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NEW YORK CITY LOCAL LAW 84 BENCHMARKING REPORT

SEPTEMBER 2013

A GREENER, GREATER NEW YORK

The City of New York
Mayor Michael R. Bloomberg

Cover Photo: Downtown Manhattan
Credit: John H. Lee

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Columbus Circle in Manhattan

Credit: John H. Lee

Executive Summary

New York City Local Law 84 (LL84), part of the Greener, Greater Buildings Plan (GGBP), requires all privately-owned properties with individual buildings more than 50,000 square feet (sq ft) and properties with multiple buildings with a combined gross floor area more than 100,000 sq ft to annually measure and submit their energy and water use data to the City. This second annual report analyzes New York City benchmarking data collected for calendar year 2011 from 13,258 properties encompassing 24,071 buildings, constituting more than two billion square feet of real estate.

For the first time, two years of benchmarking data from large New York City buildings are available for comparative analysis. This data constitutes the largest collection of benchmarking metrics gathered for a single jurisdiction in the U.S., more than the data collected from Austin, Boston, Minneapolis, Philadelphia, San Francisco, Seattle, and Washington, D.C., combined. New Yorkers are now able to track energy and water use over time and identify new opportunities to increase energy and water efficiencies. Improving efficiency in buildings is crucial, because resource consumption in buildings is responsible for 74 percent of citywide greenhouse gas (GHG) emissions, 94 percent of total electricity use, and 85 percent of potable water consumption in New York City.

By the end of 2013, the City will begin collecting additional information through the mandate for Energy Audits (Local Law 87; LL87) on the same group of covered buildings. This information will add to the understanding of energy use in large buildings and identify cost effective measures and practices to improve efficiency. In partnership with the U.S. Department of Energy (DOE), the wealth of information will be shared anonymously in national databases that will enable comparisons with buildings in other cities. By increasing data transparency on a national level, building owners, policymakers, financial and energy experts, academics, and the general public will be able to utilize data to lower energy use, reduce GHG emissions, and save money.

Key Findings

Year-over-year comparisons of data show consistencies that substantiate the quality of the data. Patterns that were observed and reported from the 2010 data were observed again in the 2011 data with minor deviations from the prior year. The Year Two compliance rate remained the same at 75 percent as compared to the rate in Year One. While immediate conclusions cannot yet be drawn from solely two years' worth of data, this report includes the following observations:

The median ENERGY STAR score increased to 67 from 64. New York City's buildings that are eligible for ENERGY STAR scores saw a slight increase in the median score, which remains consistent with the scores of buildings in Northeastern states and is higher than the national average of 50.

Sector variations in energy consumption in 2011 were consistent year over year. Retail uses again showed the widest range in energy utilization intensities with the highest users consuming five times more than the lowest users when measured on a per area basis. The multifamily sector showed the narrowest variation in energy consumption between the most and least intensive users. Multifamily properties represent the largest share of affected properties, and they consume energy fairly consistently across the city. These patterns were expected to be repeated in Year Two, and the evidence in the data validates the assumption and assures quality of the data.

The most intensive water consumption was observed in multifamily properties. Multifamily properties also represent the largest contributing sector of water use data, and these properties exhibited the highest rate of water consumption on a per square foot basis. The water use data relies primarily upon the automatic reporting by devices deployed by the local water utility and demonstrates the case for similar upload methodologies for energy consumption data.

Further refinement of data analysis is necessary to understand the factors that shape energy and water consumption profiles. A deeper understanding of the physical characteristics of buildings and their construction will supplement the energy and water utilization metrics obtained through benchmarking. Once these associations have been clearly identified, retrofits and upgrades programs can be specifically tailored to achieve the most cost effective efficiency gains for any class of large building.

Recommendations

The City will implement the following actions to improve the quality of benchmarking data and the rates of compliance:

1.

Improve Enforcement. Amendments to the local law, agency rules, and administrative processes will streamline and improve compliance. The Mayor's Office will work with City agencies to consolidate notifications and enforcement under a single entity to limit the number of data transfers and reduce opportunities for errors and omissions. By creating a dedicated outreach and enforcement unit, the City will reduce confusion and improve access to customer service and technical support.

2.

Expand ENERGY STAR scoring to reflect the diversity of buildings. Portfolio Manager, the benchmarking tool developed and managed by the U.S. Environmental Protection Agency (EPA), is the standard platform used by jurisdictions across the nation. As the largest contributor of data to Portfolio Manager, New York City must maintain an influential role in the continuing development of Portfolio Manager. For the second reporting year, EPA made minor but important fixes, particularly around establishing methods to unify building identification conventions that differ across jurisdictions. In 2013, EPA undertook a comprehensive upgrade of Portfolio Manager that includes many technical improvements, but also creates new potential challenges as users adjust to the new system and data is migrated from the older platform. The City and EPA will ensure that Portfolio Manager continues to improve and serve the long-term goals of LL84. Ultimately, the City will contribute aggregated and anonymized energy use data to a national database to enable comparative metrics for buildings coast to coast.

The potential of benchmarking data grows as Portfolio Manager's database of energy use information increases, and New York City will develop metrics and reporting platforms with federal partners to make information available to the public while preserving the needs for privacy.

3.

Automatically upload energy use data. The City will engage power utilities to implement automatic data uploads to streamline and facilitate reporting for building owners. Automatic uploads of water use data in 2011 from the NYC Department of Environmental Protection proved extremely effective in ensuring accurate metrics, and this ease of reporting when applied to energy use will improve the compliance experience for property owners.

Background and Context

PlaNYC Report - 2011 Update

26,680

private and public sector buildings covered by Local Law 84

PlaNYC

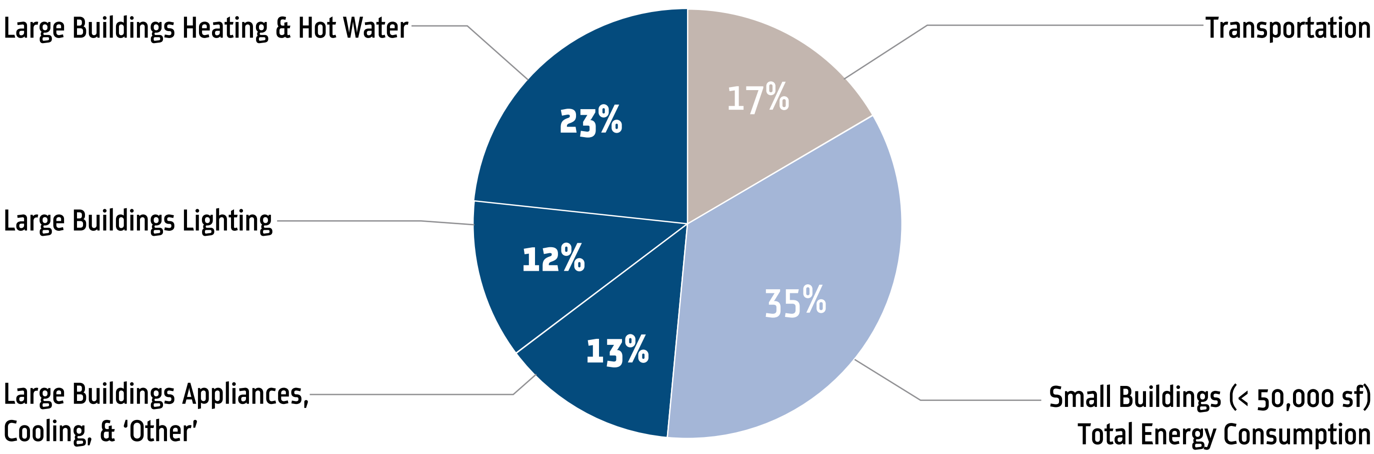
PlaNYC was launched by Mayor Michael Bloomberg on Earth Day in 2007 as an ambitious agenda to create a greener, greater New York. Updated in 2011, PlaNYC contains 132 initiatives to improve New York City's physical infrastructure, environment, quality of life, and economy. These initiatives support ten key goals, which include reducing citywide greenhouse gas (GHG) emissions by 30 percent from a 2005 baseline by 2030. Energy efficiency in buildings is the most significant opportunity to reduce emissions, because energy use in buildings currently accounts for 74 percent of total citywide GHG emissions.

Greener, Greater Buildings Plan

In 2009, Mayor Bloomberg unveiled and the City Council enacted the Greener, Greater Buildings Plan (GGBP), a groundbreaking policy composed of four local laws, financing, technical assistance, and job training. GGBP is the most comprehensive local legislation addressing energy efficiency in existing buildings in the U.S., and it is expected to reduce citywide GHG emissions by at least five percent by 2030. Additional impacts by 2030 include creation or preservation of at least 17,800 local skilled jobs and $7 billion in annual net energy savings.

GGBP focuses on New York City's largest buildings, which are roughly 15,300 private and public sector properties that include more than 26,680 buildings that are either larger than 50,000 square feet (sq ft), or are groups of buildings on a single lot that are collectively larger than 100,000 sq ft. Although they account for less than two percent of the total number of properties, the buildings covered by GGBP make up nearly half of total citywide gross floor area[1] and 48 percent of citywide energy use (Fig. 1).

[Fig. 1] **Energy Use in New York City, 2011**



Source: NYC Mayor's Office

1,001,115,162

MMBtu, Total annual source energy use

New York City's largest buildings account for:

2%

of the total number of properties

45%

of citywide gross floor area

48%

of citywide energy use

The GGBP laws were passed in December 2009, with compliance based on "tax lots" and "buildings."[2] Three of the four laws require owners of the largest buildings that are collectively larger than 100,000 sq ft, to comply with the following:

- Local Law 84 (LL84): Benchmarking – Annually benchmark and disclose energy and water use online. Benchmarking is the process of measuring a property's consumption of resources, such as energy and water, over time, and as compared to other buildings in similar classifications.
- Local Law 87 (LL87): Energy Audits & Retro-commissioning – Conduct an energy audit and perform retro-commissioning once every ten years. An energy audit is an assessment of energy use, which is used to identify sources of inefficient performance and energy conservation measures to achieve energy savings. Retro-commissioning is the process of tuning existing equipment for optimal performance.
- Local Law 88 (LL88): Lighting and Sub-metering – Upgrade lighting in all non-residential spaces to meet the current Energy Code, and provide electric sub-meters for large commercial tenants.

All building owners in New York City must comply with the fourth law:

- Local Law 85 (LL85): NYC Energy Conservation Code (NYCECC) – Comply with the local Energy Code, which is applicable to all new buildings and renovations, regardless of building size.

Benchmarking Tool

Portfolio Manager. Under LL84, buildings are benchmarked for energy use through an online tool called the ENERGY STAR Portfolio Manager (Portfolio Manager), created by the U.S. Environmental Protection Agency (EPA) and available at www.energystar.gov/portfoliomanager. Portfolio Manager allows building owners to analyze the energy and water consumption of their buildings, and provides a comparative metric

Automatic Meter Reading Devices

Building owners are required to report water use data in Portfolio Manager only after they have had automatic meter reading devices (AMRs) installed by the NYC Department of Environmental Protection (DEP) for an entire calendar year preceding the reporting year. AMRs allow building owners to track water use up to four times daily and detect leaks at an early stage. Data from AMRs is uploaded into Portfolio Manager by DEP or manually entered by building owners.

Covered Buildings

All private properties with buildings required to comply with LL84 are also described throughout this report as "covered buildings." Covered buildings are identified based on their gross floor area records in the Department of Finance's (DOF) property database, which is regularly updated to reflect changes in building ownership, assessments that recalculate gross floor area, alterations that increase a building's gross floor area, and more. Because of these changes, the list of covered buildings is updated annually to maintain accuracy.

of energy consumption and efficiency. Individuals enter information about a property, such as gross floor area, types of uses, number of workers, hours of operation, and monthly energy and water consumption. Portfolio Manager then calculates several metrics, including: an ENERGY STAR score for certain building types,[3] GHG emissions per sq ft,[4] Site Energy Use Intensity (EUI),[5] Source EUI,[6] and water use per sq ft.[7]

Buildings Required to Comply

City Government Buildings. Municipal buildings are held to a more stringent standard than private sector buildings. All City-owned buildings larger than 10,000 sq ft are required to annually benchmark. In 2012, the City benchmarked 2,051 properties (which comprises 2,615 City buildings), constituting 281.5 million sq ft.[8]

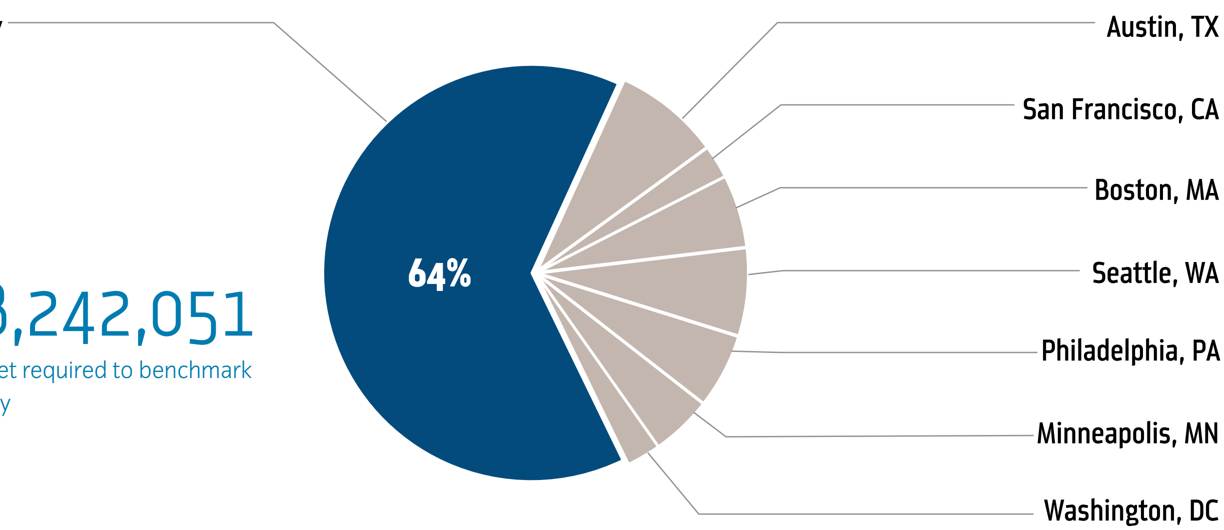
Private Buildings. As previously described, owners of buildings larger than 50,000 sq ft, or lots with groups of buildings that are collectively larger than 100,000 sq ft are required to annually benchmark. In 2012, 13,258 private sector properties (which comprises 24,071 buildings) were required to benchmark, constituting more than 2.3 billion sq ft of space.

Added together, the gross floor area required to be benchmarked under LL84 is larger than the gross floor area impacted by all other benchmarking cities in the U.S. combined, making up 64 percent of total gross floor area required to be benchmarked by U.S. cities (Fig. 2).

Public Disclosure of Data and Reporting

The results of LL84 benchmarking are made available every year online at www.nyc.gov/ll84data. Disclosed data includes weather-normalized source and site EUI, ENERGY STAR scores for eligible building types, GHG per sq ft, and water per sq ft. Aside from the geographical identifiers of BBL, BIN, and street address, the City does not verify or correct any data entries prior to disclosure.

[Fig. 2] **Gross Floor Area Impacted by U.S. Benchmarking Regulations**



2,258,242,051

Total square feet required to benchmark in New York City

Source: Institute for Market Transformation and NYC Mayor's Office

New York City's first benchmarking report analyzing 2010 energy and water data

Benchmarking and Public Disclosure Benefits

Energy efficiency in buildings represents a critical opportunity for GHG emissions reductions. However, cost effective reductions through retrofits and improved operations and maintenance have not yet occurred at a large scale due to lack of energy use information in buildings.

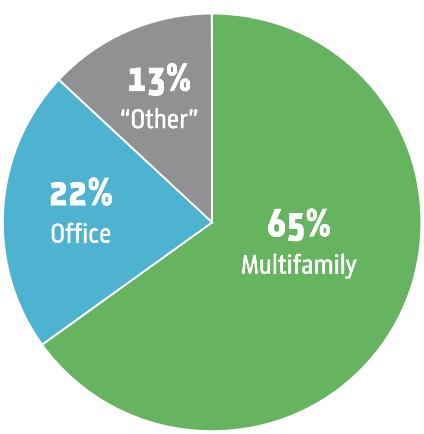
The last two years of benchmarking have provided more data to building owners about energy and water use within New York City's buildings than what was historically available. New Yorkers can now easily compare one building's energy performance to another's to understand relative efficiency. Because this information is mandatorily provided, it is more comprehensive and valid as a representative sample of the city's building stock than data from voluntary benchmarking. Furthermore, analysis of this information has revealed new insights that confirm assumptions about energy use patterns on a citywide scale.

With this data, New Yorkers can transform their energy usage, building by building. Individuals can compare year to year performance of their buildings to assess the best strategies to reduce energy use and save money. Owners can also include energy and water data as additional metrics in building management and financial decisions. At the real estate market level, the data can motivate owners to improve energy performance, since tenants will be able to make informed decisions about a building based on energy and water use. Finally, the data informs City government and utilities of the effectiveness of policies, and identifies properties and/or sectors that can benefit from additional outreach and resources.

Buildings Characteristics

Data submitted by owners of covered buildings provides granular level snapshots of building characteristics and useful context when merged with existing City datasets. For purposes of analysis in this report, benchmarking data for calendar year 2011 was first verified by DOF to ensure correct building addresses and identification, and then merged with building data from the New York City Department of City Planning's (DCP) Primary Land Use Tax Lot Output (PLUTO) database. The data was then cleaned by a research team comprised of the New York University (NYU), the University of Pennsylvania (UPenn), and NYC Mayor's Office. Further details on the data cleaning process can be found in Appendix A: Data Accuracy. Except where otherwise noted, this report describes the characteristics of covered buildings that were benchmarked for 2011 energy and water use.[9]

[Fig. 3] **Share of Gross Floor Area by Sector**



Source: New York University

Covered Buildings by Sector

The breakdown of covered buildings largely falls into three sectors: multifamily, office, and other building categories grouped together. These classifications are self-reported by building owners as part of the benchmarking process. The multifamily sector includes residential buildings that have more than one housing unit and more than 50 percent of their gross floor area devoted to residential housing. Buildings with more than 50 percent of their gross floor area devoted to office space comprise the office sector. For the purposes of this report, properties with all other reported uses are referred to as "other" properties.

1,132,539,547
gross square feet of multifamily properties*

384,746,629
gross square feet of office properties*

227,527,336
gross square feet of "other" properties*

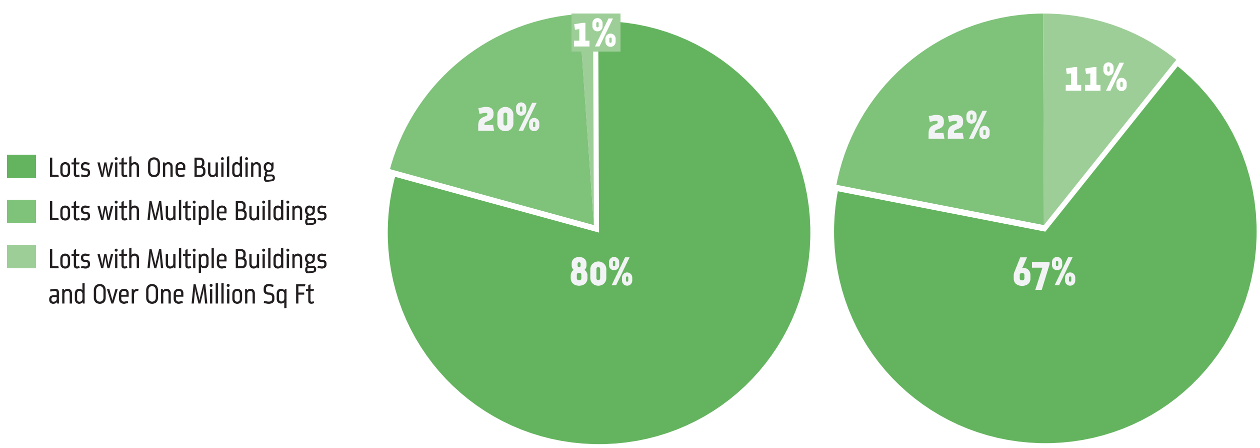
*after the first stage of data cleaning

Largely consistent with Year One data collected for calendar year 2010, covered buildings in the multifamily sector comprise the majority of gross floor area benchmarked at 65 percent; the office sector follows at 22 percent, and "other" properties make up the remaining 13 percent (Fig. 3).

Lots with Multiple Buildings

Covered buildings are identified by tax lots, which can contain one or more buildings. Because energy systems and meters are often shared among buildings on a single lot, building owners have the option to benchmark each building individually, or aggregate the data and benchmark buildings together.[10] When multiple buildings are benchmarked together, it gives the appearance of much larger buildings. Thus it is important to recognize that reported gross floor area of large properties often contain multiple buildings. In fact, 20 percent of all multifamily properties report more than one building on a lot.

[Fig. 4] **Total Number and Gross Floor Area of Multifamily Lots**



Total Number of Multifamily Lots   Total Square Footage of Multifamily Lots

Source: NYC Mayor's Office

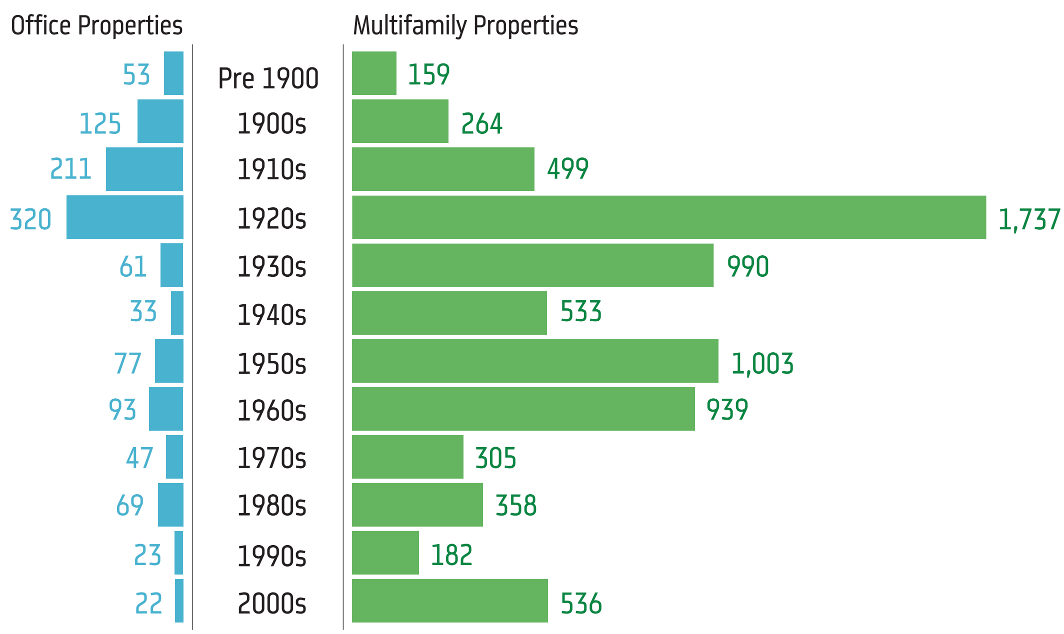
[Fig. 5] **Ten Largest Multifamily Properties by Gross Floor Area**

1. **7.7MM sq ft** (5 buildings)
2. **5.2MM sq ft** (45 buildings)
3. **3.3MM sq ft** (6 buildings)
4. **3.1MM sq ft** (39 buildings)
5. **2.9MM sq ft** (9 buildings)
6. **2.8MM sq ft** (7 buildings)
7. **2.7MM sq ft** (10 buildings)
8. **2.5MM sq ft** (31 buildings)
9. **2.5MM sq ft** (7 buildings)
10. **2.4MM sq ft** (11 buildings)

Source: University of Pennsylvania

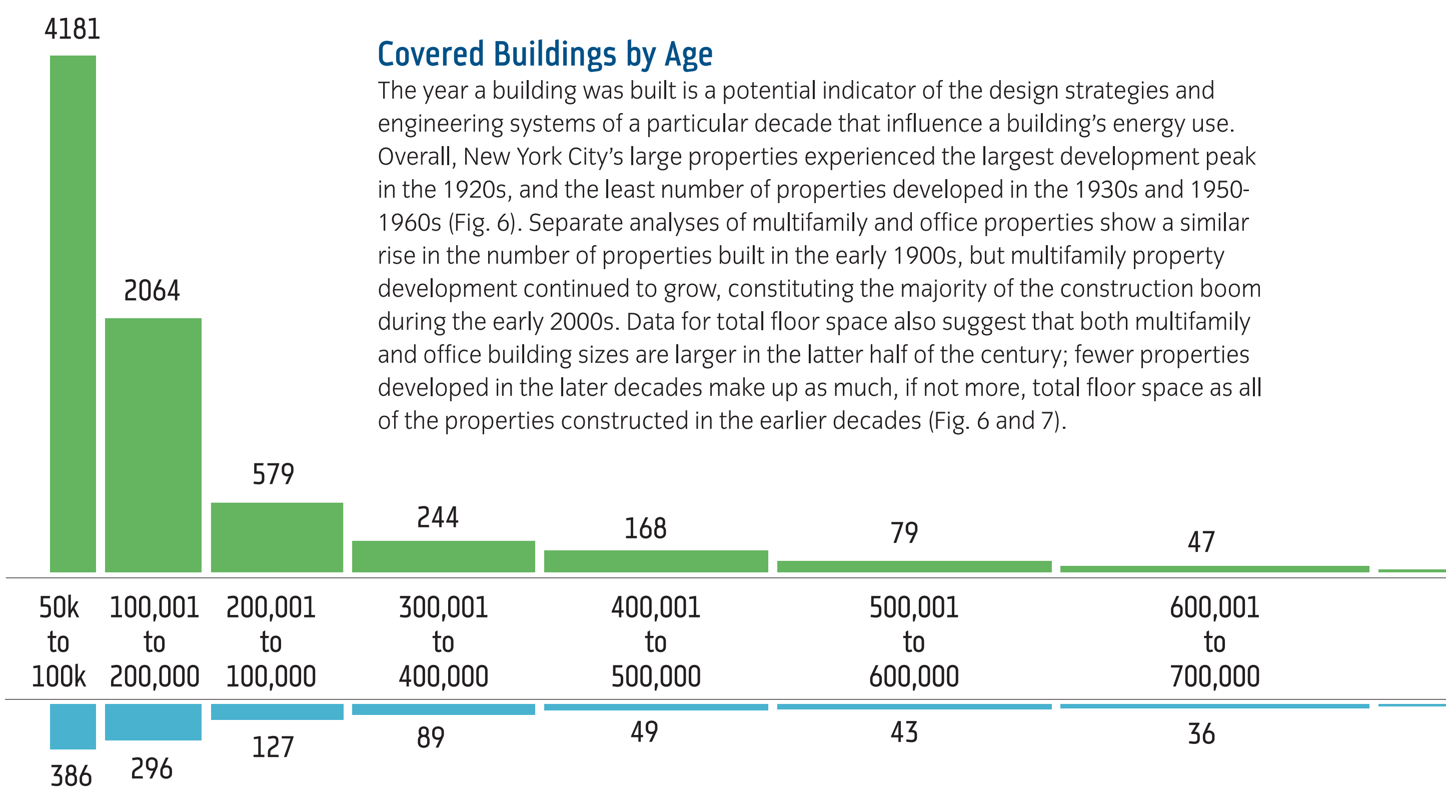
In terms of gross floor area, the same 20 percent of lots with multifamily properties that contain multiple buildings make up about a third of the multifamily gross floor area based on submittals. The top largest one percent of lots with multifamily properties and multiple buildings are over one million sq ft; however, this one percent represents a substantial portion of the overall gross floor area of benchmarked buildings in the sector, constituting 11 percent of all reported gross floor area for lots with multifamily properties (Fig. 4). Furthermore, each of the top ten largest multifamily properties contains more than one building (Fig. 5).

[Fig. 6] **Number of Properties Benchmarked by Year Built**



Source: University of Pennsylvania and NYC Mayor's Office

[Fig. 8] **Number of Properties by Gross Floor Area**[11]

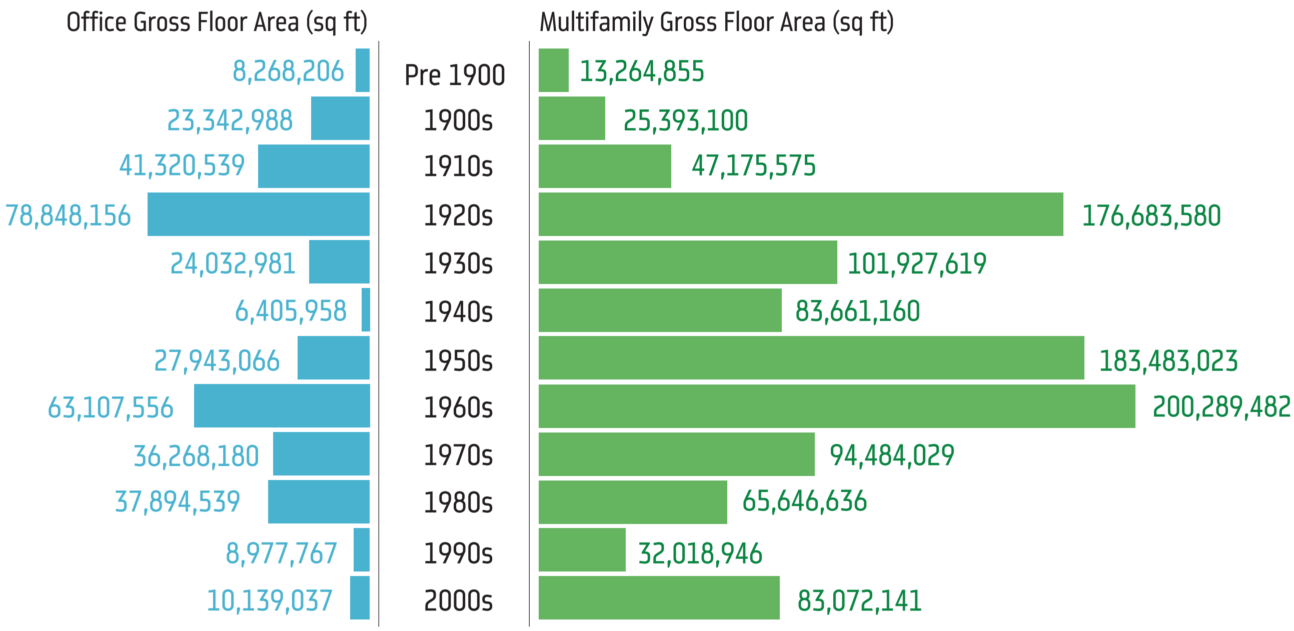


Covered Buildings by Age

The year a building was built is a potential indicator of the design strategies and engineering systems of a particular decade that influence a building's energy use. Overall, New York City's large properties experienced the largest development peak in the 1920s, and the least number of properties developed in the 1930s and 1950-1960s (Fig. 6). Separate analyses of multifamily and office properties show a similar rise in the number of properties built in the early 1900s, but multifamily property development continued to grow, constituting the majority of the construction boom during the early 2000s. Data for total floor space also suggest that both multifamily and office building sizes are larger in the latter half of the century; fewer properties developed in the later decades make up as much, if not more, total floor space as all of the properties constructed in the earlier decades (Fig. 6 and 7).

Source: University of Pennsylvania and NYC Mayor's Office

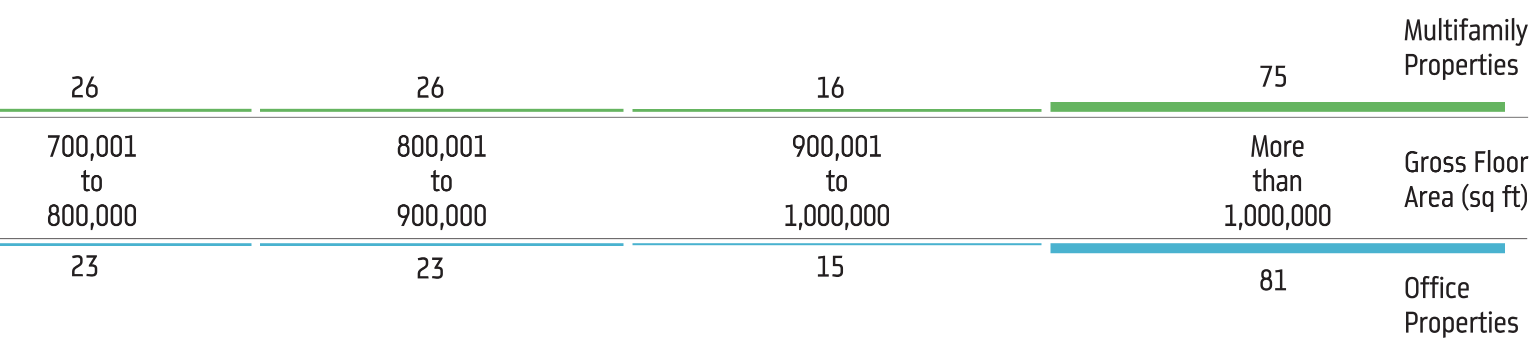
[Fig. 7] **Gross Floor Area by Year Built**



Source: New York University and NYC Mayor's Office

Covered Buildings by Size

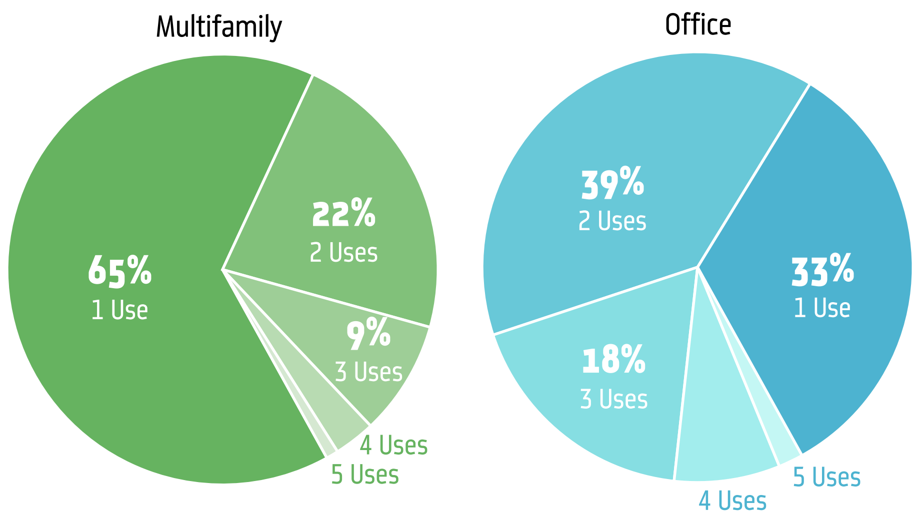
Smaller-sized multifamily and office properties comprise the highest frequency of covered buildings. Some buildings are less than 50,000 sq ft because a number of smaller buildings on lots with multiple buildings were benchmarked separately. Despite being a smaller group by number, larger sized multifamily properties (those over 200,000 sq ft) make up half of the total gross floor area captured in the multifamily data set. Multifamily properties significantly outnumber office properties between 100,000 and 700,000 sq ft in area, but the frequency of properties between the two sectors are similar as floor area exceeds 700,000 sq ft (Fig. 8).



Mixed Uses within Covered Buildings

Many buildings in New York City are mixed use, containing various combinations of space use such as residential units, office space, retail, industrial, etc. While about two thirds of multifamily properties and one third of office properties are single use buildings, the remaining properties are mixed use (Fig. 9). With mixed use properties, it is necessary to understand the composition of the property to gauge energy consumption patterns. For example, multifamily properties that reported retail as their secondary use display a statistically significant difference in average source EUI (Fig. 10). Conversely, comparing office properties that reported retail as a secondary use to those without do not reveal a significant statistical disparity in average EUI between the two groups. The presence of retail in a multifamily property is not, in and of itself, the driver of increased EUI as compared to a multifamily property without retail uses, but is a strong indicator of the different mechanical and lighting systems that are necessary to support the use patterns of mixed use properties.

[Fig. 9] **Mixed Uses in Multifamily and Office Properties**



Source: New York University and NYC Mayor's Office

[Fig. 10] **t-Test Comparison of Multifamily Source EUI with or without Retail as as Secondary Use**

GROUP	NUMBER OF BUILDINGS	MEAN	STANDARD ERROR	STANDARD DEVIATION	95% CONFIDENCE INTERVAL	
0	6511	135.4643	.5709195	46.06794	134.3451	136.5835
1	994	153.9485	1.53381	48.35760	150.9386	156.9584
Combined	7505	137.9125	.5401712	46.79578	136.8536	138.9714
Difference		-18.48415	1.579302		-21.58003	-15.38828
DIfference = mean(0) - mean(1)						t = -11.7040
Ho: Difference = 0						Degrees of freedom = 7503

Source: New York University

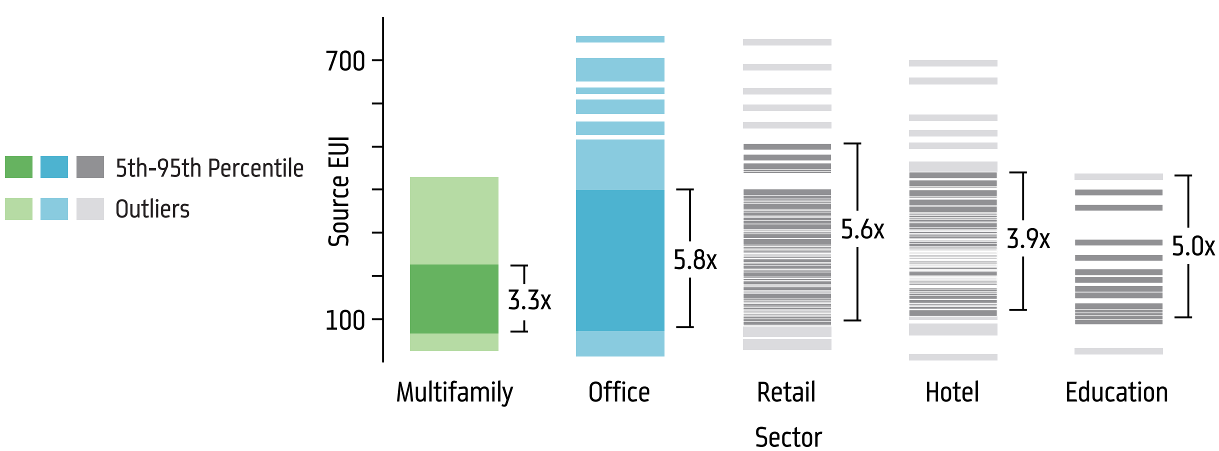
Year Two Benchmarking Results

Many of the patterns reported in 2010 data from Year One were observed again in the 2011 data in Year Two (this analysis excludes City buildings).

Variation in Source Energy Use Intensity (EUI)

A comparison of the properties reporting the highest EUI at the 95th percentile and properties reporting the lowest EUI at the 5th percentile reveals that energy use varies by a factor of about three to six among properties with similar uses (Fig. 11). The variation differs among sectors, with some sectors, particularly office and retail,

[Fig. 11] **Variation in Source EUI by Sector** (5th-95th percentile)



Source: NYC Mayor's Office

having a much larger range than others. The ranges in each of these five sectors reveal the potential for sector-specific improvement, and indicates fairly consistent levels of energy use among multifamily buildings.

Sector Impacts

Sector-by-sector analysis shows that multifamily properties continue to make up the majority of benchmarked properties, gross floor area, energy use, and GHG emissions, comprising 76 percent of the total number of buildings, 65 percent of the gross floor area, 50 percent of the energy used, and 55 percent of GHG emissions. While multifamily properties make up the most prevalent building sector, they also pose difficult targets for improving energy efficiency. Residential tenants have limited information to analyze energy and water use because utility and fuel bills are often based on aggregate building usage as opposed to individual consumption. This creates an obstacle in encouraging behavioral changes. On the building owners' side, energy management is limited by the challenge of determining individual tenant energy and water use due to lack of sub-metering and privacy concerns. Additionally, unlike longer-term leases for commercial properties, many residential properties experience a high turnover rate of short-term lease agreements, discouraging both owners and tenants from investing in long-term, deep retrofits to reduce energy use associated with electricity use. One percent of all residential properties in New York City, however, are owner-occupied cooperatives or condos that comprise 17 percent of total residential built space.[12] This suggests that a significant percentage of residential properties (by space) may be more likely to undergo longer-term energy efficiency retrofits that would confer direct financial savings to building owners.

Office property owners, particularly those of large buildings occupied by global companies with corporate social responsibility plans, tend to be motivated to pursue programs in office energy efficiency. Competitiveness within the commercial sector for low EUIs and high ENERGY STAR[13] scores may influence this sector to improve efficiency, especially as these metrics are publically disclosed online every year. (Starting in 2013, covered residential buildings will also be required to disclose LL84 reporting data; annual analysis will show whether a similar trend occurs within in this sector as well.) It is important to note that EUI is not a sole indicator of energy efficiency, but provides the baseline metrics for an individual property to measure performance over time.

Among buildings covered by Local Law 84, **multifamily properties accounts for:**

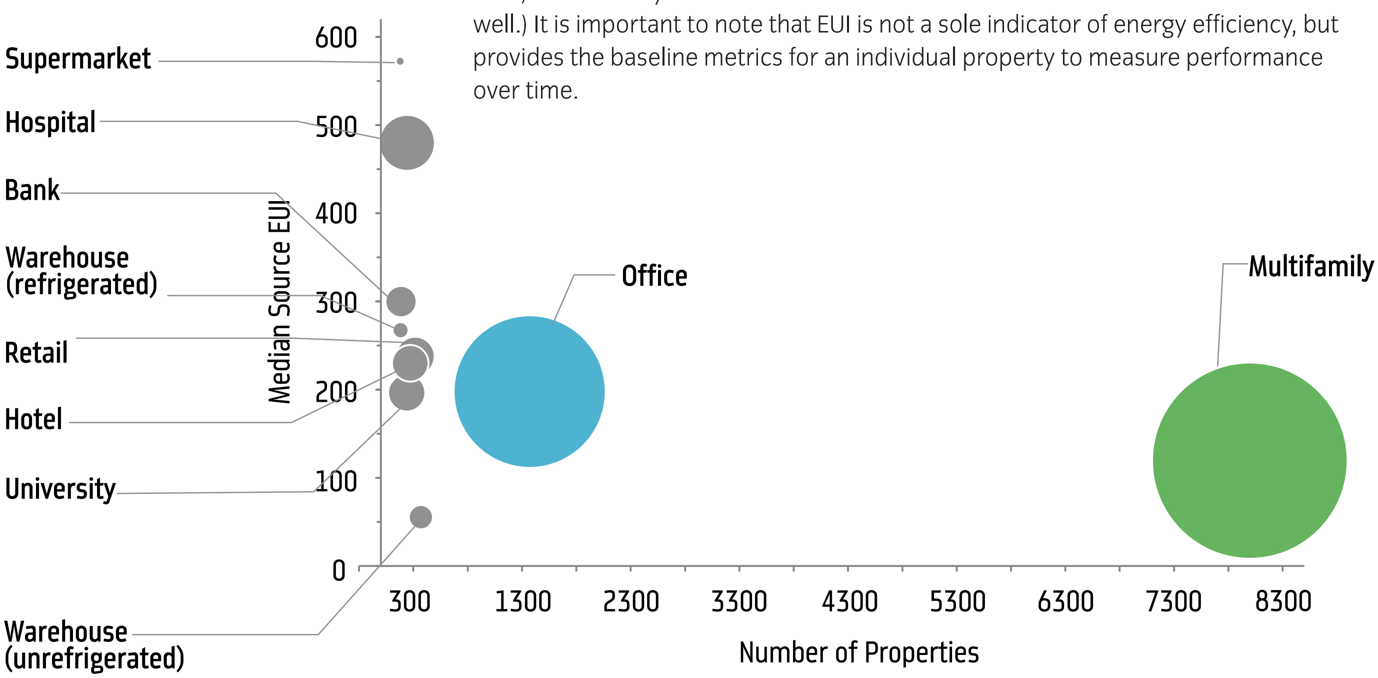
76%
of total number of buildings

65%
of gross floor area

50%
of the energy used

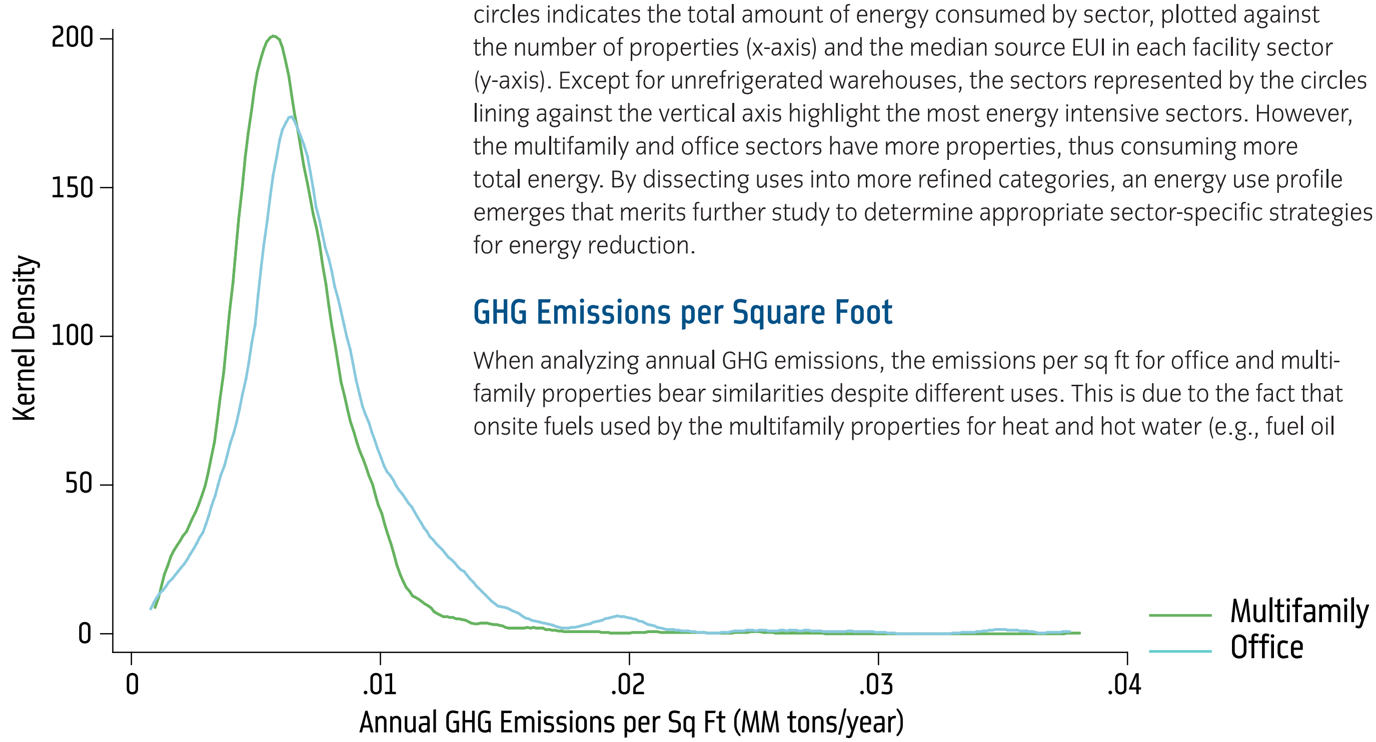
55%
of greenhouse gas emissions

[Fig. 12] **Number of Properties, Median Source EUI, and Total Energy by Building Sector**



Source: University of Pennsylvania and NYC Mayor's Office

[Fig. 13] **Kernel Density Plot of Total GHG Emissions per Square Foot**



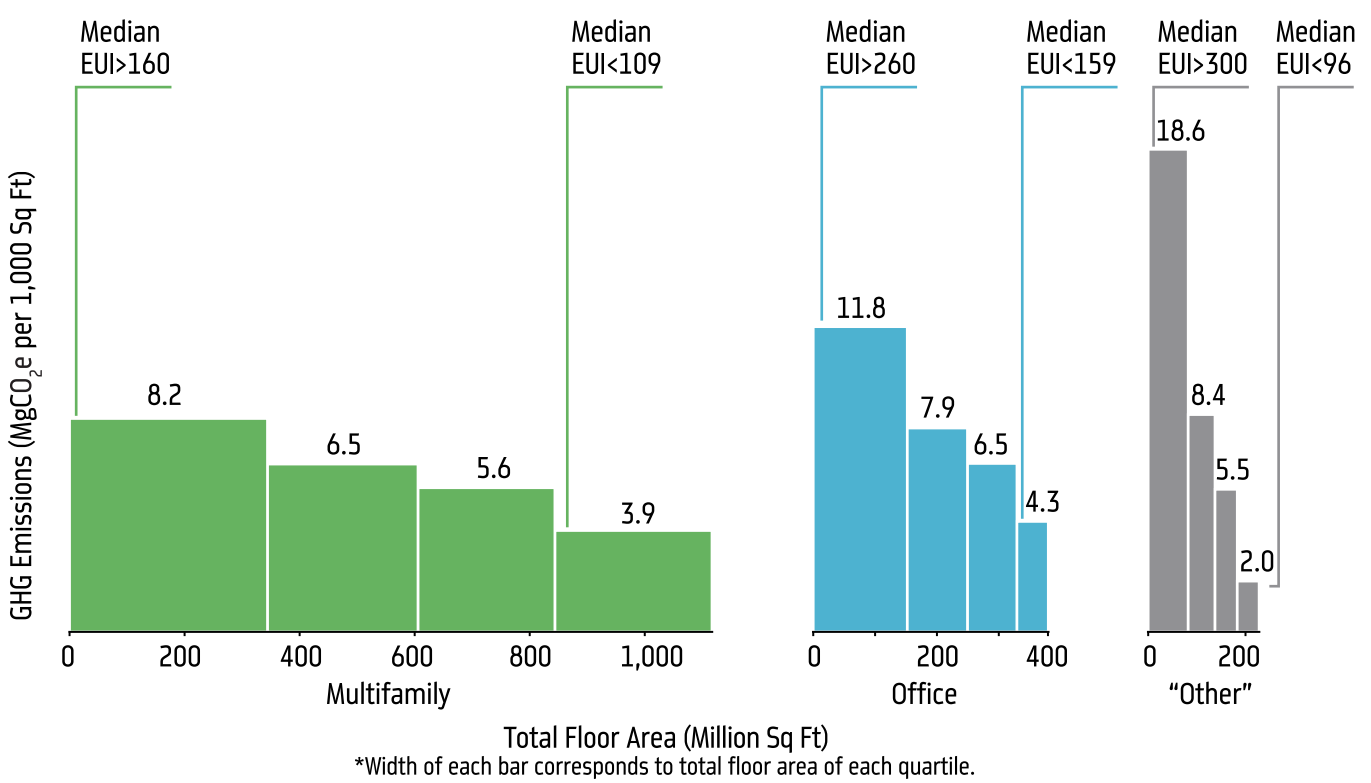
Source: New York University

The circle graph (Fig. 12) summarizes the number of properties for multifamily, office and eight other property sectors and their respective median EUI. The area of the circles indicates the total amount of energy consumed by sector, plotted against the number of properties (x-axis) and the median source EUI in each facility sector (y-axis). Except for unrefrigerated warehouses, the sectors represented by the circles lining against the vertical axis highlight the most energy intensive sectors. However, the multifamily and office sectors have more properties, thus consuming more total energy. By dissecting uses into more refined categories, an energy use profile emerges that merits further study to determine appropriate sector-specific strategies for energy reduction.

GHG Emissions per Square Foot

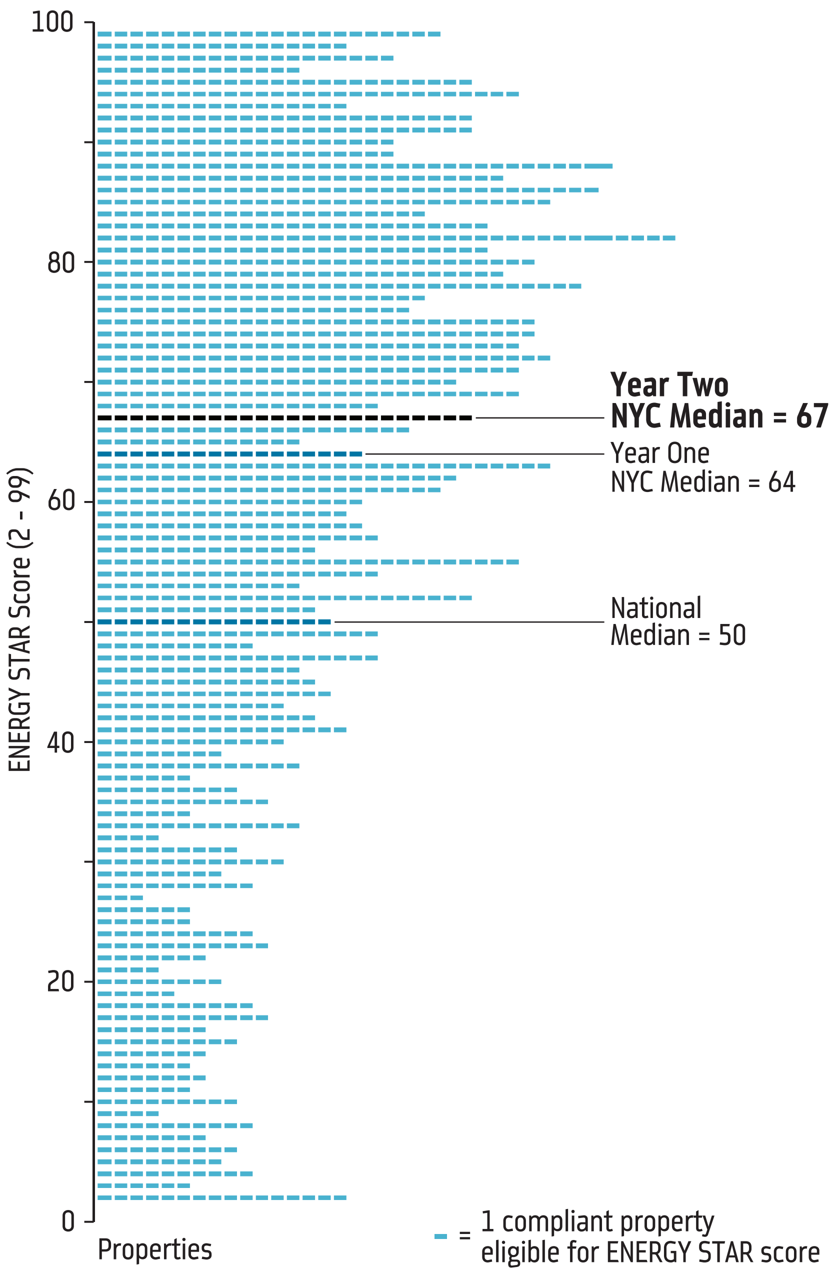
When analyzing annual GHG emissions, the emissions per sq ft for office and multi-family properties bear similarities despite different uses. This is due to the fact that onsite fuels used by the multifamily properties for heat and hot water (e.g., fuel oil

[Fig. 14] **Total GHG Emissions by Sector Quartiles**



Source: University of Pennsylvania and NYC Mayor's Office

[Fig. 15] **Distribution of ENERGY STAR Scores for Eligible Buildings in New York City**



Source: University of Pennsylvania and NYC Mayor's Office

and natural gas) are more emissions intensive than electricity, which is the most common energy source used by office properties (Fig. 25, pg. 32). The use of fuels other than electricity often requires more kBtu of energy, which results in an increase in the emissions intensity of the prevalent non-electricity energy sources. However, when compared to other fuel sources strictly on a per kBtu basis, electricity is the most emissions intensive energy source.[14]

There is more variance in the distribution of GHG emissions from the office sector when compared to the multifamily sector (Fig. 13), which is also reflected in the distribution of source EUI across this sector (Fig. 19). The relationship of annual GHG emissions per sq ft for office and multifamily properties is close, with a peak in both groups around .01 MM CO2e/sq ft. There is a secondary bump for office properties at 0.02 MM CO2e/sq ft, and both sectors have a long tail of high emitters. As Local Law 43 phases out the use of the dirtiest fuel oils, future reporting will reveal the effect it may have on GHG emissions per sq ft, particularly in the residential sector which relies on fuel oils as energy sources more so than the office sector.

Plotting the multifamily, office, and "other" properties sectors by their respective quartiles of source EUI reveals a pattern worthy of further examination (Fig. 14). While the number of properties in each quartile is the same for a given sector, the area of the quartiles differs, corresponding to their respective GHG emissions, with a wider quartile bar indicating greater emissions. For example, although the "other" properties sector stands out with the tallest bar in its fourth quartile, the narrow width corresponds to only few properties and a small built area. Furthermore, the total sum gross floor area of all of the quartiles of the "other" properties sector combined is still less than the gross floor area of the fourth multifamily quartile.

67

New York City median ENERGY STAR score in 2011

Therefore, the most energy consuming quartile of multifamily properties contribute toward more GHG emissions than entire "other" properties sector. In fact, this multifamily quartile is responsible for five percent of all GHG emissions for New York City, and 23 percent of GHG emissions from all large properties in New York City.

Distribution of ENERGY STAR Scores

The data discussed thus far can be applied to the national ENERGY STAR building scoring system to see how New York City's buildings compare nationally. There are 15 commercial building classifications that are eligible to receive an ENERGY STAR score on a scale of 1-100. These commercial building types include banks/financial institutions, courthouses, data centers, hospitals (general, medical, and surgical), hotels, houses of worship, K-12 schools, medical offices, municipal wastewater treatment plants, offices, residence halls/dormitories, retail stores, senior care facilities, supermarkets, and warehouse (refrigerated and non-refrigerated).[15]

Only 2,463 of the 13,258 properties that submitted benchmarking reports have buildings that are eligible using the ENERGY STAR score methodology. Multifamily properties which make up a majority of the submissions, along with certain other building types, and highly mixed-use properties[16] are presently not scored by ENERGY STAR.

The median ENERGY STAR score for 2011 data is 67, higher than the national median of 50 (Fig. 15). For the purpose of analysis, and consistency with the previous report, buildings that earned an ENERGY STAR score of 1 or 100 are omitted due to the uncertainty of data entry errors. The skew of distribution of ENERGY STAR scores towards the high end indicates New York City's buildings are more efficient than the national average. In general, buildings in the Northeast appear to be performing better than the national average (as compared to the 2003 Commercial Building Energy Consumption Survey, CBECS). This observation will be analyzed over the years to determine if it manifests as a true trend.

Multifamily Working Grades

Comparable information will be available if a national scoring system for multifamily properties is developed similar to ENERGY STAR.[17] In the meantime, building owners can compare their multifamily properties to other New York City properties to understand energy use and efficiency. The table below (Fig. 16) shows a potential grading system based on benchmarked buildings subject to annual updates as more building owners comply with accurate information. However, it should be noted that the scores are normalized only for weather and do not take into account other factors.

[Fig. 16] **Multifamily Working Grades**

A	EUI ≤ 109
B	109 < EUI ≤ 132
C	132 < EUI ≤ 160
D	EUI > 160

Source: NYC Mayor's Office

Years One and Two Compared

Comparison of Years One and Two Results

The ongoing reporting of energy use over time allows for analysis of trends and validation of assumptions. Comparison between Year One benchmarking of 2010 data to Year Two benchmarking of 2011 data suggests changes in certain aspects of energy use reporting and identifies similarities in others. Overall, data quality in Year Two improved from Year One.[18]

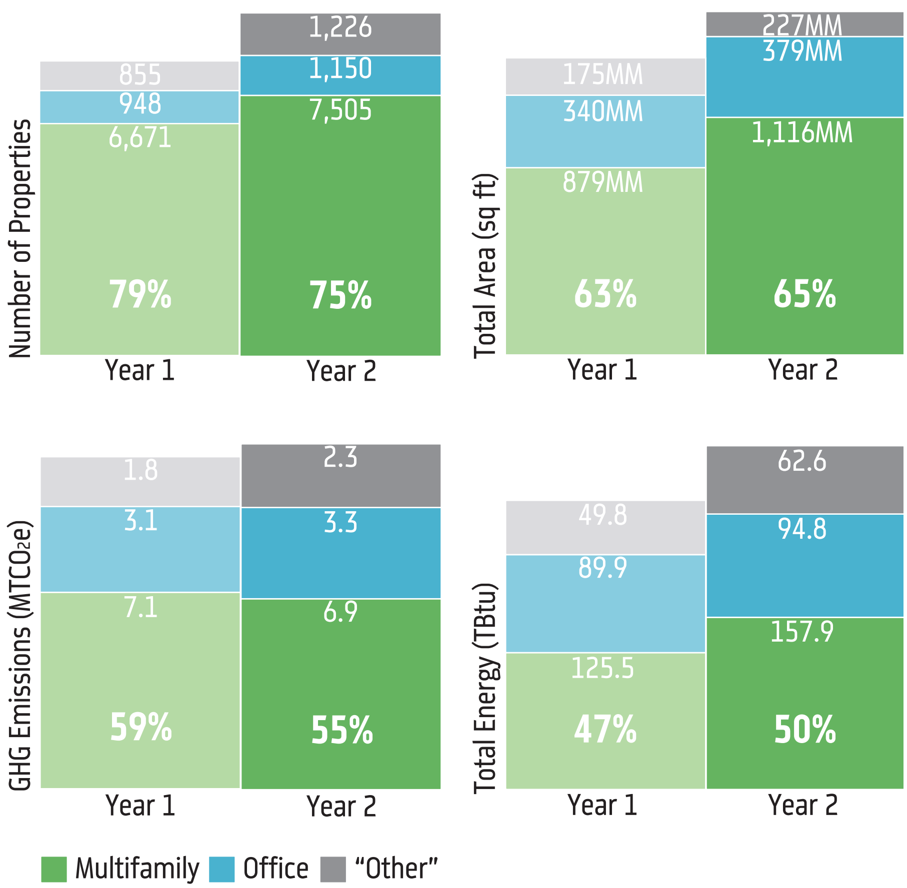
Changes in Proportional Impact

There is an overall 17 percent increase in total submittals from Year One to Year Two. Comparison of the submitted data was after extensive data cleaning, including the removal of EUIs below five and above 1,000 kBtu/ sq ft, an additional two percent outliers for the multifamily and office sectors, and other data entry errors. The overall increase of remaining submittals in Year Two after such cleaning of obvious errors suggests the data quality improvements in the second year of reporting.

Sector analysis of the submittals by sector (multifamily, office, and other properties) reveals noteworthy shifts between Year One and Year Two. Proportional to total submittals, the aggregated "other" properties exhibits the greatest increase in submittals at 43 percent, followed by the office sector at 21 percent, and the multifamily sector with a 13 percent increase. Overall, there is a 17 percent increase, which is relatively similar across the sector types. Reported gross floor area also displays similar relative percentages across the sectors (Fig. 17).

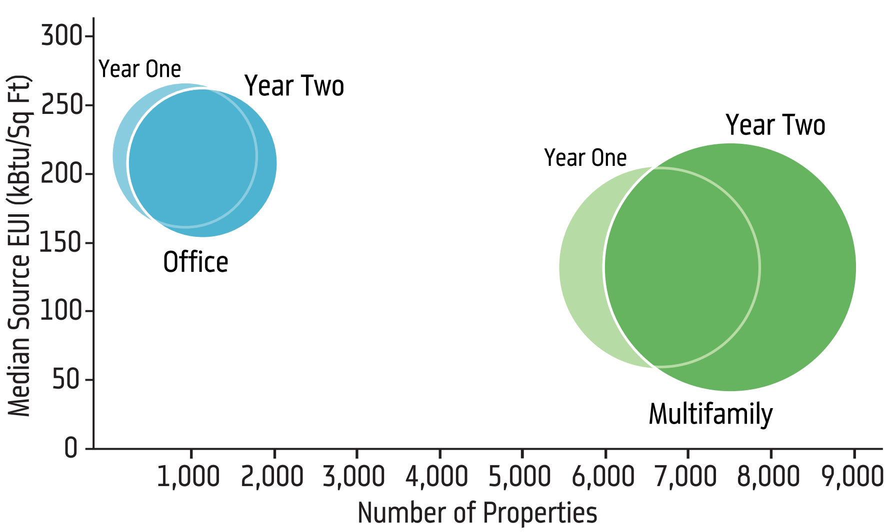
Total energy consumed by the multifamily and "other" sectors remained proportionally similar over the years, with a slightly larger shift noted in the office sector. Conversely, the greater shifts in GHG emissions were observed in the multifamily and "other" sectors.

[Fig. 17] **Year Over Year Factor Comparisons of Multifamily, Office, and "Other" Properties**



Source: NYC Mayor's Office

[Fig. 18] **Year Over Year Comparison of Median EUI, Number of Properties, and Total Energy Per Sector**[19]



Source: University of Pennsylvania and NYC Mayor's Office

These statistics warrant further investigation to answer why, despite a significant increase in submittals, the proportional gross floor area, energy usage, and GHG emissions decreased for the office sector. Such variations may be attributed to data quality improvement as building owners become increasingly familiar with Portfolio Manager and the nuances of LL84. Over time, if these data points fail to normalize, then additional enforcement of data quality will be warranted.

Comparison of Source EUI

While the previous section highlighted proportional differences across the building types, sector median analysis allows another perspective. The size of the circles below (Fig. 18) corresponds to the total energy use reported in Tera British thermal units (10^{12} Btu). The horizontal placement of the circle corresponds to the number of properties within the sector, and the vertical placement corresponds to the median source EUI in kBtu/sq ft. The multifamily sector exhibits shifts in total energy at over 25 percent, while the office sector only shifts by five percent. Also, the median source EUI values remained virtually the same for multifamily and office sectors between reporting years.

An additional indicator of the quality of the reporting is that for two consecutive years the median source EUI for New York City properties aligns with the median for regional databases, indicating consistency with a similar building stock subject to similar climate conditions. Examining just the median source EUI for New York City multifamily and office properties reveal their close agreement with the Northeast in national databases for the second year in a row (Fig. 19). Multifamily properties in New York City have a median EUI of 132.1, while the median EUI for the Residential Energy Consumption Survey (RECS) 2005 database is 130. For office properties, the New York City median EUI is 207.3,

132.1
New York City median EUI for multifamily properties

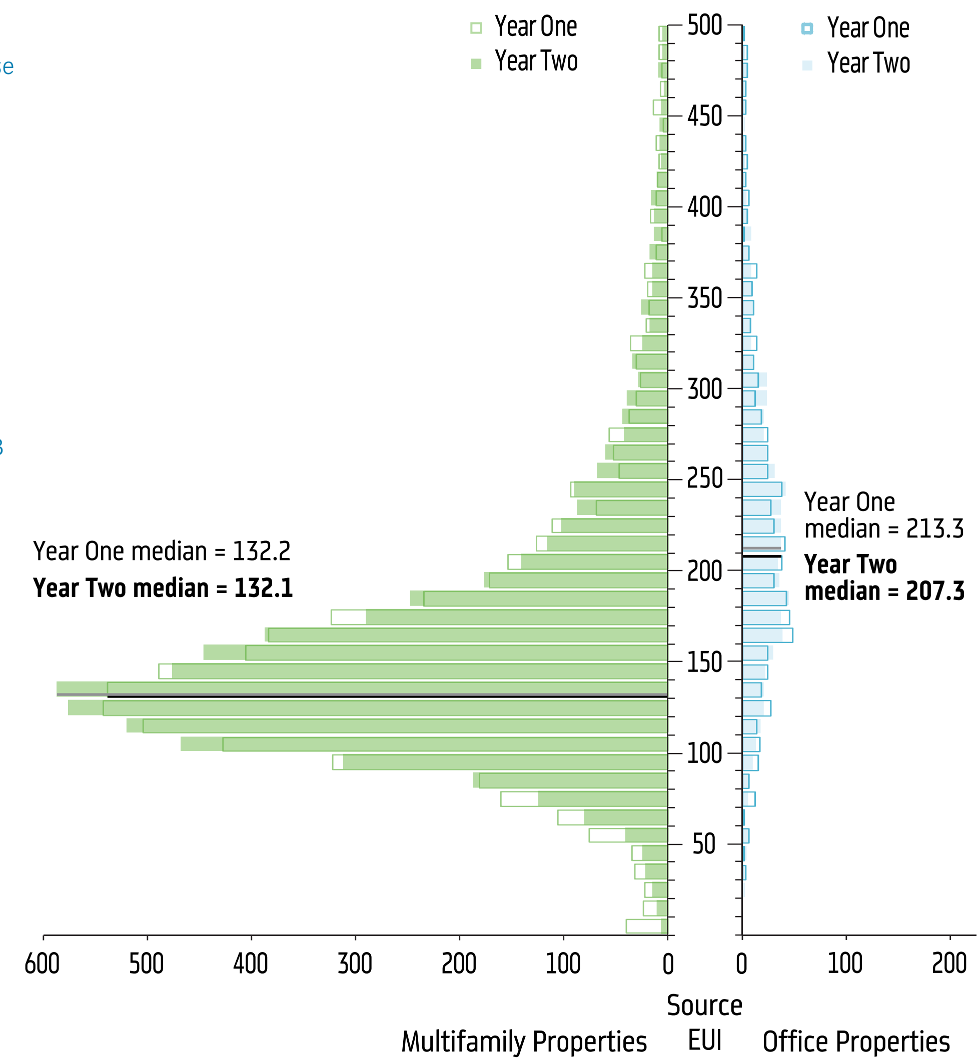
130
median EUI for the Residential Energy Consumption Survey (RECS) 2005 Database

207.3
New York City median EUI for office properties

210
median EUI for the Commercial Building Energy Consumption Survey (CBECS) 2003 Database

compared to 210 for the 2003 CBECS database. The bell-shaped curve distribution of multifamily frequencies is also an indicator of reasonable data quality and alignment with regional norms, even while the office distribution displays a slightly less normal distribution.

[Fig. 19] **Source EUI Histograms for Multifamily and Office Sectors**

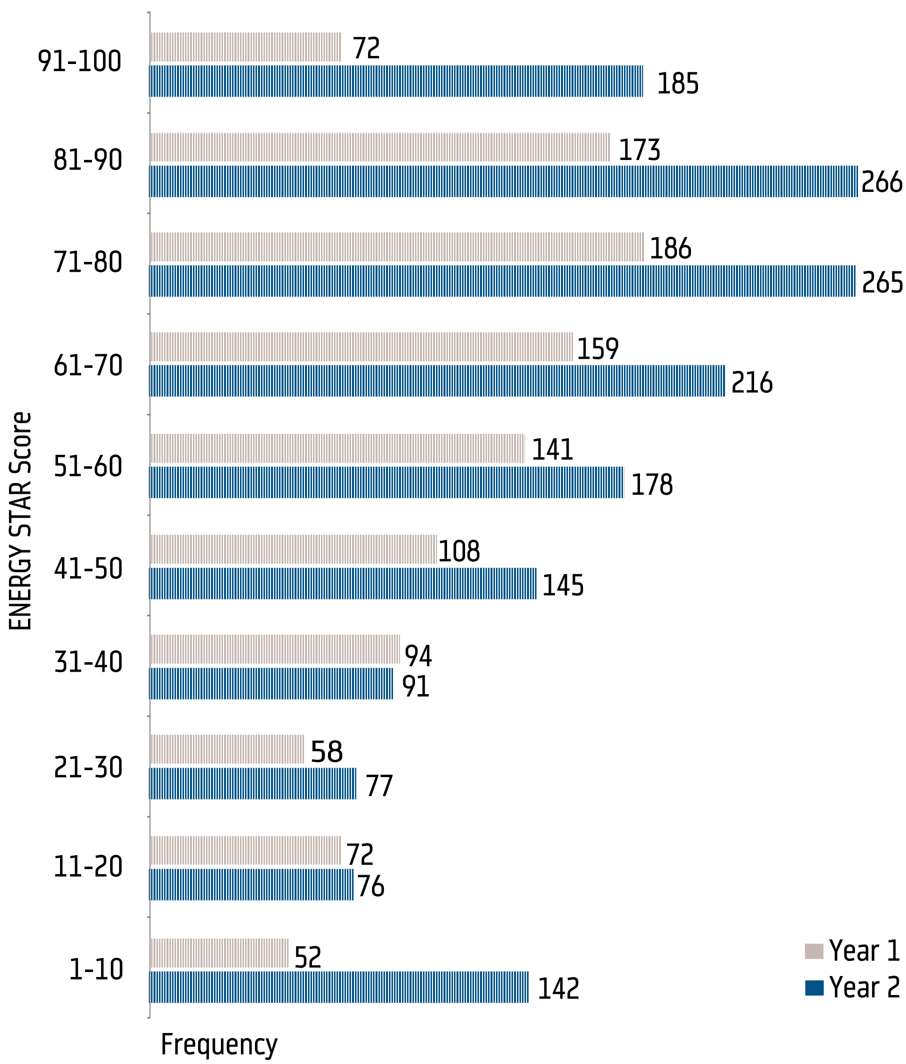


Source: New York University

ENERGY STAR

The median ENERGY STAR score for Year Two reporting increased to 67, up three points from the Year One median of 64 (Fig. 20). A comparison of ENERGY STAR scores achieved in both years shows a consistent increase in Year Two scores across all deciles except for 31-40. Notably, the most frequent scores in Year Two were between deciles 71-90, an ideal range given that buildings with scores above 75 receive ENERGY STAR certifications. Of the Year Two submittals, 25 percent were ENERGY STAR eligible buildings, up from just 20 percent of submittals in Year One. Applying the same analysis methodology as in Year One, 284 more buildings were eligible for ENERGY STAR scores in Year Two than in Year One.

[Fig. 20] **Year Over Year Deciles Comparison of ENERGY STAR Scores**



Source: University of Pennsylvania and NYC Mayor's Office

Office Case Study: 5 Penn Plaza

In 2011, 5 Penn Plaza was benchmarked with an ENERGY STAR score of 71. The data also revealed that the building was consuming a large quantity of both fuel oil and electricity. This encouraged building management to analyze the building's energy use to determine ways to lower its energy use and improve its ENERGY STAR score. Working with CodeGreen Solutions, a sustainable building solutions consulting firm based in New York City, building management initiated an American Society of Heating Refrigerating and Air-Conditioning Engineers (ASHRAE) Level 2 energy audit and retro-commissioning of the building's systems, which identified both large capital improvements and lower cost items to improve building performance. The building management immediately began to implement the lower cost items such as upgrading common area lighting, installing occupancy sensors in all base building restrooms, putting timers on each floor's electric hot water heater to prevent excess usage during periods of vacancy, installing pipe insulation on a large hot water tank (which was previously bare), installing a boiler efficiency module and installing efficient lighting and occupancy sensors during the fit-out of a new full floor tenant.

As a result of these improvements, the building's ENERGY STAR score increased to 75 in early 2012, and the building received an ENERGY STAR Certification from EPA. As of early 2013, the score is at 77, and the building recently achieved LEED Silver certification for Existing Buildings, Operations & Maintenance (LEED-EBOM). Additional changes include a five percent decrease in source EUI, a reduction of electricity use by two percent, and a 25 percent reduction in consumption of heating oil No. 4.

77
ENERGY STAR score as of early 2013

25%
reduction in fuel oil consumption

5%
decrease in source EUI

"Benchmarking our building proved to be highly beneficial as it identified the need for further investigation of our energy usage. Furthermore, the continual benchmarking helped us demonstrate that the implemented energy improvements at the building have resulted in an increase in our ENERGY STAR score."

- Abe Ramadan
Building Manager, 5 Penn Plaza

Multifamily Case Study: 250 Cabrini Boulevard

While many buildings install advanced boiler control panels, 250 Cabrini Boulevard, a seventy-seven unit coop, decided to fix the real issue: the steam distribution piping. This pre-war building is heated by a two-pipe steam distribution system, and experienced classic overheating and comfort issues. The coop board and Century Management hired Steven Winter Associates, Inc., a New York City full-service building consulting firm, to design and commission a comprehensive heating system upgrade. After conducting an ASHRAE Level 2 energy audit, the building added equipment and air vents to improve the steam distribution, inserted radiant barriers behind every radiator to reflect more of the heat into the building, and coupled the changes with a new boiler control and sensors that respond to interior apartment and outdoor temperatures.

The building now saves approximately $11,000 per year in operating expenses, and has reduced maintenance costs due to eliminating the need for nearly all of the steam traps that remove condensation without loss of steam. Residents now enjoy greater comfort, and the coop is expected to comply early with LL87 by building off these efforts. The second year of benchmarking data, which includes only a few months of usage after the upgrades, shows a six percent reduction in fuel oil consumption. Current data shows further reductions in fuel oil consumption (15 percent), leading to a 21 percent decrease in heating fuel usage over the entire 2011-2012 heating season, and a nine percent decrease in source EUI.

$11,000

saved in operating costs per year

15%

reduction in fuel oil consumption

9%

decrease in source EUI

“We can now easily monitor the aggregate temperatures of interior apartments by use of wireless sensors strategically placed within the property. Based on this empirical data, the boiler automatically adjusts its steam output. This function drastically reduces the guess work and outside temperature anticipation. From these sensors and our own careful monitoring, we can see the results of decreased energy use and fuel consumption in the benchmarking data.”

- Jacob Sirotkin
Property Manager, 250 Carbrini Blvd

Factors that Contribute to Energy Consumption


Credit: New York City Economic Development Corporation

Factors that Contribute to Energy Consumption

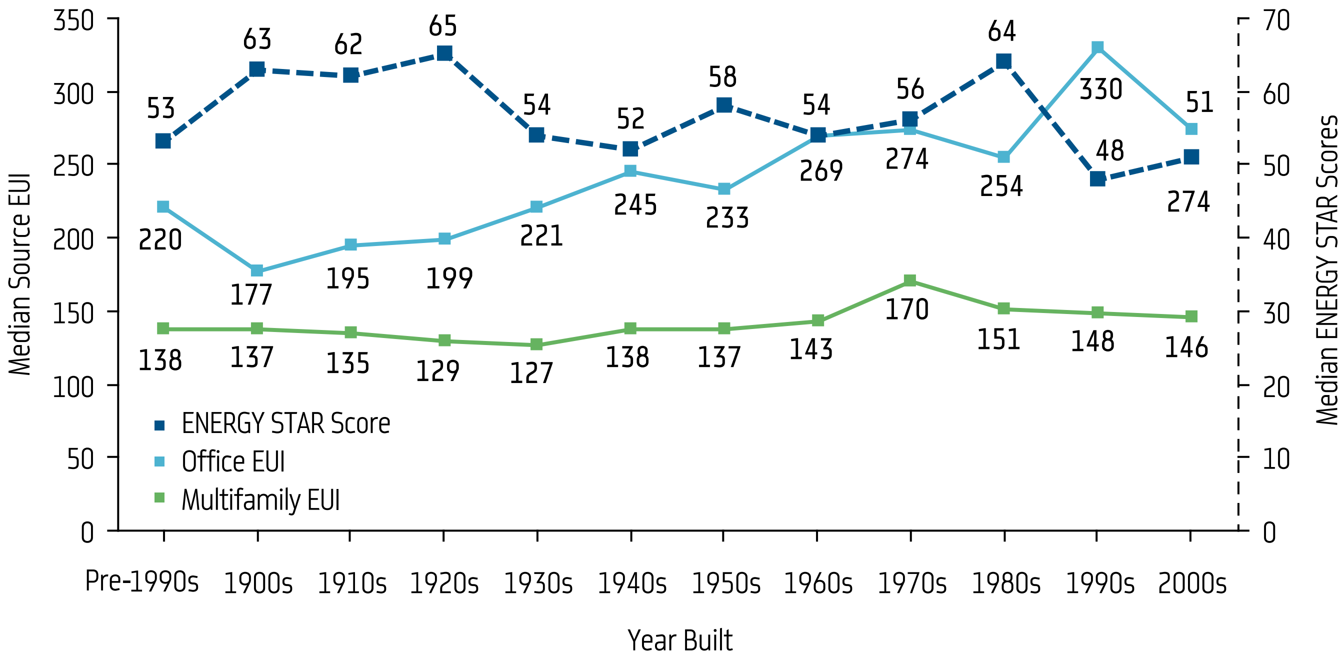
Benchmarking data not only allows for measurement of energy use, but also provides data to identify potential factors that contribute to energy consumption, such as the year of construction, building sector, geographic distribution, use of space within the property, and fuel source. When viewed in aggregate through these filters, trends emerge that validate certain assumptions made in the 2012 report about how energy is used, while eliciting new questions to guide policy forward.

Age and Energy Use

Multifamily and office properties both show trends in energy use per square foot in relation to their age when viewed by decade from the turn of the 20th century to present. Multifamily properties built in the first three decades of the 1900s reveal nearly identical energy consumption levels, with slight declines for each decade, and the lowest consumption levels in properties constructed in the 1930s (Fig. 21). The general trend shows an increase in median source EUI from mid-century with the sharpest spike seen with buildings built in the 1970s. A decline in consumption intensity is seen again with properties built between the 1980s to the present, comparable to 1960s levels. Further analysis of building envelopes and fuel consumption systems, particularly during the 1970s, will elucidate the sources of these emerging patterns. Data collection of the specifics of envelope and equipment will be necessary to conduct such analysis.

EUIs within the multifamily sector are fairly consistent, irrespective of the era built. The most significant increase in median EUIs for the multifamily sector occurs in properties constructed in the 1970s. This increase is accompanied by a sharp decrease in built gross floor area of covered buildings from this decade, suggesting that

[Fig. 21] **Median Source EUI and ENERGY STAR Scores by Building Sector and Built Year**



Source: New York University and NYC Mayor's Office

properties from the 1970s are using energy at higher rates on a per area basis. By identifying these correlations for further analysis, a more targeted policy approach for specific building types can be formed to achieve energy efficiency gains within specific sectors that will yield greater reductions in overall energy use.

Office properties display more fluctuation in the median EUI when looking at property age than the multifamily sector, with a general trend of more significant increases in EUI in newer properties. The doubling of built area constructed at the turn of the last century through the 1920s coincides with slight increases in EUI and also increases in ENERGY STAR scores. The office buildings built in the 1930s exhibit a downward turn of ENERGY STAR scores with jumps in median EUI, coincident with sharp decreases in total built area. Similarly, buildings constructed in the 1990s display a sharp increase in median energy use per sq ft while total gross floor area sharply decreases as compared to previous decades. These observations warrant further investigation to uncover the factors that are likely contributing to these trends. Beginning in the 1990s, significant behavioral and operational changes began to take effect in office space utilization. Office properties exhibited a sharp increase in median EUI and for the first time in a century had a median ENERGY STAR score below the national median. Employee densification over large, continuous, column-free floors and heavy computational loads began to typify how office spaces are now built and occupied in more recently constructed commercial spaces. The same factors, however, cannot explain the correlations between increases in EUI and decreases in total built area during the 1930s. Instead, analysis of the types of commercial spaces that were in demand beginning in the post-Great Depression 1930s and 1940s and the ways those same spaces are utilized today can uncover the reasons for these trends and identify potentials for energy efficiency gains.

Office buildings built in the 1990s show the highest median EUI as well as the lowest median ENERGY STAR score. Meanwhile the office buildings constructed in the first decade of the 1900s reveal the lowest average EUI mean and the third highest ENERGY STAR scores. The data alone would suggest that the office buildings constructed in the last 30 years are performing at much lower efficiency levels, perhaps due to the preference for glass curtain wall versus the earlier 20th century buildings with masonry walls and fewer windows, though such an assumption cannot be confirmed without additional specific information about the building envelopes and mechanical systems. Further analysis of the construction methodologies and specific office uses correlated with the age of the building will identify specific targets for energy conservation campaigns.

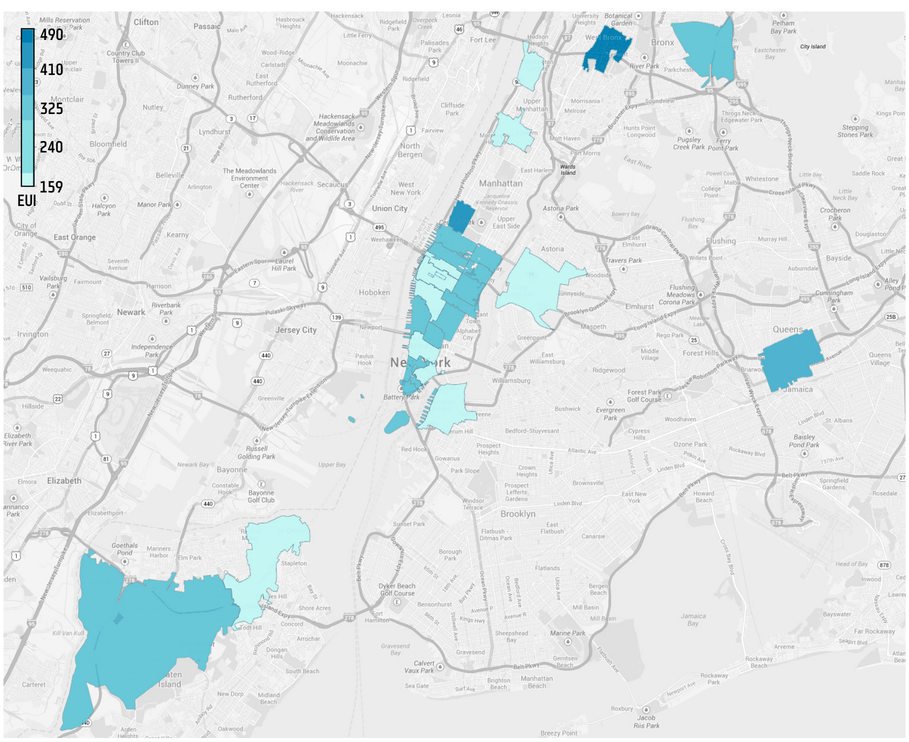
Geographic Distribution

At a building lot specific level, office and multifamily use mapped data shows higher EUIs in specific neighborhoods such as the commercial districts of midtown and lower Manhattan as well as multifamily neighborhoods throughout the five boroughs. However, more refined information is needed before drawing any conclusive causal relationships. Note that large lots on the maps showing lot level EUI ranges are more visible due to their size than smaller buildings. Thus, these maps are useful for analyzing EUI composition among lots and very small neighborhoods, but is less effective at showing potential patterns at larger spatial scales.

Median Office EUIs

When analyzed at the scale of zip codes, the offices with the ten highest median EUIs and those with the ten lowest median EUIs are nearly all located in Manhattan, reflecting the borough's high density of office buildings (Fig. 22). The highest and lowest EUI zip codes are often in close proximity or adjacent to one another on the map, thus making it challenging to draw further conclusions about the impact of geographic distribution on EUIs in the office sector without additional information. Zip codes with high median EUIs also tended to have a larger median building area in square feet. Additional information and analysis is needed in order to shed light on any causal relationships between building office building size, EUI, and geographic location.

[Fig. 22] **Geographic Distribution of Median Office EUI**

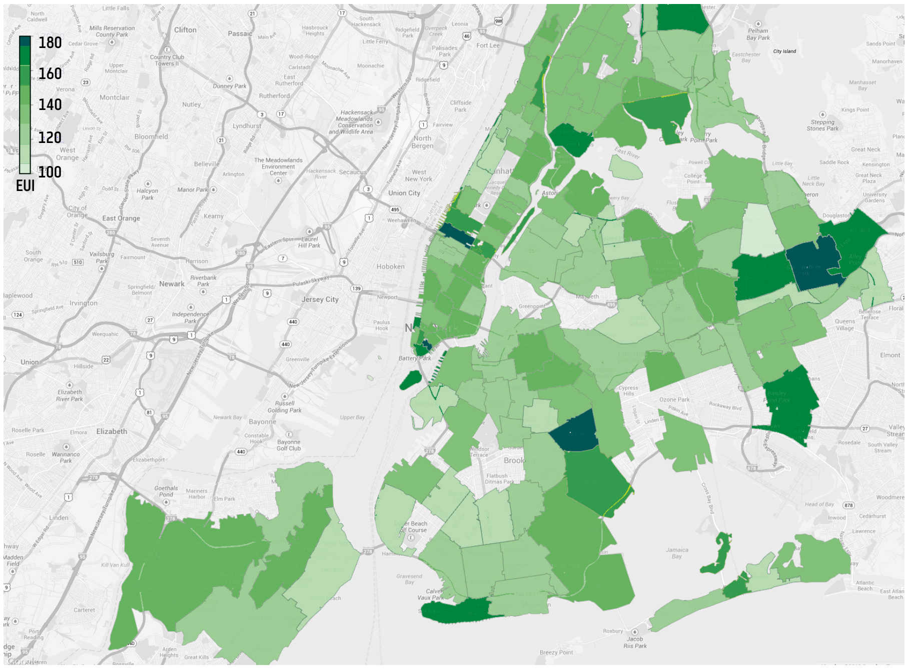


Source: New York University

Median Multifamily EUIs

The zip codes with the ten highest median multifamily building EUIs (Fig. 23) tend to have higher median household incomes and larger median floor areas than the neighborhoods with the ten lowest median multifamily EUIs. There are some notable outliers, however, and therefore more research and analysis—especially with additional data from the third year of benchmarking—may shed

[Fig. 23] **Geogrpahic Distribution of Median Multifamily EUI**



Source: New York University

light on these patterns and potential relationships among geographic location, EUI, income, and building size.

Subsidized and Unsubsidized Housing

Based on the similarity of the boxplots in the graph below, there is no conclusive substantial difference between the source EUIs for subsidized and unsubsidized housing (Fig. 24); though this observation must be tempered by acknowledging potential inaccuracies in the way classification as subsidized housing was reported. Subsidized as defined in Portfolio Manager is a property that receives some type of local, state, or federal affordable housing subsidy for some or all units.[20] Continued observation of this comparison is necessary to substantiate the hypothesis that publicly assisted housing status has no bearing on the energy efficiency of multifamily properties.

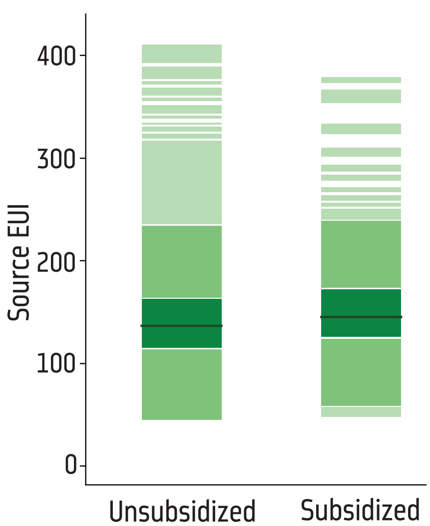
Age and Fuel Mix

The combination of fuels used within buildings vary by sector and age. For example, electricity and district steam use comprises a smaller proportion of energy use in multifamily buildings. In contrast, multifamily buildings use more fuel oil in relation to other energy sources, and the proportion of natural gas derived energy used in multifamily buildings is far greater than in office buildings (Fig. 25).

Natural gas dominates the energy portfolios of multifamily buildings constructed after 1930, accounting for 40-57 percent of the energy portfolios of the buildings built during this period. Multifamily buildings from the 1990s to present rely almost exclusively on natural gas and electricity for their energy needs (roughly 60 percent natural gas and 40 percent electricity), while older buildings use higher proportions of fuel oil (25-52 percent). With Local Law 43 set to phase out the use of the dirtiest fuel oil, such energy sources will play a smaller and smaller role in the energy portfolios of all buildings in years to come. District steam plays a minimal role in the energy use of multifamily buildings.

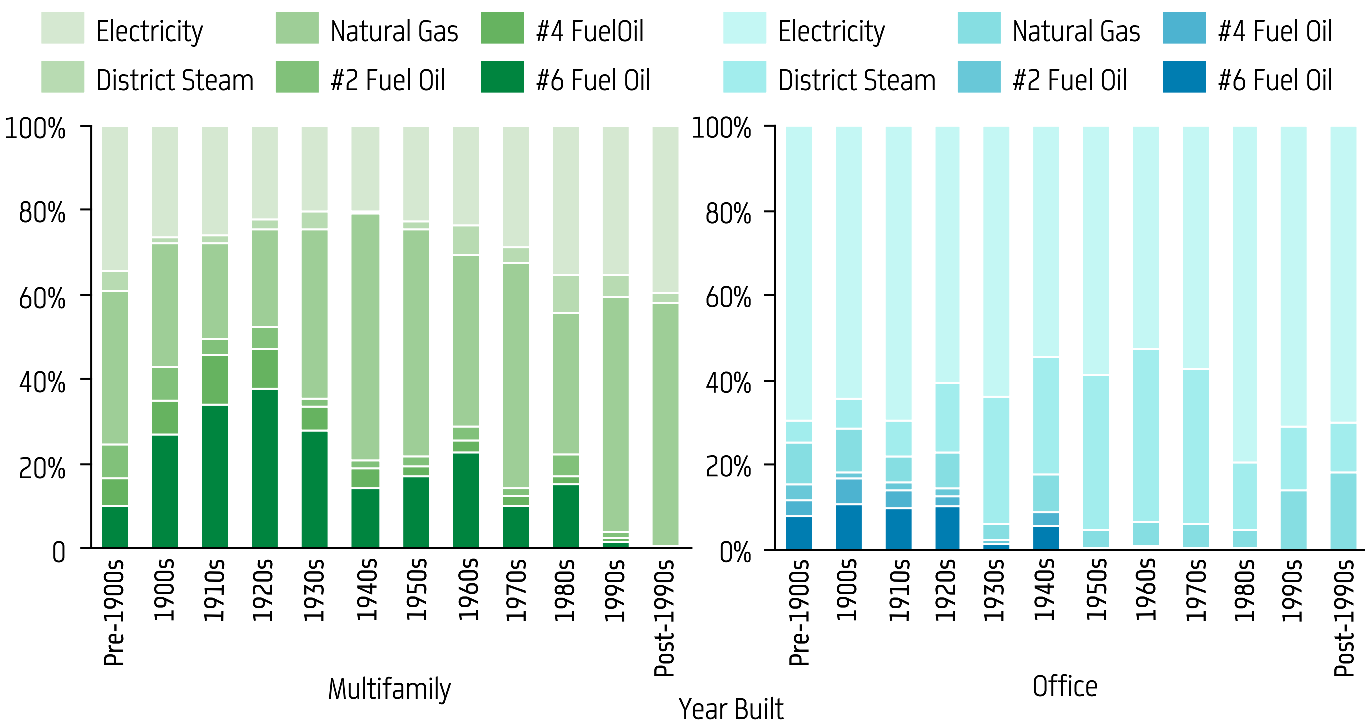
The vast majority of the energy portfolio for office buildings of all ages comes from electricity, ranging from 52-79 percent of energy use. District steam accounts for 27-39 percent of office building energy use in buildings constructed during the middle of the 20th century (1930-1980). The proportion of energy coming from fuel oil, particularly the heavily polluting fuel oils No. 5 and No. 6, is negligible in buildings constructed after 1990; however those built earlier than 1930 still rely on these fuel oils for roughly 10 percent of their energy consumption.

[Fig. 24] **Boxplot of Source EUI by Unsubsidized and Subsidized Housing**



Source: New York University

[Fig. 25] **Multifamily and Office Energy Mix by Year Built**



Source: New York University and NYC Mayor's Office

Water Use

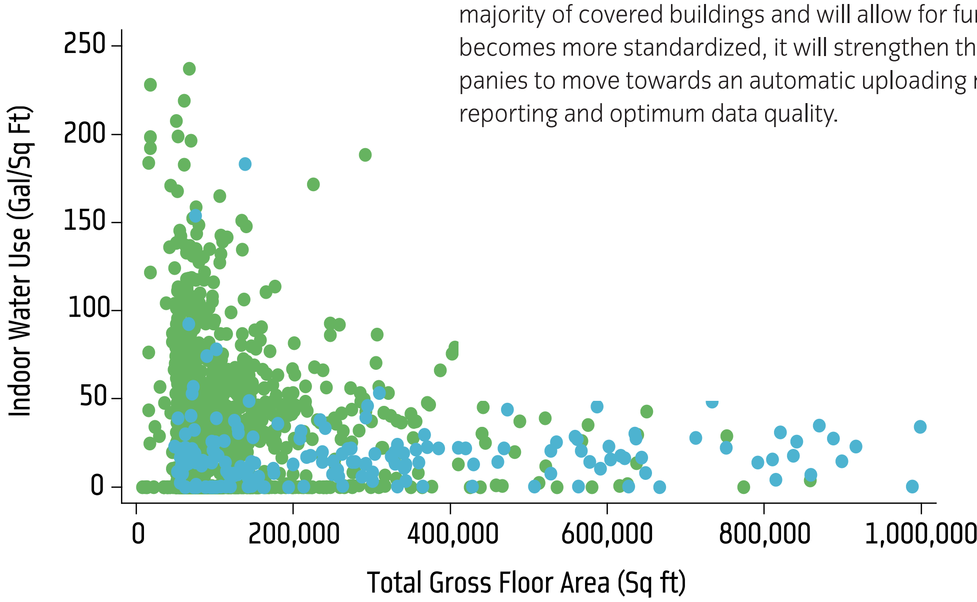
LL84 requires benchmarking of water use for buildings over 50,000 sq ft, but only after such buildings have been equipped with Automatic Meter Reading (AMR) equipment by DEP for the entire calendar year being benchmarked. DEP's AMR system provides water use information in hourly data intervals, graphically display data, and offer leak notification alerts to building owners based on abnormal spikes in water consumption. Under LL84, building owners must request DEP to automatically upload the water data of covered buildings into the benchmarking tool.

By the end of 2011, DEP's aggressive frontage meter swap campaign resulted in the installation of over 820,000 AMRs. Of this total, approximately 6,000, or 45 percent of LL84 covered buildings were eligible to benchmark their 2011 water use using DEP's Automated Benchmarking System (ABS). Although the ABS was not required for Year Two LL84 compliance, the City strongly encouraged owners of covered buildings to report 2011 water use water via automatic upload or manual entry. Only one percent of AMR-eligible properties successfully utilized the ABS request to automatically upload water use data, and approximately eight percent of the total LL84 covered buildings manually entered their water use, resulting in approximately 1,100 LL84 covered buildings submitting water data for calendar year 2011.

The multifamily sector is the greatest contributing sector to the water use data set, and also has the highest average water use per square foot. The data set shows that the multifamily sector has a wide range of water consumption across buildings of similar size (Fig. 26). In contrast, water use per sq ft for the office sector remains relatively constant irrespective of building size. Identifying abnormal usage through the installation of AMR technology can allow DEP to target water conservation campaigns, particularly in the multifamily buildings that exhibit such a wide variance of use amongst similarly sized buildings.

As this number of AMRs in covered buildings increases, water reporting data quality will also improve; the data reported in 2013 will include water use for the vast majority of covered buildings and will allow for further analysis. As water uploading becomes more standardized, it will strengthen the case for the energy utility companies to move towards an automatic uploading methodology for more fluid energy reporting and optimum data quality.

[Fig. 26] **Multifamily and Office Water Use**



Source: New York University and NYC Mayor's Office

Local Law 84 Compliance

75%

of properties required to benchmark met compliance in Year Two

Local Law 84 compliance for private sector properties is verified by DOF through a process of matching information from DOF's tax lot database with corresponding information gathered from building owners' submittals. Comparative analysis of compliance data shows that the number of submittals was higher in Year Two than in Year One. In Year Two, building owners surpassed the 64 percent compliance mark by May 1, 2012, achieving 67 percent compliance, and met the same 75 percent compliance rate by August 1, 2012.

Compliance by Borough

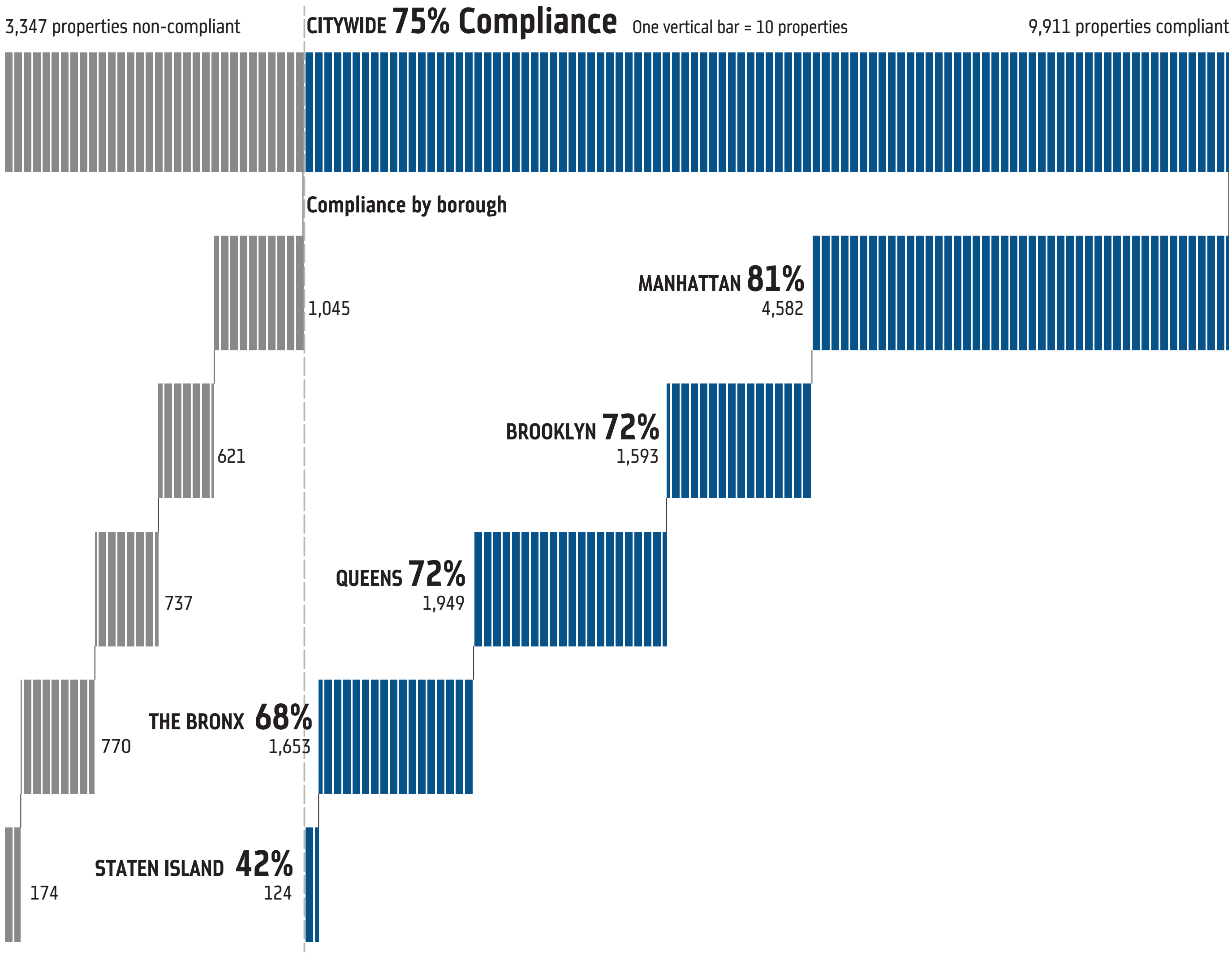
The result of Year Two benchmarking compliance by borough is very similar to Year One results (Fig. 27). The boroughs that have the most covered buildings tend to have higher compliance rates; Manhattan has the most covered buildings and the highest compliance at 81 percent. Conversely, the borough with the fewest covered buildings, Staten Island, has the lowest compliance rate at 42 percent.

Compliance by Sector

Of the three sectors emphasized in this report, the multifamily sector has the highest compliance rate at 81 percent (Fig. 28). The high compliance rates in the multifamily and office sectors drive the overall LL84 compliance rate, which has remained strong at 75 percent in Year Two.

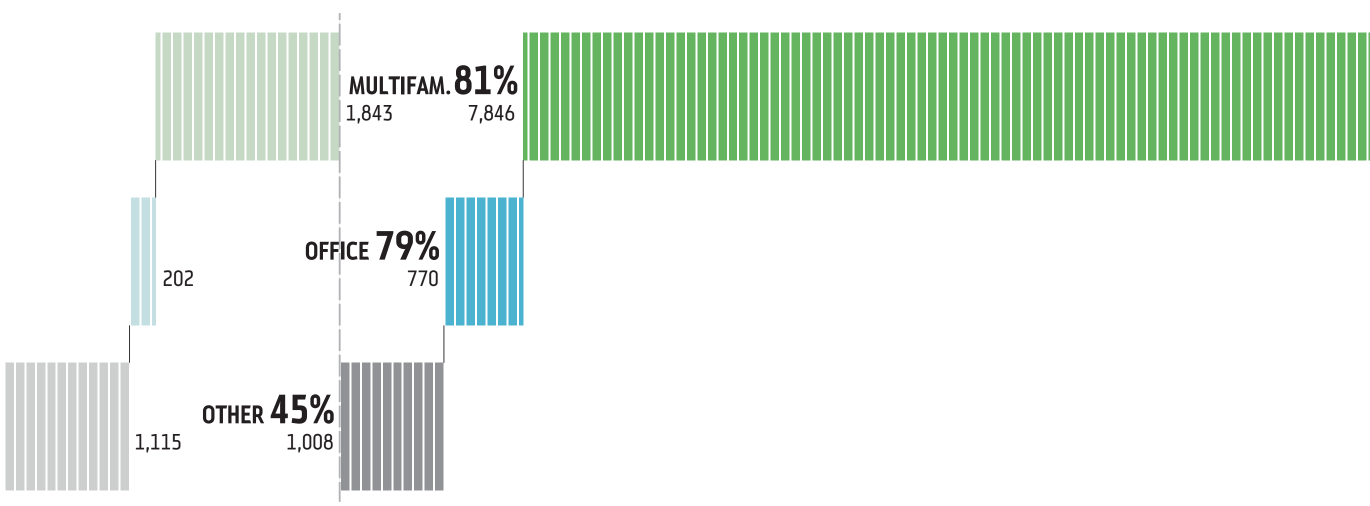
Understanding compliance rate by sector has the potential to improve the efficacy of outreach strategies and enable strategic targeting of sectors with low compliance rates. Examining the compliance data in greater detail, particularly within the other properties sector could yield significant insight to drive effective outreach efforts.

[Fig. 27] **Number of Compliant Properties and Rates by Borough**



Source: NYC Mayor's Office

[Fig. 28] **Number of Compliant Properties and Rates by Sector**



Source: NYC Mayor's Office

Compliance by Gross Floor Area

In Year Two, 74 percent of the gross floor area on the covered buildings list was in compliance with LL84; this is consistent with the 75 percent compliance rate described above. The multifamily sector shows a higher compliance rate by gross floor area than the number of properties that complied (85 percent versus 81 percent, respectively). Conversely, “other” properties show an overall 40 percent compliance rate for gross floor area despite a 45 percent compliance rate by number of properties (Fig. 29).

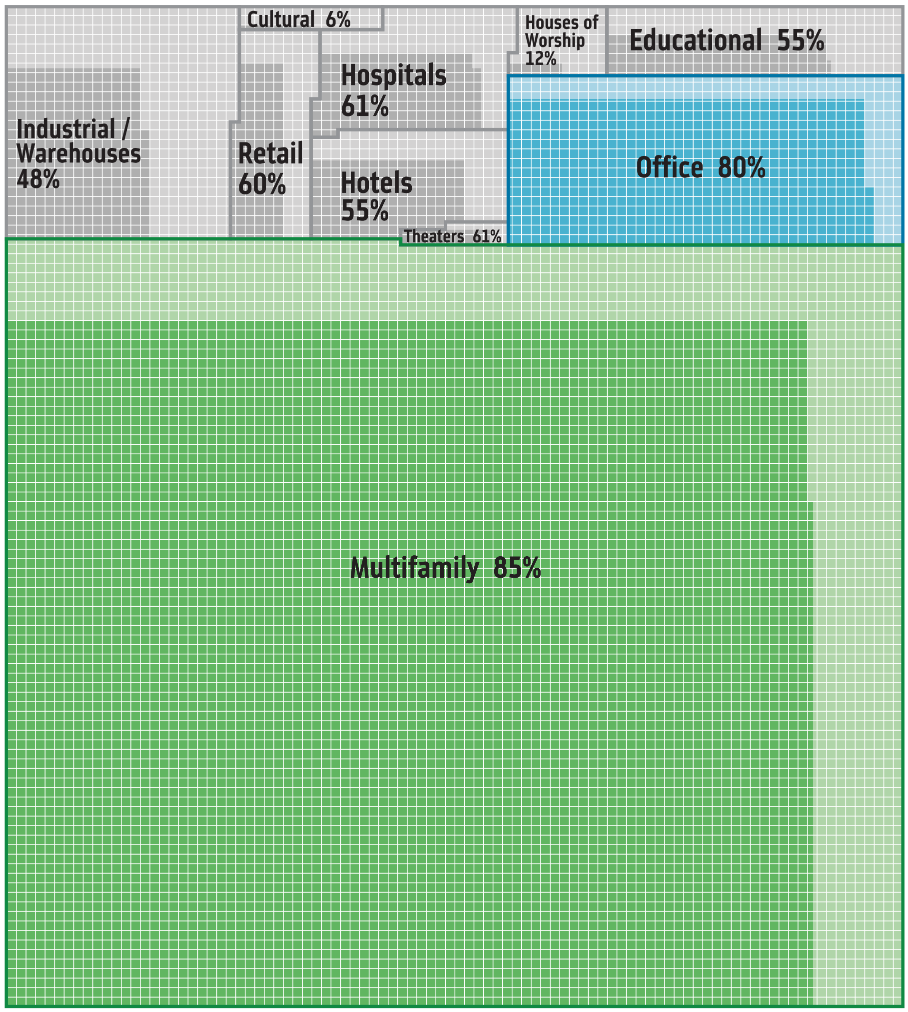
[Fig. 29] **Compliance by Sector Gross Floor Area**

74%

gross floor area that achieved compliance in Year Two

1,668,232,620

square feet of gross floor area that achieved compliance in Year Two



□ = 250,000 sq. ft.

Source: NYC Mayor’s Office

Compliance by Lots with Multiple Buildings

The building stock in New York City is complex, and there are a fair number of buildings that share systems and/or reside together on a single lot. Of the covered buildings, 12 percent have multiple buildings that together total 100,000 sq ft or more, and the remaining 88 percent have a single building of 50,000 sq ft or larger. Compliance rates among properties with multiple buildings increased to 70 percent, and lots containing a single building achieved 75 percent compliance. Easy access to building level data will help improve compliance in both groups and improve the accuracy of benchmarking results.

Following the first public disclosure of non-residential buildings in September of 2012, it is now easier for the public to see which buildings are in compliance. With residential buildings' benchmarking data scheduled to be disclosed starting in 2013, the compliance status of all covered buildings will be available online and easier to identify, which may impact future compliance rates.

Outreach

Outreach efforts were instrumental in achieving high compliance in a relatively short period of time in Year Two. For example, the Mayor's Office coordinated closely with utility companies, Consolidated Edison, Inc. (Con Edison) and National Grid, to improve both the quality of the whole building aggregated energy and water information they provided to building owners, and the payment process for requesting data. Live, one-on-one support of the Benchmarking Help Center also provided call-center assistance to building owners. The Association of Energy Affordability (AEA), with support from the New York State Energy Research and Development Authority (NYSERDA), provided additional resources such as a free online training, and the Urban Green Council (the New York Chapter of the U.S. Green Building Council) offered presentations and free online publications.

The City also developed numerous outreach materials in addition to conducting both broad and targeted outreach. For example, the Mayor's Office developed several online guidance documents that covered topics such as benchmarking for the first time, a refresher for building owners benchmarking for the second time, instructions for generating a compliance report and submitting documents to the City, water benchmarking tutorials, and the latest LL84 news and information. Other agencies also provided benchmarking information on their respective websites. Additionally, the Mayor's Office sent out a GGBP email digest to a growing list of over 500 subscribers on a regular basis to circulate timely announcements and reminders.

In Year One, the City identified consulting firms that benchmarked a significant number of covered buildings. The City worked with these stakeholders to improve data quality by providing feedback on accurate reporting; further details on this process can be found in Appendix A: Data Accuracy. The City also worked with universities and hospitals participating in the Mayor's Carbon Challenge, a voluntary carbon reduction program with participants pledging to reduce GHG emissions by 30 percent in 10 years.

The Benchmarking Help Center

Recognizing the importance of one-on-one support for building owners to navigate the Portfolio Manager website, submit accurate data and comply with LL84, the City partnered with NYSERDA to launch the Benchmarking Help Center in April 2011. Staffed by City University of New York (CUNY) Building Performance Lab undergraduate students, the Benchmarking Help Center receives calls from building owners about specific benchmarking concerns. The Center answered calls for several months leading up to the benchmarking deadline in both years, and continues to field benchmarking questions related to LL84. The success of the help center has influenced similar outreach services in Washington, D.C. and Seattle, and is continually evaluated as a model by other cities with benchmarking requirements, such as Minneapolis, Philadelphia, and Boston.

Policy Recommendations

Changes to the City's Local Law and Rule

The Year One report identified potential modifications to LL84 and the accompanying administrative rules. The City began the process of exploring these options and was working towards the modifications prior to Superstorm Sandy in late 2012. Given the large disruption, the law and rule amendments were postponed. The Mayor's Office proposes the following recommendations with respect to legislation:

Due Date. Building owners have been largely successful in meeting the May 1 deadline, and thus to be consistent every year and avoid confusion among building owners, the Mayor's Office no longer recommends changing the May 1 deadline.

Tenant Letter. When LL84 was initially signed into law, Con Edison and National Grid were not providing aggregated whole building energy data. Therefore, the law included a provision requiring owners to request this information from separately metered commercial tenants. However, since LL84 went into effect, both companies have made aggregated whole building data available. Consequently, sending the letter to tenants is now an unnecessary burden. The Mayor's Office will remove this requirement from the law.

Multiple Buildings on Multiple Tax Lots. The administrative rules of LL84 allow for individual lots that share building systems to report information separately. However, the administrative rules will also be formally amended to allow for buildings on different lots sharing the same energy systems to be benchmarked together. This practice is currently accepted to demonstrate compliance so long as the multiple lots are properly accounted for when submitting through Portfolio Manager. Continued flexibility in reporting can make compliance easier for owners of buildings with shared systems, either on the same lot or on different lots, and can improve data accuracy.

Improving Access to Accurate Information

Automated Meter Reading Equipment. DEP continues to install AMRs on an increasing number of buildings, and automatic uploads of the data expands the wealth of information. Con Edison, National Grid, and DEP have all been engaging partners in providing information. The City will correct the administrative errors encountered in the water use reporting and will directly engage the electric and gas utilities to provide an automatic data upload framework to make energy benchmarking reporting easier for property owners.

Accurate Gross Floor Area. The acquisition of accurate gross floor area measurements continues to elude both the building owners and municipal entities. The gross floor area reported in the DOF database often does not include sub-grade floor areas, so the reported area could be as much as 10 percent less than the gross floor area as defined in Portfolio Manager. To accurately obtain a property's gross floor area, the owner must measure the building(s) or calculate from floor plans. The lack of accuracy is exacerbated by a lack of a standardized measurement methodology. As the City begins to implement LL87 in 2013, the professionals conducting the energy audits will capture more accurate gross floor area data that can eventually be merged with the benchmarking data; this will be an incremental process because only a fraction of all buildings undergo energy auditing in a given year. A standard practice guideline for measuring gross floor area will be developed to aid the administration of LL87 to ensure accurate depictions of building size.

Education to Real Estate Professionals. Real estate professionals such as brokers and appraisers who understand benchmarking information can apply it in their practices. There is an inherent economic value in energy efficiency, and a building's energy consumption can be a critical factor in purchasing, renting, and management decisions. The City will provide training and education to this professional sector. A deeper understanding of energy performance in the market will influence purchasing decisions and operational behaviors that can lead to more energy efficient utilization of real estate.

Coordinating Building Identification

Upgrading Portfolio Manager. To help with tracking for compliance, EPA created the Unique Building Identifier (UBI) field in response to the requests from cities using Portfolio Manager for mandatory benchmarking. This scenario is not necessarily ideal for building owners in New York City as it complicates the reporting process and creates opportunities for clerical errors. However, the larger goal is to closely align New York City's reporting process with Portfolio Manager and to contribute to a national database of building energy performance. New York City at present contributes the largest share of the national data about energy use in buildings and therefore can influence the continued evolution of Portfolio Manager. However, this influence must be tempered by the larger goal of maintaining a reporting scheme that is accessible to as many U.S. cities as possible, many of which have underlying incompatibilities in data formats. The City will develop with EPA future iterations of Portfolio Manager that meet the localized needs of cities across the nation without compromising the reliability of a common national database.

Improving upon Benchmarking Reporting

Expanding ENERGY STAR Scoring to Multifamily Properties. EPA has entered into a partnership with Fannie Mae Multifamily Mortgage Business to help multifamily property owners and managers reduce energy consumption and costs and increase the affordability, sustainability, and quality of their properties. Through this partnership, Fannie Mae and EPA are working together toward the development of a national ENERGY STAR building performance scale, which will enable multifamily property owners and managers to compare their energy performance with similar properties nationwide, accounting for differences in weather and building and operational characteristics. The Mayor's Office will support EPA and industry stakeholders as they work to release an ENERGY STAR performance score for multifamily properties.

Properly Accounting for High Density and High Energy Space Types. High intensity energy uses such as data centers, trading floors, and television studios that exceed 10 percent of the floor area are exempt from the disclosure requirement. These particular high intensity uses are powerful generators of economic activity, and any policy that disadvantages such uses could render New York City less competitive in attracting businesses and a highly skilled workforce. Yet, the energy consumed by these uses cannot continue to be ignored as they represent a sizable share of energy utilization. The Mayor's Office will study how to address these types of uses and fairly report energy consumption without unnecessarily penalizing building owners that host high densities and high energy-consuming space types that skew the perception of actual energy efficiency.

Expanding Enforcement. Data quality can be assured only through confirmation of the reports and requiring modifications of reports bearing incorrect information. The City will provide staffing and resources to conduct enforcement audits that will improve the quality of submitted reports while also creating a culture of high quality data among the practitioners and building owners.

Creating a National Energy Efficiency Data System. The enormous data set produced by LL84 can be even more valuable when linked and coordinated with other data about buildings both locally and at a national scale. The City will link benchmarking data to the information that is forthcoming under the energy audit and retro-commissioning law of GGBP (LL87). In addition to the fields that will be publicly disclosed under LL84, New York City will make anonymous detailed data from GGBP available through the U.S. Department of Energy's (DOE) Buildings Performance Database (BPD), which includes data from other State and municipal benchmarking programs, energy efficiency incentive programs, the U.S. Energy Information Administration's CBECS and RECS datasets, the records from Portfolio Manager, and data from other Federal programs. The BPD will allow users to examine groups of similar buildings nationwide to analyze trends in building characteristics and performance, discover opportunities for improvement, and forecast project performance and risk. Other software tools can also access the BPD to run their own analyses, while the anonymity of individual records will be maintained.[21]

Other jurisdictions and entities around the nation are also collecting increasing amounts of building data. All of this data will be standardized, systematized and linked so that building owners, contractors, researchers, financiers, and other experts can universally access broad national energy data sets. The Mayor's Office, with DOE and their partners, will develop a common set of data definitions and file format, called the Building Energy Data Exchange Specification (BEDES) to create a standard database platform for State and local governments to merge, cleanse, track and store data from multiple sources, including Portfolio Manager, property tax assessor records, city planning databases, and audit reports.

APPENDICES

Appendix A: Data Accuracy

Data Cleaning Methodology

The data set of properties that submitted by August 1, 2012 includes 12,412 out of the 13,258 properties in the Year Two covered buildings list. Before conducting analysis, the academic partners of this report, Dr. Constantine Kontokosta of New York University (NYU) and Dr. David Hsu of the University of Pennsylvania (UPenn), developed a cleaning methodology to remove errors and improve the accuracy of the data set (Fig. 30). NYU and UPenn's cleaning process resulted in 10,059 covered lots with a combined gross floor area of 1.74 billion sq ft of space.

[Fig. 30] **Cleaning Metholdogy for Overall Data Set**

CLEANING STEPS - TOTAL DATA SET	REMOVED	PROPERTIES REMAINING
Covered Buildings List	--	13,258
Original dataset based on submittals	--	12,412
(-) Missing square footage	532	11,880
(-) Zero square footage	55	11,825
(-) Missing EUI	676	11,149
(-) Zero EUI	1	11,148
(-) Duplicates	501	10,647
(-) Duplicate ENERGY STAR IDs with individual PLUTO info	433	10,214
(-) Above 1,000 kBtu/sq ft EUI	112	10,102
(-) Below 5 kBtu/sq ft EUI	43	10,059

Source: New York University

NYU and UPenn applied further data cleaning to the multifamily and office properties. Because much of the analysis in this report is based on these two sectors that represent over 90 percent of submittals, the academic partners gave particular scrutiny to their data quality. Both NYU and UPenn spent considerable time and resources cross-referencing the dataset to come to an agreement on which data points warranted removal. In addition, a technical advisory group comprised of energy consulting firms, and EPA, gave guidance to the cleaning methodology. In developing the second level of cleaning, the academic partners spent the majority of time verifying duplicate entries such as those with identical Portfolio Manager identification numbers, reported gross floor areas, street address, building identification numbers (BINs), and/or other identifying information. The academic partners removed these in addition to duplicate entries that were missing gross floor area and or BINs.

To further clean the data, the academic partners removed outlier entries with EUIs less than the 1st percentile and those greater than the 99th percentile, removing EUIs below 33.2 and above 422.2 kBtu/sq ft for multifamily properties, and EUIs below 18.0 and above 775.3 kBtu/sq ft for office properties. NYU and UPenn's second level cleaning process resulted in 7,505 multifamily and 1,150 office properties (Fig. 31).

[Fig. 31] **Cleaning Metholdogy for Multifamily and Office Properties**

CLEANING STEPS - MULTIFAMILY	REMOVED	PROPERTIES REMAINING
(-) Buildings with zero or missing square footage or EUI	--	7,751
(-) Buildings with EUI below 5 or above 1,000 kBtu/sq ft	92	7,659
(-) Buildings below the 1st percentile and above the 99th percentile	154	7,505

CLEANING STEPS - OFFICE	REMOVED	PROPERTIES REMAINING
(-) Buildings with zero or missing square footage or EUI	--	1,191
(-) Buildings with EUI below 5 or above 1,000 kBtu/sq ft	17	1,174
(-) Buildings below the 1st percentile and above the 99th percentile	24	1,150

Source: New York University

The "other" properties data set did not have extreme outliers, and therefore did not need additional cleaning. To test this hypothesis, the Mayor's Office applied additional cleaning to the "other" properties data by removing outliers. Because the resulting mean EUI (220.5) was similar to the original mean EUI (225.6), the difference was not enough to warrant further cleaning.

Gross Floor Area Entry Errors

In addition to duplication errors in both years of reporting, the data set also contains underreporting of gross floor area. Underreporting is determined by comparing the gross floor area inputted by the building owner and the gross floor area in the covered buildings list. The City instructs building owners to rely on their own records and building blueprints to report gross floor area, not the information on the covered buildings list, which DOF uses solely as a baseline to determine if a property must comply with LL84. Using the latest records of gross floor area information, DOF updates the covered buildings list annually to track new buildings that are required to benchmark, buildings no longer required due to specific reasons, and buildings that must continue to benchmark. However, such gross floor area information potentially excludes areas such as sub-grade levels and non-rentable spaces. Omission of these areas impacts reporting of EUI, water usage, and ENERGY STAR scores, since Portfolio Manager measures these per sq ft.

When building owners underreport gross floor area by using the covered buildings list gross floor area information, their properties will appear to be less efficient with higher EUIs and water usage per sq ft, and lower ENERGY STAR scores. Analysis of the Year Two data set shows that approximately 13 percent of multifamily sector entries and seven percent of office sector entries reported gross floor areas at least five percent smaller than areas reported in Year One. Additionally, across all sectors in Year Two, approximately 20 percent of submittals reported gross floor areas at least five percent smaller than in Year One.

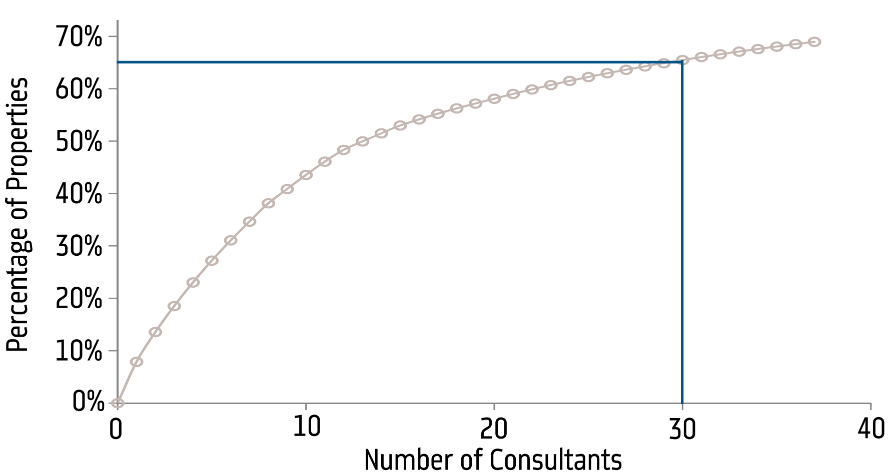
Service Provider Firms Data Analysis

Just as the City approached its energy efficiency challenges for a million buildings with a strategy for 15,000 buildings through GGBP, it also targeted a smaller group of stakeholders in order to impact a large number of buildings by engaging with service providers.

For Year Two benchmarking, about two-thirds of all submittals were handled by 30 service provider firms, similar to the number of submittals in Year One (Fig. 32). The circles represent the cumulative percentage of properties benchmarked by an increasing number of consulting firms, arranged such that the firm serving the most number of properties comes first, followed by the firm with the next largest number of properties, and so on.

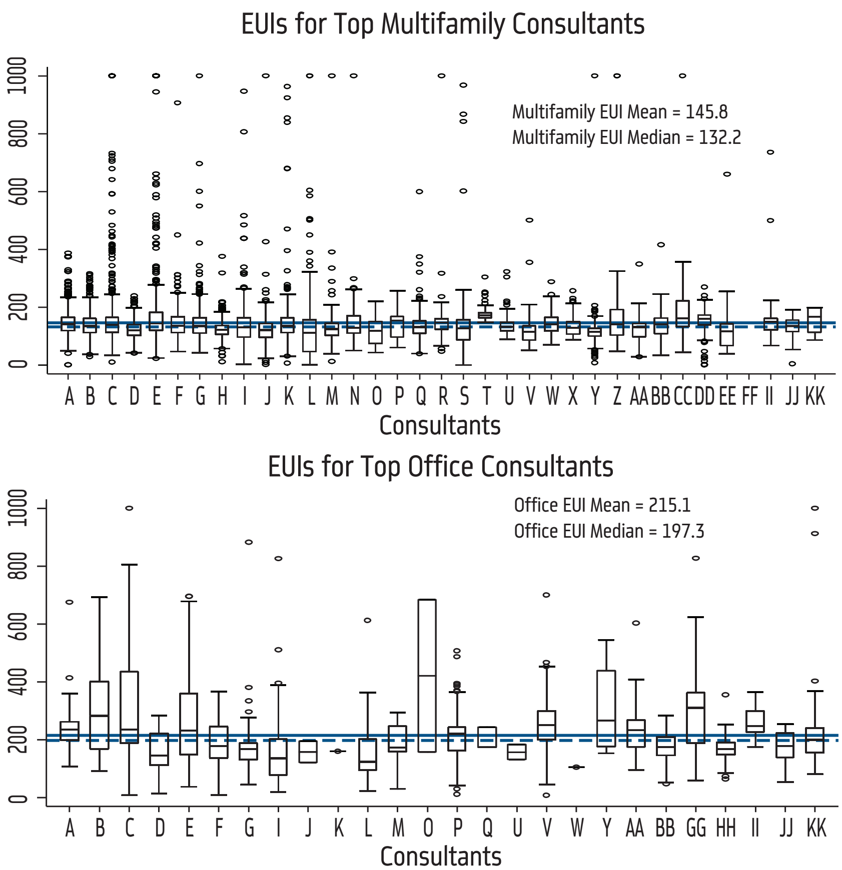
Recognizing the large scale impact of coordinating with this group of service providers, the Mayor's Office conducted analysis and outreach to facilitate improvements in data quality. Using the entries inputted by service providers, the Mayor's Office analyzed the data quality by comparing distributions of the EUIs of 35 consulting firms in a box-and-whisker chart (Fig. 33). In this chart, each column represents the rage of EUIs obtained by a specific firm. The box represents the range of source EUIs from the 25th to the 75th percentile, the interquartile range. The thick dark line within the box represents the median value of source EUIs. The whiskers go 1.5 times the interquartile range, with the circles representing the outliers. The horizontal dashed line indicates the New York City median for the subset of the respective sector. Note that the median and mean EUIs identified in the graphs correspond to the subset of consultants identified, not the overal median and mean EUIs for the entire sector.

[Fig. 32] **Percentage of Properties Benchmarked by Service Provider Firms**



Source: NYC Mayor's Office

[Fig. 33] **Distribution of Multifamily and Office EUIs by Sample Consultants**



*Consultants with > 50 submittals

Source: University of Pennsylvania and NYC Mayor's Office

From the analysis, certain firms stand out as being markedly different from the rest, potentially indicating a problem with the consultants' methodology. As an example, the median EUI for several consultants, indicated by the solid line within each respective box, may be higher or lower than the median EUI for the sample set, indicated by the dashed horizontal blue line. Additionally, the consultants may display many outliers above the whisker or below. Feedback from consultants revealed that sometimes these variations resulted from different types of buildings that each firm worked with, while others revealed incorrect methodologies.

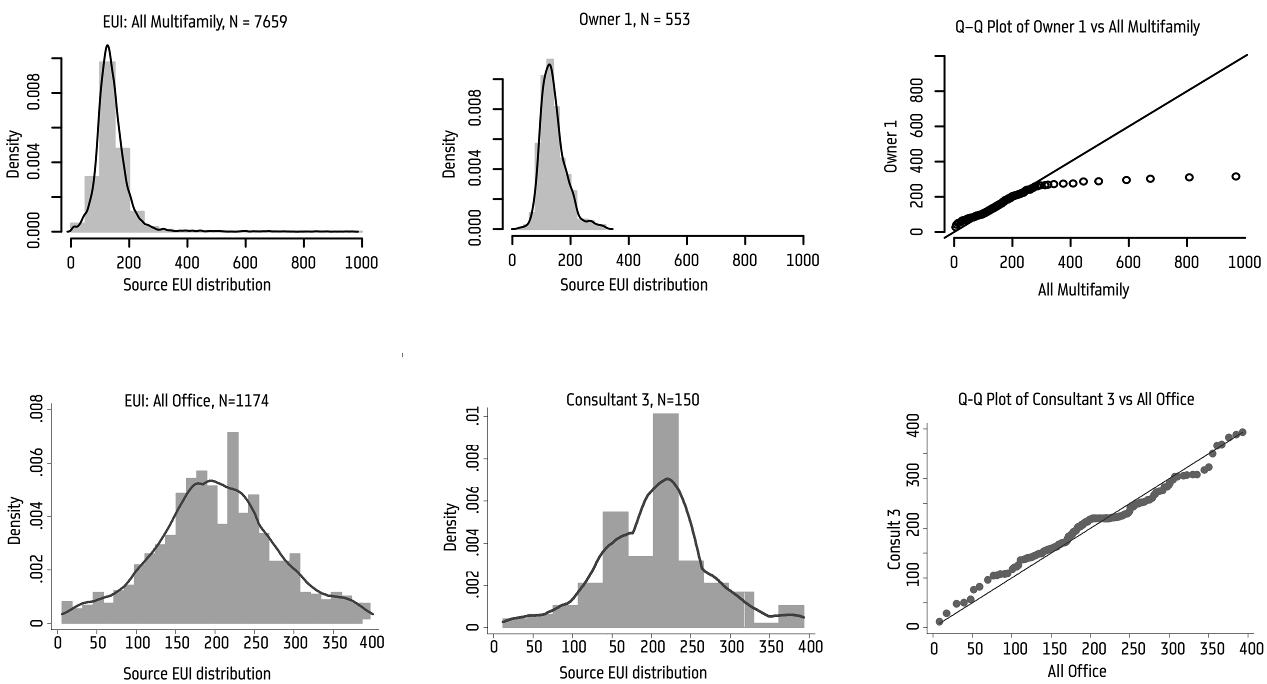
The Mayor's Office reached out to all 35 service provider firms with these graphs that served as "report cards" to help consultants conduct quality assurance checking on their benchmarking methodologies. In addition to sending these graphs, the Mayor's Office also sent consultants a breakdown of common errors by data types. The common mistakes in reporting included: zero or missing gross floor area, user entered gross floor area equal to PLUTO city database gross floor area, and missing facility type information. These led to errors including: zero or missing EUI, EUI less than 30 kBtu/sq ft or larger than 1,000 kBtu/sq ft, or an ENERGY STAR score of 1 or 100.

Comparison with Control Groups

Further analysis of comparing the EUI distribution of a sample consultant that provided a large number of submittals with relatively few entry errors allows for overall data quality assessment. The sample set was created from two data sets considered to be accurate – a building owner's and a consultant's, both of whom benchmarked and audited many properties (Fig. 34). Histograms and quantile-quantile ("Q-Q") plots were applied as general diagnostics to see how the area and source EUI samples compare to those of the general population.

Both plots show the fit between the larger database and smaller sample set. The Source EUI distribution of the sample properties are a close match to the overall office population in the beginning, and then vary towards the top. Conversely, the size distribution of the sample properties is a close match from the middle to the end of the trendline. These comparisons indicate that the samples of energy and property size data from the building owner and the consultant are distributed similarly to the general population, except for at the extreme upper and lower ends of the population distribution.

[Fig. 34] **Area and EUI comparisons between Sample Set and Multifamily Properties**



Source: University of Pennsylvania and NYC Mayor's Office

Common Problems Causing Data Inaccuracies

Multiple Service Addresses. Con Edison's data system designates a building's energy data according to a building's service address. When a building has more than one service address due to a different mailing address or building systems shared across mulitple buildings on a lot, the building's energy data is disaggregated among all the building's service addresses. Therefore, reported data may have been incomplete if building owners did not include all service addresses in the aggregated data request to Con Edison.

Under-reporting of Gross Floor Area. As in Year One, many building owners used the gross floor area figures in the covered buildings list. This leads to underreporting true gross floor area, since DOF's data does not include information on sub-grade levels.

The 24-Hour Waiting Period. As in Year One of benchmarking, Portfolio Manager did not have automatic uploading, thus requiring a 24-hour waiting period[22] for any changes to be reflected in the inputted data. Because of this, many last minute entries received by the City by the benchmarking deadline did not have the final data, and resulted in forms with inaccurate energy profile information, BBL numbers, gross floor area, etc.

Multiple Buildings on Multiple Lots that Share Systems (i.e. campus reporting). One of the ways New York City distinguishes itself is in the placement of its building stock on tax lots. Multiple buildings on a single lot commonly occur, as well as multiple buildings that span several lots. These properties often share base building systems, such a co-generation facilities or boilers. Due to the complexity of these building arrangements and the simplicity of reporting functionality in Portfolio Manager, these properties can be challenging to benchmark. As observed in Year One, not all users in Year Two properly utilized the pro-rating methodology as specified in the rule. Users often allocated all gross floor area and energy usage to a single property, while assigning zero gross floor area and energy to other shared buildings. Not only was the procedure not aligned with EPA protocols, it also resulted in much of the data being removed as outliers during data scrubbing.

Appendix B: Definitions

Entities:

AEA – Association of Energy Affordability

AEE-NY – New York Chapter of the Association of Energy Engineers

ASHRAE – American Society of Heating, Refrigerating and Air-Conditioning Engineers

BPL – City University of New York Building Performance Lab

BOMA/NY – New York Chapter of the Building Owners and Managers Association

Con Edison – Consolidated Edison, Inc.

CUNY – City University of New York

DCAS – New York City Department of Citywide Administrative Services

DCP – New York City Department of City Planning

DEP – New York City Department of Environmental Protection

DOB – New York City Department of Buildings

DOE EIA – United States Department of Energy's Energy Information Administration

DOF – New York City Department of Finance

EPA – United States Environmental Protection Agency

IMT – Institute for Market Transformation

NYCEEC – New York City Energy Efficiency Corporation

NYECC – New York Energy Consumers Council, Inc.

NYSERDA – New York State Energy Research and Development Authority

NYU – New York University

REBNY – Real Estate Board of New York

The City – The City of New York, city government

The Mayor's Office – New York City Mayor's Office of Long-Term Planning and Sustainability

UPenn – University of Pennsylvania

Acronyms:

ABS – Automated Benchmarking System

AMR – Automatic Meter Reading

BBL – borough, block, and lot number

BEDES – Building Energy Data Exchange Specification

BIN – building identification number

BIS – Building Information System

CBECS – Commercial Building Energy Consumption Survey

eGRID – New York City's EPA Emissions & Generation Resource Integrated Database

EUI – energy use intensity

GGBP – Greener, Greater Buildings Plan

GHG – greenhouse gas

kBtu – one thousand British thermal units

LEED – Leadership in Energy and Environmental Design

LIDAR – Light Detection and Ranging

LL84 – Local Law 84: Benchmarking

LL85 – Local Law 85: New York City Energy Conservation Code

LL87 – Local Law 87: Audits & Retro-commissioning

LL88 – Local Law 88: Lighting & Sub-metering

NYCECC – New York City Energy Conservation Code

Q-Q – Quantile-Quantile plot

PLUTO – NYC Primary Land Use Tax Lot Output Database

RECS – Residential Energy Consumption Survey

sq ft – square feet

TBtu – tera British thermal units

UBI – unique building identification field in ENERGY STAR Portfolio Manager

Appendix C: Endnotes

1. According to the Department of Finance's (DOF) database of taxable properties and the Department of Citywide Administrative Services' (DCAS) database of City buildings, New York's citywide gross floor area is estimated to be 5.75 billion square feet. Proportionally, properties required to comply under the Greener, Greater Buildings Plan (GGBP) make up 2.58 billion sq ft, which is 45 percent, or nearly half of citywide gross floor area.

2. According to the Department of City Planning (DCP), a *lot* is a "parcel of land identified [by the City] with a unique borough, block, and lot number for property tax purposes." *Building* refers to a permanent "structure that has one or more floors and a roof…and is bounded by open areas or the lot lines of a zoning lot." There can be multiple buildings on a single lot. For the purposes of this report, the term *property* is also used and refers to one or more buildings on the same lot that are owned by a single owner. Most analysis is done on the basis of properties, unless otherwise noted.

   New York City Department of City Planning (2013). NYC Zoning - Glossary. Retrieved from http://www.nyc.gov/html/dcp/html/zone/glossary.shtml

3. ENERGY STAR is a measure of efficiency in the form of a 1-to-100 percentile ranking for specified building types, such as offices, hospitals, and retail, with 100 as the best score and 50 as the median. The ranking compares a building's energy performance against a nationally representative survey, the Commercial Buildings Energy Consumption Survey (CBECS), and independent industry surveys of buildings. The ENERGY STAR score is normalized for weather and building attributes.

4. Portfolio Manager calculates emissions with the carbon coefficient based on New York City's EPA Emissions & Generation Resource Integrated Database (eGRID) sub region, which includes Westchester. The coefficient used in EPA calculations differs slightly from the coefficient used in the annual *Inventory of New York City Greenhouse Gas Emissions*, which applies solely to New York City.

5. Site Energy Use Intensity (Site EUI) equals the amount of energy consumed on site (in kBTU, per year, per gross sq ft), in addition to the energy lost in the generation and transmission process. Site EUI in the report is weather-normalized, unless it is specified otherwise.

6. Source Energy Use Intensity (Source EUI) is the amount of energy needed to create all the energy consumed on the site, per square foot. For example, this accounts for energy lost due to the generation and transmission of electricity. All references to Source EUI in this report are weather-normalized unless otherwise noted.

7. Water use per square foot gives a measure of how efficiently a building uses water.

8. City properties are benchmarked separately by DCAS Division of Energy Management (DEM), and the Department of Education (DOE). In 2012, Non-DOE properties and campuses benchmarked by DEM totaled 127.62 million sq ft. In 2012, schools and other DOE properties benchmarked by DOE totaled 154.19 million sq ft. This area includes CUNY senior colleges and HHC facilities, which the City is not responsible for benchmarking. Together, all City properties total 281.51 million sq ft.

9. The compliance deadline for 2011 reporting under LL84 was May 1, 2012. Building owners who failed to comply by this deadline could clear their violations after paying the fine(s) triggered by failure to comply by May 1, 2012 and submitting their benchmarking data by August 1, 2012. This report is an analysis of all benchmarking data submitted by August 1, 2012.

10. Due to varying options for reporting lots with multiple buildings (e.g. benchmarking each building on the lot individually, benchmarking some buildings together while reporting others independently, benchmarking all buildings on the lot as a single building, etc.), the number of buildings will differ from the original covered buildings count.

11. Note that these histograms were created from the 9,881 properties that remained after final data cleaning, which removed EUIs below five and above 1000 kBtu/sq ft, in addition to two percent outliers at the tails. These histograms also exclude buildings with gross floor area larger than one million sq ft.

12. Based on DCP's Primary Land Use Tax Lot Output (PLUTO) database.

13. The ENERGY STAR score accounts for use characteristics and operational patterns to provide a comparative metric across multiple buildings, and therefore is an indicator of relative efficiency.

14. U.S. Environmental Protection Agency (2011, March). ENERGY STAR Performance Ratings Methodology for Incorporating Source Energy Use. Retrieved from http://www.energystar.gov/ia/business/evaluate_performance/site_source.pdf?2391-c864

15. U.S. Environmental Protection Agency (n.d.). Use Portfolio Manager. Retrieved from http://www.energystar.gov/PortfolioManager

16. "Highly mixed use buildings" refers to those buildings that do not have a single use that accounts for more than 50 percent of its gross floor area; in other words, any commercial building whose space includes two or more use classifications, none of which account for more than 50 percent of the gross floor area.

17. It is important to note that while EPA is working to develop an ENERGY STAR score for multifamily buildings, EPA is still in the early stages of the process and conducting data analysis.

18. The compliance deadline for 2011 reporting under LL84 was May 1, 2012. Building owners who failed to comply by this deadline could clear their violations after paying the fine(s) triggered by failure to comply by May 1, 2012 and submitting their benchmarking data by August 1, 2012. This report is an analysis of all benchmarking data submitted by August 1, 2012.

19. The size of each circle corresponds to the energy used in the sector. The graph excludes buildings with EUI below five and above 1,000 kBtu/sq ft.

20. In Portfolio Manager before the 2013 upgrade, subsidized housing was determined by the multifamily attribute that indicated if the property was 'Affordable Housing' as opposed to 'Market Rate.' Note that these attributes were noted as 'Optional' entries in Portfolio Manager.

21. U.S. Department of Energy - Energy Efficiency Renewable Energy (2013). Building Technologies Office: Buildings Performance Database. Retrieved from http://www.buildings.energy.gov/BPD

22. The waiting period is no longer necessary with the 2013 upgrade to Portfolio Manager.

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