy appetites - money on utility bills. Within a month of the garage lighting retrofit, the company found that the building used 27% less electricity overall than the same month the year before. Similar improvements have been made to all three of Kilroy's Fremont buildings. To help offset its investments, Kilroy property managers worked with Seattle City Light to take advantage of rebates and other incentives. The company is now working toward ENERGY STAR certification for the Lake View property.

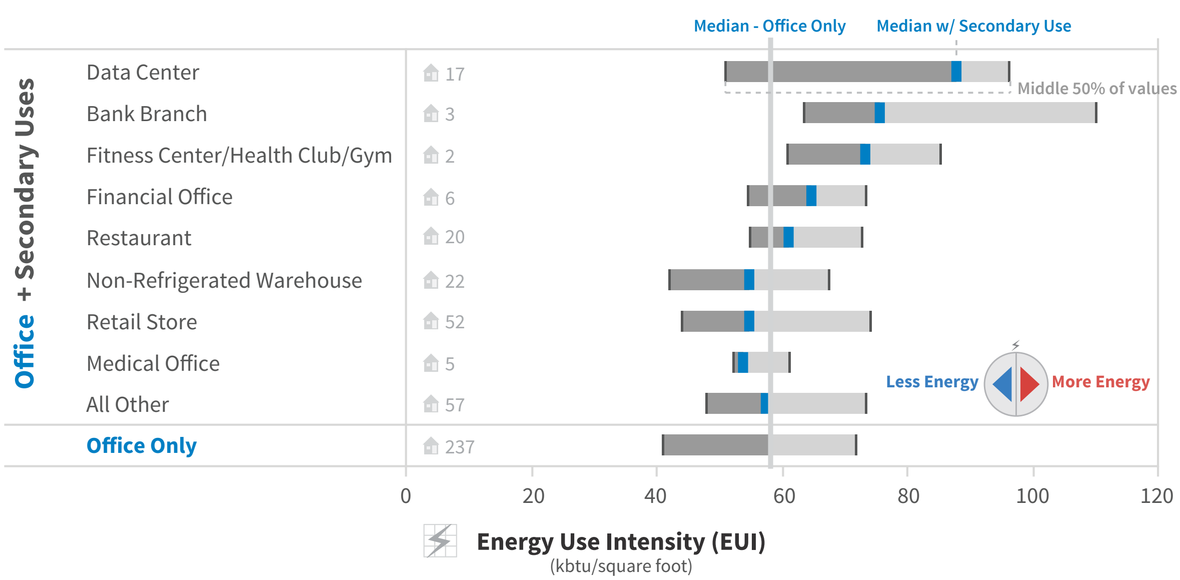
Kilroy Realty Corporation

Secondary Uses

Unlike for multifamily housing buildings, only certain secondary uses appeared to increase whole building EUIs for offices. Figure 20 groups buildings by the largest secondary use by square footage in the building after the office use (some buildings may have additional uses). Uses associated with higher whole-building EUIs included data centers, bank branches, fitness centers, financial offices, and restaurants. Non-refrigerated warehouses and retail spaces did not appear to increase whole-building EUIs. This can be explained by the higher baseline energy intensity of offices; in other words, offices use more energy per square foot than most retail spaces and non-refrigerated warehouses.

The large impact of some building uses, such as data centers, on EUI demonstrates the importance of properly accounting for these functions to receive a meaningful ENERGY STAR score. Improving the energy efficiency of these uses can have a strong positive impact on whole-building energy performance, and may even achieve energy savings comparable to what is possible in office spaces.

Figure 20: **Site EUIs for Office Buildings with Common Secondary Uses**



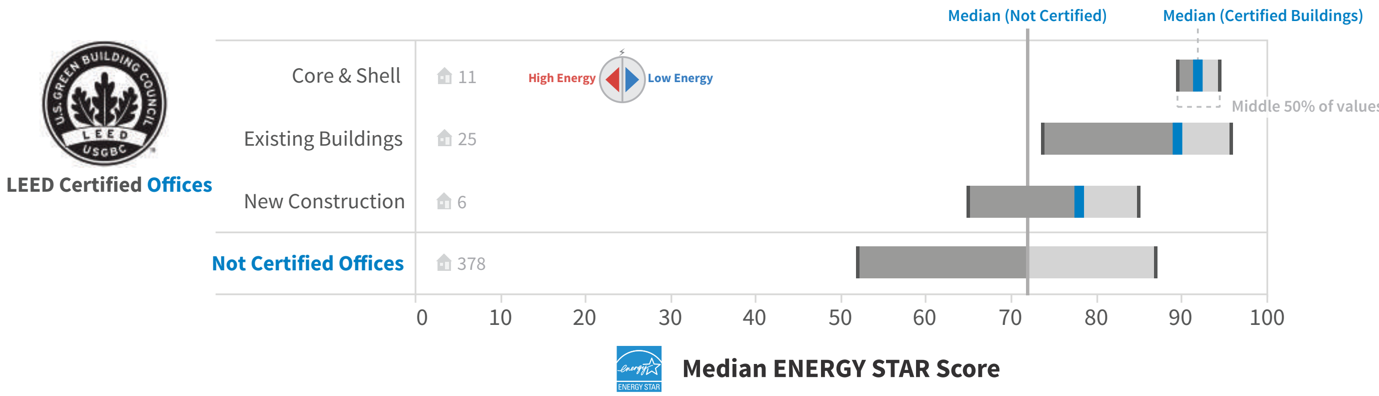
LEED Certified Office Buildings

LEED (Leadership in Energy and Environmental Design) certified office buildings in Seattle generally performed better than their uncertified counterparts. To assess the energy outcomes of this green building certification, offices with building-level LEED certification—New Construction, Existing Building, and Core & Shell projects—were compared against uncertified buildings. LEED New Construction (NC) applies to buildings that are being newly constructed or going through a major renovation. LEED Existing Buildings: Operations and Maintenance (EB) rating system is focused on best practices for building operations, management, and maintenance. Finally, LEED Core & Shell (CS) applies to buildings where the owner is responsible for the design and maintenance of the electric and mechanical systems, but not for tenant spaces.[15]

15 To learn more about LEED rating programs, visit http://www.usgbc.org/certification.

The ENERGY STAR score takes differences in building and space characteristics into account, making this metric the most appropriate comparison between non-certified and LEED certified buildings, which tend to be newer and more diverse in mix of space types. Figure 21 shows that over 75% of LEED buildings of all three certification types are performing better than the median non-certified building—and nearly all of them are eligible for ENERGY STAR certification.

Figure 21: **Office ENERGY STAR Scores by LEED Certification**



The performance of LEED EB-certified buildings shows that older buildings are not necessarily less efficient than newer buildings, and underscores the importance of continued management for maintaining high efficiency. The median LEED EB-certified building was constructed in 1985, compared with 2006 for NC and 2009 for CS, yet these buildings perform comparably or better. Three LEED EB-certified buildings were built before 1930.

While Seattle is home to many LEED NC buildings, only seven are included in the 2013 benchmarking dataset. Federal buildings are excluded from the benchmarking requirement and campus buildings (not sub-metered) were not required to report in 2013. For example, the University of Washington has over 10 LEED NC certified buildings that are not possible to benchmark individually. While the initial results appear promising, conclusions about the energy performance of LEED NC buildings cannot yet be drawn.

9. Annual Trends & Energy Savings Opportunities

The building energy benchmarking dataset allows for retrospective assessment of energy trends, comparing 2013 overall building performance to past performance, as well as for forward-looking assessments of energy savings opportunities. This chapter discusses annual trends and summarizes building sectors that could benefit from improvement.

Annual Performance Trend

Energy use for buildings benchmarking in both 2012 and 2013 remained stable, with a slight overall decrease of 0.6% . This reduction was driven by a decrease in electric consumption of 1.7% but balanced somewhat by in an increase in natural gas consumption of 2.8%. This comparison used weather normalized energy values and excluded buildings that added or removed a fuel source, as well as buildings with a change in EUI of 50% or greater.[16] By focusing on energy consumption for a fixed set of buildings, this method assumed no net change in square footage from 2012 to 2013 (See Appendix B, page 52, for more information).

A comparison of median EUIs by building type between 2012 and 2013 shows some differences for the values reported in the annual report. These are largely due to the additional buildings in the 2013 dataset and are discussed in Appendix B.

Energy Savings Potential

Energy savings provide an annual return on investment for building owners. Past research has found that energy savings are largest, and most readily achievable, for the lowest performing buildings. A study by the EPA found buildings that began benchmarking with poor ENERGY STAR scores (below the median of 50) saved twice as much energy as those starting with above average energy efficiency.[17]

About 30% of the buildings reported to Seattle rated worse than the ENERGY STAR median and several sectors, including grocery stores, medical offices and distribution centers, had more than 50% of buildings rated worse than the median. These sectors are ripe with energy savings. Although few in number, each of these building types is very energy intensive and thus represents an opportunity for energy savings.

Reducing an energy-intensive building's EUI to Seattle's median is a realistic goal for many buildings that can result in significant energy and cost savings for owners and tenants. As shown in Table 4, a typical supermarket with a medium-high EUI (75th percentile) could save $13,800 per year

16 A change of EUI of 50% or greater is very unlikely to occur due to a change in building performance. In the newly released Benchmarking and Transparency Policy and Program Impact Evaluation Handbook, the US Department of Energy has excluded buildings with a change in EUI of 50% or greater when making longitudinal comparisons. Handbook available at: http://energy.gov/eere/slsc/downloads/benchmarking-and-transparency-policy-and-program-impact-evaluation-handbook.

17 ENERGY STAR DataTrends, October 2012. www.energystar.gov/buildings/tools-and-resources/datatrends-benchmarking-and-energy-savings by reducing energy use to the median EUI.[18] A medical office could save $31,600; a distribution center could save $9,300. High EUI buildings in other sectors also have the opportunity to capture significant annual savings. A medium-high use office building could save $14,800, and a high-rise multifamily building could save $31,000. A medium-high use senior care community could save $46,900 per year; a hotel could save $25,500.

As discussed earlier in this report, offices, high-rise multifamily housing, and hotels have a large impact on the citywide energy use despite being relatively few in number of buildings. Focused efforts to improve their energy performance could have a substantial effect on the city's overall energy use.

If all buildings in Seattle with EUIs higher than the median reduced their energy intensity to the median, then total annual energy consumption would decrease by 3.46 million kBtu with annual greenhouse gas emissions reductions of over 321,000 tons CO_2e and bill savings of $52.8 million. Multifamily and office buildings alone would account for 43% of energy savings, greenhouse gas reductions, and cost savings. If all but the highest performing buildings reduced enough energy to become high performers (top quartile: 25th percentile of EUIs), total energy consumption would decrease 5.31 million kBtu with bill savings of $81.3 million.[19]

Table 4: **Annual Savings Potential of Moving from 75th to 50th Percentile - Even Being "Average" Can Save Money**

Building Types	Annual Cost Savings Potential
Senior Care	$46,900
Medical Office	$31,600
High-rise Multifamily	$31,000
Hotel	$25,500
Office	$14,800
Supermarket	$13,800
Distribution Center	$9,300

18 Energy savings potentials were calculated by the difference between the 75th percentile and median EUI, multiplied by the median square footage of that building type. Cost savings were calculated using cost assumptions for each fuel type, weighted by the proportion of energy consumption for each building type.

19 Assuming $0.01825 per kBtu of electricity and $0.009 per kBtu of natural gas and steam, and weighted by the distribution between electric, gas, and steam energy consumption for each building type.

10. Next Steps

As Seattle approaches its fourth year of data collection and analysis, the benchmarking program is well positioned to capitalize on the wealth of information and industry engagement that has resulted from successful policy implementation. Addressing the following opportunities will build on the benchmarking program's data-rich foundation and better position the Seattle market to act on building energy performance information. These strategies will continue to improve and strengthen the benchmarking program, facilitate energy efficiency gains, and support next generation policy initiatives.

Expand data validation methods and engagement.

To enhance the quality of individual building energy benchmarking reports, continue to evolve data validation methods to improve and maintain accuracy. Based on outlier analysis, review of data coupled with proactive outreach narrows the outlier pool, increases data reliability, and provides building owners and the market with the most valuable and meaningful performance metrics. An enhanced internal database system will allow staff to flag outlier reports needing additional assistance and/or data validation.

Promote and encourage ENERGY STAR certification.

Encourage and support owners with ENERGY STAR scores above or near 75 to apply for ENERGY STAR certification. The EPA's certification process results in more accurate data through third-party building data validation. ENERGY STAR scores require more inputs than EUIs, but are able to adjust for increasingly relevant factors such as IT loads and secondary uses. In turn, these efforts to improve the quality and precision of information will provide building owners with more valuable outputs and feedback to make further improvements. Additionally, performance is promoted in the marketplace resulting in greater appreciation for Seattle's high performing buildings. More information is available at www.energystar.gov/buildingcertification.

Increase transparency and use of benchmarking data.

Seattle's Climate Action Plan includes future actions to implement to reduce emissions from existing buildings, namely making information from building energy benchmarking reports publicly accessible to better inform the market. Seattle's existing policy restricts the transparency of individual building performance data and Seattle is currently one of two cities with a benchmarking law that does not require public transparency. Seattle has an opportunity to learn from cities with public disclosure to develop local policy recommendations that not only increase market transparency, but also further the effective use of performance metrics.

Evolve the role of technical assistance to encourage action.

Continuous benchmarking support and education has sustained Seattle's high compliance rates and generated up-to-date owner and manager contact information. The high touch technical assistance role presents on-going opportunities to encourage owners to improve building performance by referring poor performers to local utility incentive programs that can save money and make buildings more desirable to tenants. Owners and managers with multiple facilities benchmarked are also primed to learn how to access portfolio level data to target opportunities and prioritize efficiency investments. Expanding the benchmarking workshop series will build on established relationships and teach owners how to save energy and pursue ongoing performance monitoring.

Expand feedback mechanisms to inform and motivate owners and the market.

The wealth of information attained annually by the City of Seattle is best applied when shared with those that can act upon it. Seattle piloted office performance profiles (see page 10) to create a feedback loop with owners and their representatives highlighting how their building stacked up to their peers. Expanding the performance profiles to the multifamily market will increase the reach and application of benchmarking data and direct building owners to incentive programs to achieve greater energy efficiency.

Seattle's buildings database capability should be enhanced to create an automated feedback loop to highlight building performance at the time of report submittal. An automated confirmation email, similar to an Opower report, could show how the building performed relative to its Seattle peer group and encourage action through links to utility and other programs targeted to the building type and need.

Appendix A: Data Accuracy

Data Cleaning

A key step in analyzing Seattle's benchmarked buildings' energy use is determining which data to include in the analysis. The baseline of buildings was the 3,216 buildings considered compliant, with an EUI greater than zero for the 2013 calendar year. All buildings in this set were included in the analyses of benchmarked building characteristics.

To analyze energy trends, buildings with identified errors were removed in addition to outlier EUI reports for the three largest building types. These exclusions included the following: buildings likely missing some or all natural gas consumption (see Table 5 below); buildings that reported steam consumption in incorrect units; a few buildings with unique data quality issues identified by Seattle OSE, such as meters not associated with properties; and the top and bottom 1% of office, multifamily, and non-refrigerated warehouse buildings. This data cleaning exercise removed 200 buildings from the total benchmarking dataset, leaving 3,016 buildings for performance trends analysis.

Buildings without complete and consistent data were further excluded for longitudinal or year-to-year analyses. Buildings either missing 2012 data, with a year-to-year change in EUI of 50% or more, or with gas included in 2012 or 2013 (but not both) were excluded from analysis. A total of 464 buildings were excluded for one or more of these reasons, resulting in a dataset of 2,552 for longitudinal analyses.

Table 5: **Summary of Data Cleaning**

Stages	Buildings
Original Compliance Dataset	3,216
2013 Error Identified	(200)
2013 Analysis Dataset	3,016
50% Change in EUI or 2012 Error Identified	(464)
Year-to-Year Analysis Dataset	2,552

Data Quality Indicators

Use of Portfolio Manager Data Exchange (Automated Benchmarking)

To estimate the rate at which building owners used Portfolio Manager's Data Exchange for automated upload of monthly fuel consumption, the analysis team used two methods. (1) The first metric indicated whether the building owner had ever shared the building with the given utility (Seattle City Light, Puget Sound Energy, or Enwave), the first step in setting up Data Exchange. Buildings shared with a utility served as the upper bound of the estimate. (2) The second metric indicated if the building had a virtual meter provided by the utility (these meters have unique names) through Data Exchange, which definitively indicated a current automated upload. However, meter-level information was not shared by all building accounts with the City of Seattle. (This does not prevent the City from getting the consumption data, just the virtual meter name.) Buildings with a virtual meter served as the lower bound estimate. Anecdotal evidence suggests that once buildings are shared with a utility, most Portfolio Manager users do not stop the building share if they later decide to upload bills manually or if the building no longer needs gas service (i.e. a restaurant tenant with gas service vacates). While this is not necessarily a problem for data accuracy, it can make determining who has current data exchange difficult if the current virtual meter name is not also shared with the City of Seattle.

Table 6: **Data Exchange Use Estimates**

Energy Source	Lower Bound	Upper Bound	Range
Electricity	80%	86%	6%
Natural Gas	60%	88%	28%
Steam	n/a	56%	n/a

Notably, the range in natural gas estimates is much higher than in electric automated benchmarking. However, there are some known causes for this range (see page 15). Building owners may have encountered a problem setting up the automated data exchange, continued uploading data manually, or realized that their building did not have natural gas. Further analysis of buildings that were shared with PSE — but did not report any natural gas consumption — revealed that these 126 buildings had a systematically lower distribution in EUI, suggesting these buildings have erroneous benchmarking reports. As noted previously, these buildings were excluded from the benchmarking dataset used to study 2013 energy performance trends.

Building Square Footage

As described in the report, the reported square footage value was compared to King County Assessor records. Over half (54%) of the Portfolio Manager reports including a gross square footage (GFA) value that fell within 1% of Assessor records. Thirty-five percent included a value smaller than Assessor records and 11% included a value greater than Assessor records. Nearly half of the buildings that reported a smaller GFA than the Assessor record had parking listed in the Assessor record. This suggests that many of these buildings appropriately excluded separately-metered parking.[20]

[20] *For more information on Portfolio Manager's treatment of parking areas, visit http://portfoliomanager.supportportal.com/ics/support/KBAnswer.asp?questionID=15974.*

Outlier Survey

Multifamily and office buildings with extremely high and low EUIs (i.e., outliers) received a voluntary online questionnaire designed to understand whether the EUIs were driven by data quality issues or by building and space use characteristics. Outliers were defined by the following EUI thresholds: ≤30 and ≥100 for offices and ≤15 and ≥80 for multifamily, corresponding to approximately the highest and lowest 7% of EUIs for offices, and 3% for multifamily. One hundred thirty-eight surveys were sent and 57 responses were collected.

The online questionnaire included a mix of open-ended and multiple-choice questions to collect qualitative data on building uses. Responses were used to both confirm and supplement Portfolio Manager data. The questionnaire collected information on:

- The business activities of the largest tenants in the office space
- Any secondary uses (non-office or non-multifamily) in the building
- Energy sources (electric, gas, and steam)
- Whether meters for all common and tenant spaces in the building were included
- Spaces dedicated to computer servers
- Periods of building vacancy in 2013
- Multifamily amenities (pool, gym, common area kitchens, etc.)
- Building operating patterns

The primary explanations for outlier EUIs are shown in Table 7. Explanations for high EUIs are presented first, followed by low EUIs. Note that square footage errors can cause both high and low EUI outliers depending on the direction of the error.

Table 7: **Explanation of High and Low Outliers EUIs, Multifamily and Office Buildings**

	Explanation	Multifamily		Office		Grand Total
		High	Low	High	Low	
High EUI	High-Intensity secondary space	7		8		15
	Special needs housing	4				4
	Known inefficiency in building	5		1		6
	Amenities	1				1
	Extra meters	1				1
High or Low	Square footage error	1	2			3
Low EUI	Missing meters		5		6	11
	Vacant		3			3
	Total Explained	**19**	**10**	**9**	**6**	**44**
	Unknown reason	*7*	*3*	*1*	*2*	*13*
	Total Surveyed	**26**	**13**	**10**	**8**	**57**

The most frequent explanation for high energy consumption among multifamily and office buildings was a high energy secondary space use. For multifamily housing, four of the seven buildings did not separately define high energy intensity secondary uses. For offices, high-use secondary spaces appeared to be correctly included and categorized in Portfolio Manager.

Another related driver of high EUIs among multifamily housing was special needs housing. These buildings included medical spaces dedicated to in-building care or kitchens for providing meal services. None of the four buildings in this category defined secondary space uses, possibly because building owners consider them to be single-use buildings (e.g. “special needs housing”) despite the noted sub-uses that may be appropriate to define separately for benchmarking purposes.

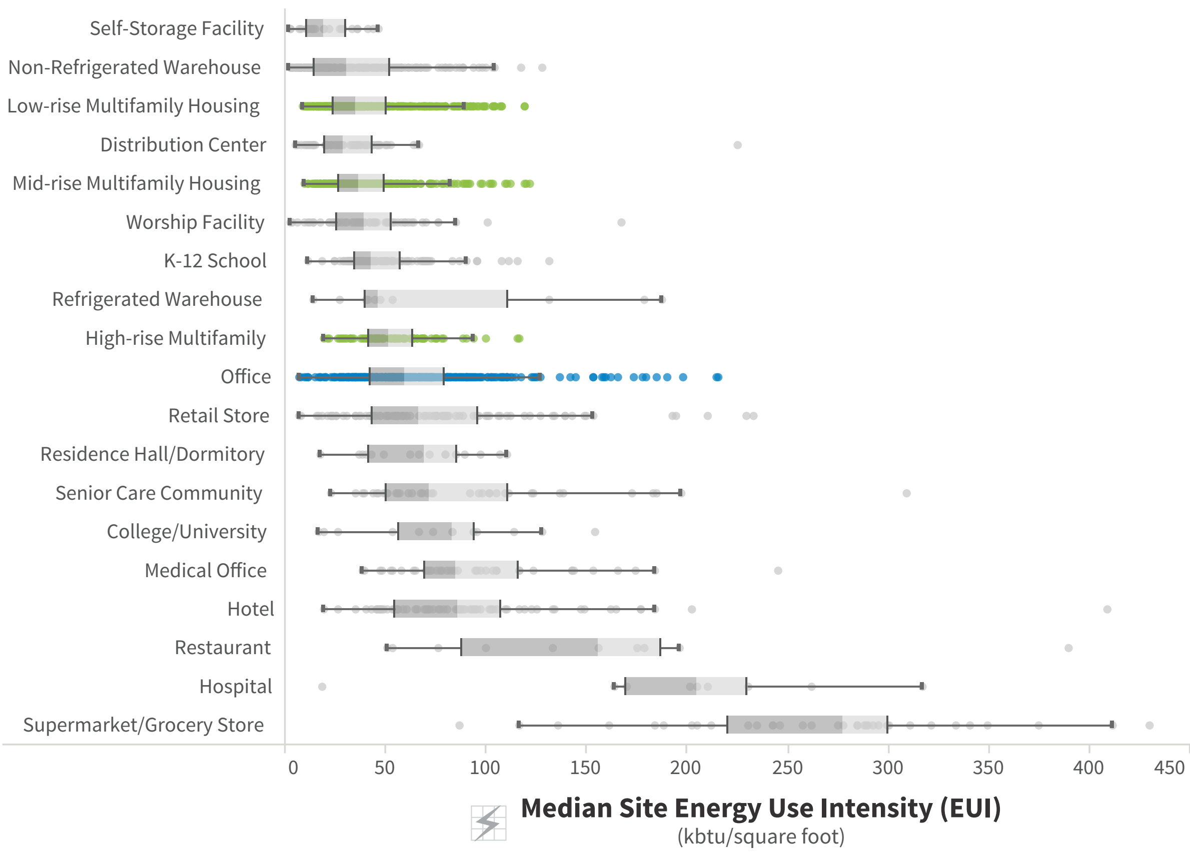
Notably, only two high-use buildings appeared to be explained by an error in the EUI calculation; one building erroneously included extra meters while the other input a larger GFA than the actual value. Six buildings indicated known inefficiencies. In contrast, low-EUI buildings were frequently explained by errors in the EUI calculation. Eleven buildings were missing meters; two were explained by a GFA that was larger than the actual value while three were explained by a significant vacancy in the building, not an EUI calculation error. Of the 57 buildings that responded, eight had high outlier EUIs that could not be explained via the survey method. Five low outlier EUI buildings could also not be explained. These 13 buildings would likely need additional follow up and potentially in-person visits to better understand their energy use patterns.

Appendix B: Energy Performance Results

Overall Energy Performance Ranges

Figure 22 shows individual buildings' site EUIs in the context of the performance ranges. Each dot represents an individual building's EUI, and the boxes represent the second (dark gray) and third (light gray) quartiles. Together, the buildings within the boxes comprise the 50% of buildings closest to the median. This view shows both the high proportion of buildings near the median (within the boxes), and the existence of a few extreme outliers (those far outside the "whiskers" extending from the boxes). While some of these outliers EUIs can be explained by intensive uses within a building, such as an office with a data center, others represent poorly performing buildings (see Appendix A, Outlier Survey).

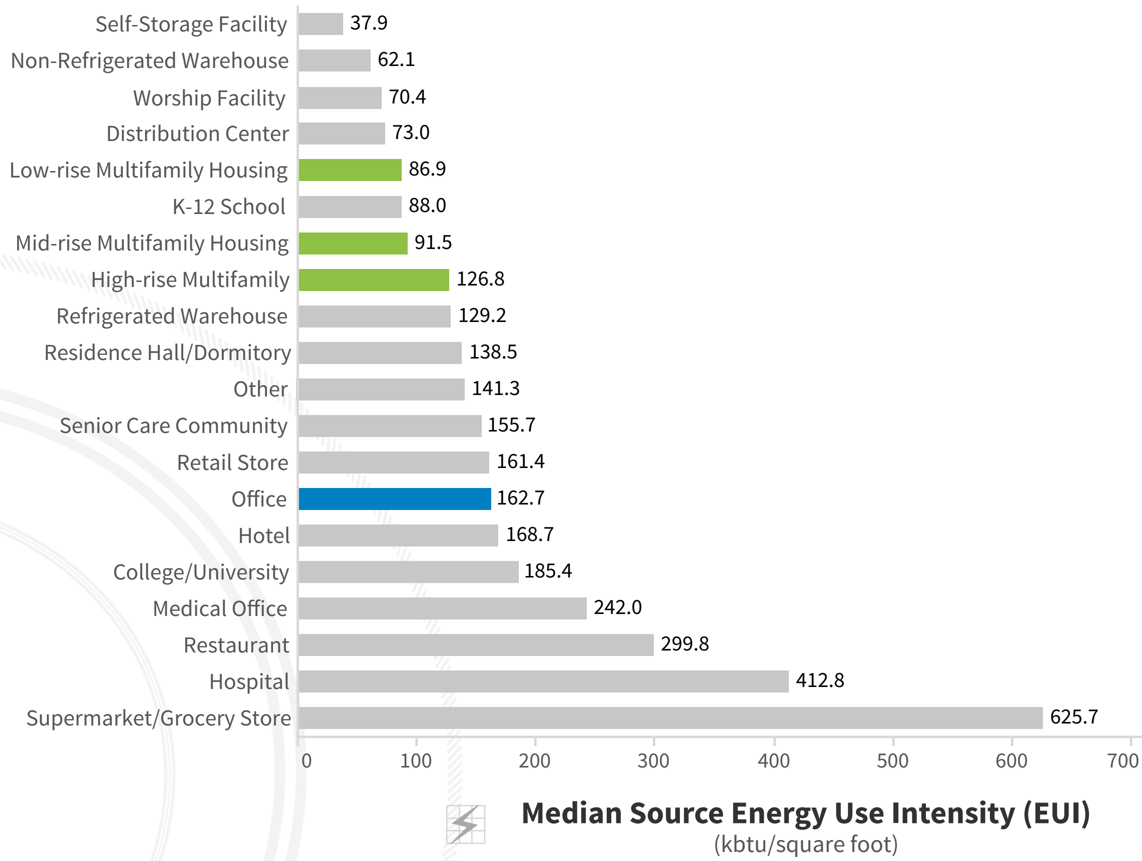
Figure 22: **Site EUI Performance Range and Distribution by Building Type**



Source EUI

Source EUI measures the total energy required to power and heat a building both on- and off-site. Source EUI takes into account the relative efficiency of different energy sources, and provides a complete picture of a building's total energy impact. While site EUI is more relevant for building owners and managers to understand their buildings' performance, source EUI is another important metric for making comparisons at the national level, and Portfolio Manager uses source EUI to calculate ENERGY STAR scores. For more information, visit the Portfolio Manager website.

Figure 23: **Source EUIs by Building Type**



Annual Energy Trends

One of the long-term goals of Seattle's building energy benchmarking ordinance is to understand the trends in building energy consumption over time, including related metrics like greenhouse gas emissions. 2012 was the first year that the ordinance included buildings 20,000 to 50,000 square feet, therefore 2013 is the first year that year-to-year comparisons can be made for the entire dataset.

However, a measured change between 2012 and 2013 is not necessarily indicative of a trend, so caution should be used when interpreting these results. Variation from year to year is expected, regardless of whether the long-term trend is decreasing, increasing, or constant. Therefore, a trend cannot be confirmed until several years of data are collected.

Longitudinal Analysis Methodology

The longitudinal analyses presented in the report include the subset of buildings that have valid data for both 2012 and 2013. Buildings with the following data issues were excluded:

- Change in EUI of 50% or more from 2012 to 2013
- Reported natural gas in 2012 or 2013, but not both years

Additionally, when calculating the change in total energy use from 2012 to 2013, a net change in total square footage was assumed. While a number of buildings may have made changes that resulted in addition or removal of floor area, changes in square footage are more likely caused by errors and corrections. Accordingly, the percent change in total energy consumption is equivalent to the percent change in total EUI.

Changes in EUI by Building Type

As noted in the report, the median EUIs for some building types changed between the 2012 data analysis and the 2013 data analysis. These changes were due to differences in the number of buildings included in the dataset, building type definitions, and corrections.

The 2012 data analysis was conducted with data from 80% of required buildings. The 2013 data analysis was conducted with 99% of the required buildings, an increase of 530 buildings. The majority of building type median EUIs showed reasonable fluctuation between 2012 and 2013. However, the median EUIs for building types with fewer buildings were more sensitive to the effect of additional buildings. Additionally, as Portfolio Manager added more specific building types in this time period, some buildings changed categorization. For example, the warehouse category was expanded for 2013 to include separate designations for distribution centers and refrigerated warehouses.

Changes in retail and hotel building median EUIs were large enough to merit investigation. The median retail EUI was 60.4 kBtu/sf in 2013, compared with 74.1 in 2012. When comparing only the 79 retail buildings that reported in both 2012 and 2013, the change was much smaller: a median EUI of 63.7 for 2012 compared to 66.6 for 2013. The median hotel EUI was 73.1 kBtu/sf in 2012, compared with 85.8 in 2013. The increase appears to be largely attributable to a 25% increase in the number of hotel buildings reporting data in 2013. The added buildings appear to have a much higher distribution of EUIs, which substantially affected the median of this small population (67 buildings). For buildings that were included in both 2012 and 2013, the median EUI of buildings increased by about 5 kBtu/sf. These smaller changes were likely due to corrections made between 2012 and 2013, as discussed in the Data Accuracy section of this report.