URBAN GREEN

The City of New York
Mayor Bill de Blasio

New York City's Energy and Water Use Report

10 Years of Data

December 2020

Urban Green Council's mission is to transform buildings for a sustainable future in New York City and around the world.

We focus on buildings because they account for two-thirds of the city's carbon emissions. We **convene** stakeholders to seek consensus; we **research** solutions that drive change locally and globally; we **advocate** for cutting-edge policy; and we **educate** a broad range of industry professionals.

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NYC Mayor's Office of Sustainability

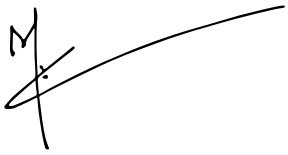
Data is fundamental to developing ambitious and sound policy that delivers meaningful outcomes to confront the climate emergency.

New York City's actions over the past 10 years came from grappling with the stark data in our earliest greenhouse gas inventory showing 5 percent of buildings contribute 36 percent of citywide emissions. This drove the passage of benchmarking and energy audit laws, data which provided a deep understanding of how buildings consume energy. These laws also kicked off an era of confronting climate impacts from the built environment nationally: after New York, more than 30 U.S. cities and two states adopted similar benchmarking policies. Another eight cities passed some form of energy audit law.

Here in New York City, those benchmarks and energy audits informed Local Law 97, which set carbon reductions targets in our largest buildings. It is the centerpiece of the Climate Mobilization Act, a suite of laws that, when taken together, is one of the boldest climate policies focused on the built environment ever enacted.

Despite these policy successes, the converging health, economic, environmental, and social justice crises of 2020 have underscored the fact that the climate challenges we face do not exist in a vacuum. We will continue to need robust data to not only understand our building, transportation, and energy systems, but the role those systems play to either reinforce social injustice or to dismantle it.

The ambitious work documented here is a monument to our progress thus far and a catalyst to inform how we continue to craft and implement aggressive climate mitigation programs that prioritize frontline communities, lower carbon emissions, and work in service of a thriving future for all New Yorkers.



Mark Chambers, R.A.
Director, Mayor's Office of Sustainability

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Executive Summary

Addressing climate change means addressing the energy used in buildings. Two-thirds of New York City's greenhouse gas emissions come from this sector, and the city needed reliable data to create effective policy to reduce emissions and track progress.[1] Enter benchmarking.

An Investment in Efficiency

In 2010, the City of New York became one of the first American cities to start collecting data about the energy and water used in large buildings. With a decade of data in hand, this report examines whether buildings are on track to meet the city's climate goals. The report also provides a first look at the energy and water use in midsize buildings; historical and sectoral comparisons of large-building energy use; an introduction to the new energy efficiency grades; and a preview of what's needed to comply with the building emissions law in 2024.

Over the last 10 years, total emissions from roughly 3,200 regularly benchmarked properties fell by about 22.6 percent (Figure 2). Median emission intensities for the entire benchmarked set followed the same trend. However, many factors other than efficiency influence building emissions; these include weather, fuel choice and sources of steam and electricity generation. Energy efficiency was responsible for more than one-third of the drop. Switching to cleaner fuels contributed another one-quarter, and natural gas now accounts for nearly half of benchmarked energy.

Adding Midsize to the Mix

In 2017, benchmarking expanded to include midsize buildings (25,000–50,000 square feet), and the program now covers 60 percent of NYC's square footage—an addition of roughly 9,000 properties for a total of 25,000 properties encompassing more than 3 billion square feet. That's more benchmarked area than Los Angeles, Chicago, Washington, D.C., Atlanta and Kansas City combined and is the largest dataset of its kind in the nation.

Regulation's Impact

Many building energy regulations were generated during the last decade. Two of these were implemented long enough ago that we now can gauge their success: the Clean Heat program (mandated by Local Law 43 of 2009), and NYC's first-ever Energy Conservation Code (NYCECC), a more stringent version of the state code.

The Clean Heat program required buildings to phase out heavy fuel oils (numbers 5 and 6) by 2015 and was a tremendous success. Over 98 percent of heavy oil combustion has been eliminated from benchmarked buildings; by 2016, that trend could be seen citywide. About 80 percent of benchmarked buildings now use natural gas for heat and hot water, as it's 30 percent less carbon intensive. Gas also produces less particulate matter and other air pollution, so those conversions had the added benefit of improving local air quality. Each of the four key pollutants tracked by NYC's Community Air Survey fell by at least 29 percent over the last decade.[2]

Energy codes are critical tools for improving buildings, and NYC implemented its first city-level code in 2010. This code aimed to improve efficiency in new construction and cover more building renovations. Multifamily buildings constructed since then use half as much fuel per square foot as those built before 1980. Advancements in building technology played a part, but these dramatic improvements illustrate that code development, education and enforcement are worth the effort.

Acceleration Needed to Meet 80x50

New York City building emissions have been falling at an encouraging rate, but that pace has recently slowed. Energy efficiency has paid off for some properties, but it remains germinal in many building sectors. If these trends continue, buildings will miss the city's goal to reduce greenhouse gas emissions 80 percent from 2005 levels by 2050.

Reaching 80x50 will be a gargantuan task, requiring commitment from the building industry and strong government leadership. To foster transparency, Local Law 33 of 2017 brought Energy Efficiency Grades to building lobbies in October 2020. Those grades—A, B, C and D—are based on the 2019 benchmarked data. Offices fared well—almost half got As and Bs. But most multifamily buildings and hotels earned Cs or Ds.

The four key pollutants tracked by NYC's Community Air Survey fell by at least 29% in the last decade.

The grades are based on Energy Star Scores, a metric developed by the U.S. Environmental Protection Agency to judge building performance based on energy use along with considerations for weather, occupancy and other factors. Beyond grades, NYC's Building Emissions legislation (Local Law 97 of 2019) will judge NYC's midsize and large buildings solely by their carbon emissions intensity beginning in 2024.

The 2024 emissions limits were set as an achievable target since only one out of five properties (the most intensive emitters) must make changes to meet them. Many office properties have already made significant improvements, and just one in 10 still has work to do to avoid fines for excess emissions. Most properties currently over the cap could comply by reducing emissions by less than 10 percent, and low-cost energy efficiency measures should be at the top of their list. It's time for NYC's building sector to be the driving force behind emission reductions.

FIGURE 1

Citywide Greenhouse Gas Emissions by Sector, 2019

Data: *LL84 2019 filtered for data quality and emissions, N = 22,767; NYC Greenhouse Gas Inventory*

TOTAL ANNUAL EMISSIONS (55.1 MILLION TONNES CO_2e)

Large and midsize buildings were responsible for over half of NYC's building emissions—34 percent of the citywide total. Every year, New York City reports greenhouse gas emissions from transportation, waste and all buildings in its Greenhouse Gas Inventory. Benchmarked buildings are not reported as a subset, but their emissions are included under the broad categories of residential and commercial buildings. Similarly, New York City's benchmarking data includes greenhouse gas emissions generated through Portfolio Manager. However, the geographical boundaries that define its emission rates do not exactly match the city's Inventory.

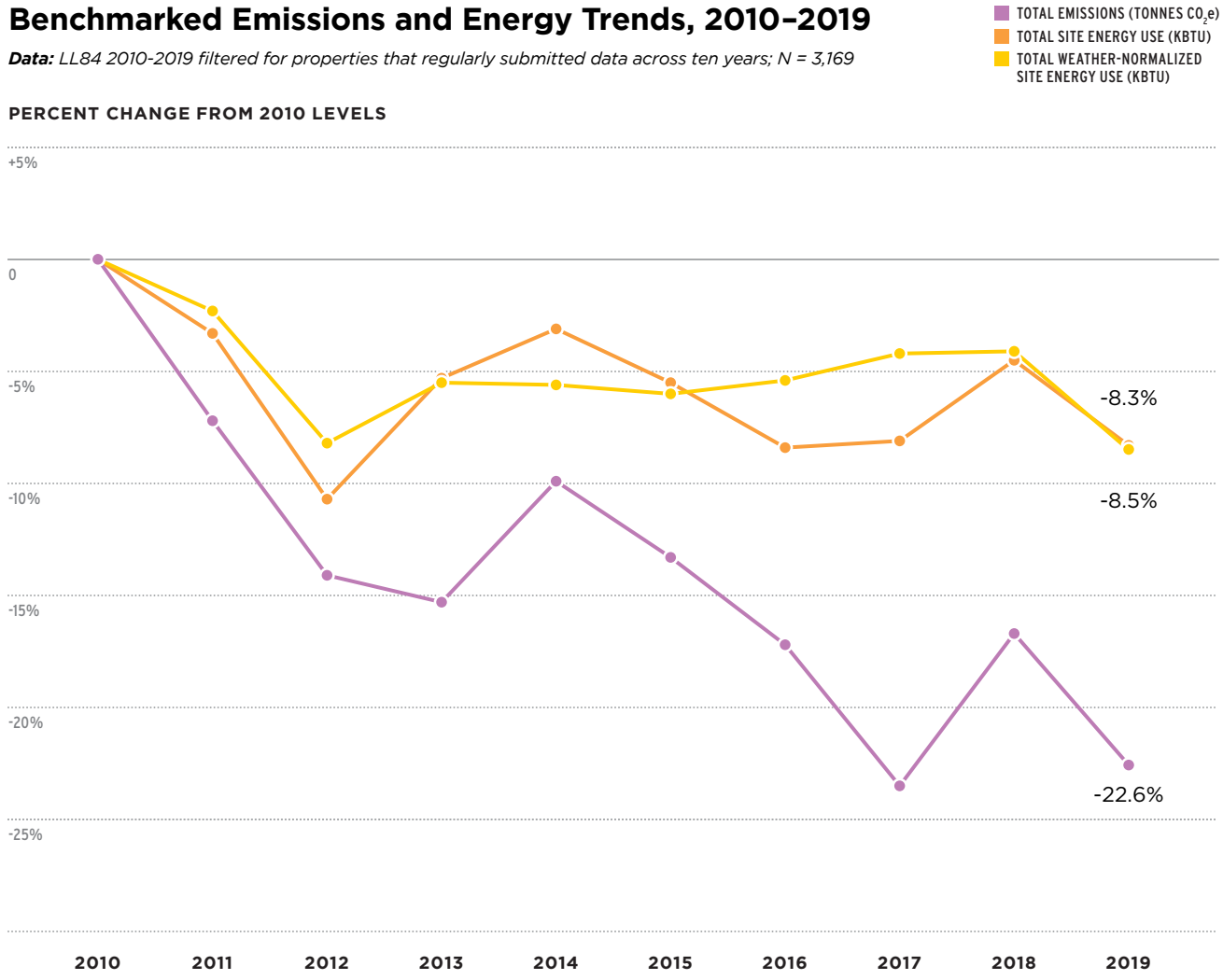
In Figure 1, we have recalculated the greenhouse gas emissions of New York's midsize and large buildings using benchmarked energy data and the emission rates from the Inventory. Roughly 23,000 properties submitted enough data to calculate their emissions, and missing data from another 5,000 properties was estimated based on similar benchmarked properties.

In 2019, large and midsize buildings were responsible for over half of NYC's building emissions, over 18 million metric tons of carbon (Figure 1). This represents fewer than 50,000 buildings—less than 5 percent of the city-wide total—but they have the capability to cut vast amounts of carbon with basic energy efficiency retrofits.

FIGURE 2

Benchmarked Emissions and Energy Trends, 2010–2019

Data: *LL84 2010-2019 filtered for properties that regularly submitted data across ten years; N = 3,169*



Emissions fell 23 percent since 2010 among regularly benchmarked properties.

Regularly benchmarked properties submitted data with enough detail for emission calculations nine out of the past 10 years. Tracking energy used within these buildings, known as site energy, can offer clear insight on efficiency. Weather-normalized site energy fell in 2012 after Hurricane Sandy but rebounded and stayed steady for years afterward. Part of this drop can be attributed directly to benchmarking itself.[3] Finally, it flattened after a colder 2018 winter and then fell another 2 percent in 2019 following a similar heating season.

Lower energy use contributed roughly 35 percent of last decade's greenhouse gas reductions; every fuel source except natural gas recorded a decline. So it appears that some efficiency upgrades have yielded benefits, and we will continue to track these.

The rest of the decade's carbon reductions, 65 percent, resulted from fuel switching across New York's energy landscape. Electric power generation converted from oil to cleaner, cheaper gas. Thus, New York City benefited from electricity that became 15 percent less carbon intensive by 2019.[4] That transition is now complete, so the local grid may not get cleaner until it switches to renewable power. The other fuel switch occurred inside buildings, as thousands of boilers were forced to stop burning heavy fuel oil. Replacing oil with cleaner fuels in these buildings contributed roughly one-quarter of their carbon cut through 2019.

A Decade of Data

New York City has collected information on the energy and water use of a majority of its large buildings for the past 10 years, providing New Yorkers with a decade's worth of data to investigate trends in energy use and the effects of regulations and initiatives targeted toward big buildings.

Ten Years of Benchmarking

Benchmarking is mandated under New York City's Greener, Greater Buildings Plan (GGBP); the requirement is called The Benchmarking Law (Local Law 84 of 2009, LL84). Making benchmarking data available to the public gives owners an incentive to enhance their buildings' energy and water performance, while also spurring data-driven decision-making. This report supplements the publicly available data by offering a comprehensive look into the benchmarked building types and energy data trends.

Both compliance and data quality have steadily improved since benchmarking was implemented. Last year, roughly 25,000 properties submitted data with sufficient enough detail to be included in this analysis. This report uses this extensive, detailed data to reflect on benchmarking results over the past decade.

For properties that benchmarked regularly over the past decade, emissions fell 23%. Cleaner electricity and steam is responsible for about 40% of that decline.

Some properties had near-perfect benchmarking records. For the 3,120 large properties that benchmarked regularly over the past decade (that is, they submitted data at least nine out of 10 years), emissions fell 22.6 percent. The median carbon intensity across all benchmarked buildings followed a similar trend. There are five main drivers of changes in these benchmarked emissions: variable weather (controlled for by normalization with degree days); cleaner electricity generation; improved district steam production and delivery; accelerated fuel switching; and more efficient energy use.

Cleaner electricity and steam is responsible for about 40 percent of that overall emission decline. Fuel switching and energy efficiency in buildings are responsible for the rest of the emissions drop to date. The following graphs discuss these and other trends in more detail.

Let's Talk About Carbon

Quantifying sustainability in buildings has also changed. Buildings have traditionally been judged on a metric called energy-use-intensity (EUI)—the amount of energy use per area. Similarly, water use was measured by water-use-intensity (WUI). But this report also looks at the *carbon intensity* of buildings, which measures greenhouse gas emissions per area resulting from fuel combustion, electricity and district steam use.

Carbon intensity is influenced by more factors than energy use. For example, a building might use more electricity as cooling demand increases over the next decade, but the carbon intensity of this energy use can decrease over the same time period if grid electricity generation becomes cleaner. Overall, understanding trends in terms of carbon intensity can help align the building sector with society-wide decarbonization initiatives.

This renewed focus on measuring carbon linked to New York City's building sector is an integral part of Local Law 97 of 2019 (LL97), which puts a limit on the greenhouse gas emissions from operations. Benchmarked energy data from the past decade was used to establish these emissions limits by building type.[5]

About the Data

This is NYC's sixth benchmarking report and is significant for containing a series of firsts:

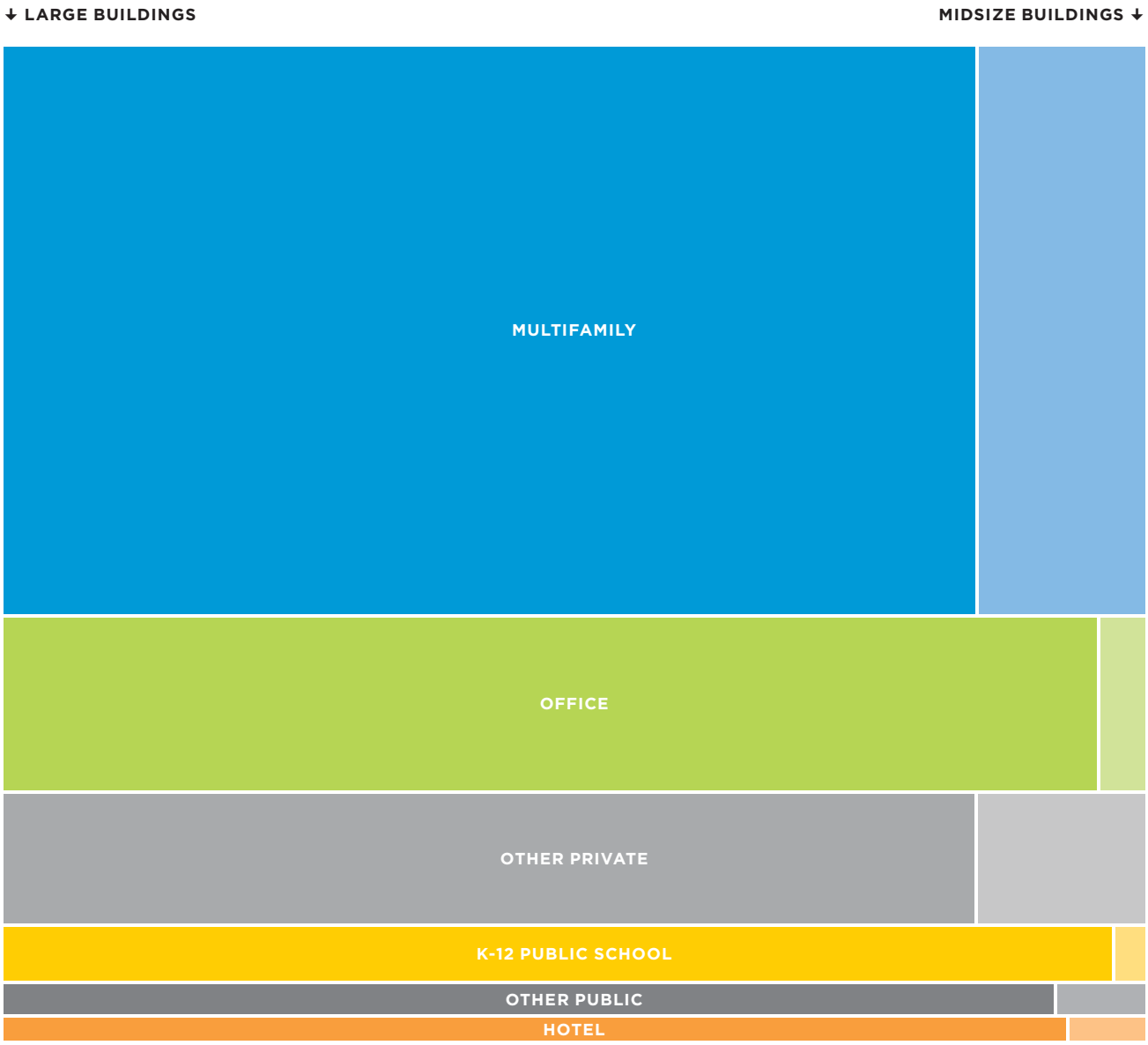
- the first dive into benchmarking data from midsize buildings;
- the first trend analysis of 10 years of benchmarked energy use and emissions in NYC;
- the first summary of the results of NYC's Energy Efficiency Grades, posted in buildings this year.

This report isn't the only place where much of this data can be found: It's required by law to be publicly disclosed annually and available online via the NYC Open Data platform, located at opendata.cityofnewyork.us. These datasets are large and have some issues that need to be corrected before analysis. You can find Urban Green's cleaning methodology and associated dataset at urbangreencouncil.org/benchmarking2020.

FIGURE 3

Benchmarked Floor Area by Building Sector, 2019

Data: *LL84 2019 filtered for data quality; N = 24,441*



	TOTAL AREA	PROPERTIES
Multifamily Large	1.388 billion SF	10,150
Multifamily Midsize	237.4 million SF	6,480
Office Large	473.4 million SF	1,590
Office Midsize	19.3 million SF	530
Other Private Large	314.8 million SF	1,780
Other Private Midsize	54.1 million SF	1,520

	TOTAL AREA	PROPERTIES
K-12 School Large	148.7 million SF	1,130
K-12 School Midsize	4.0 million SF	110
Other Public Large	78.4 million SF	550
Other Public Midsize	6.5 million SF	190
Hotel Large	59.1 million SF	300
Hotel Midsize	4.1 million SF	120

Midsize properties increase benchmarked floor area by over 300M square feet. In 2016, Local Law 133 lowered the building compliance threshold for benchmarking from 50,000 to 25,000 square feet. Midsize buildings began reporting energy and water use data in 2017. These new additions to the benchmarking dataset represent 37 percent of all benchmarked buildings but comprise only 12 percent of the total square footage. Over 85 percent of private midsize buildings subject to the benchmarking requirement—almost 9,600 properties—submitted data in 2019.

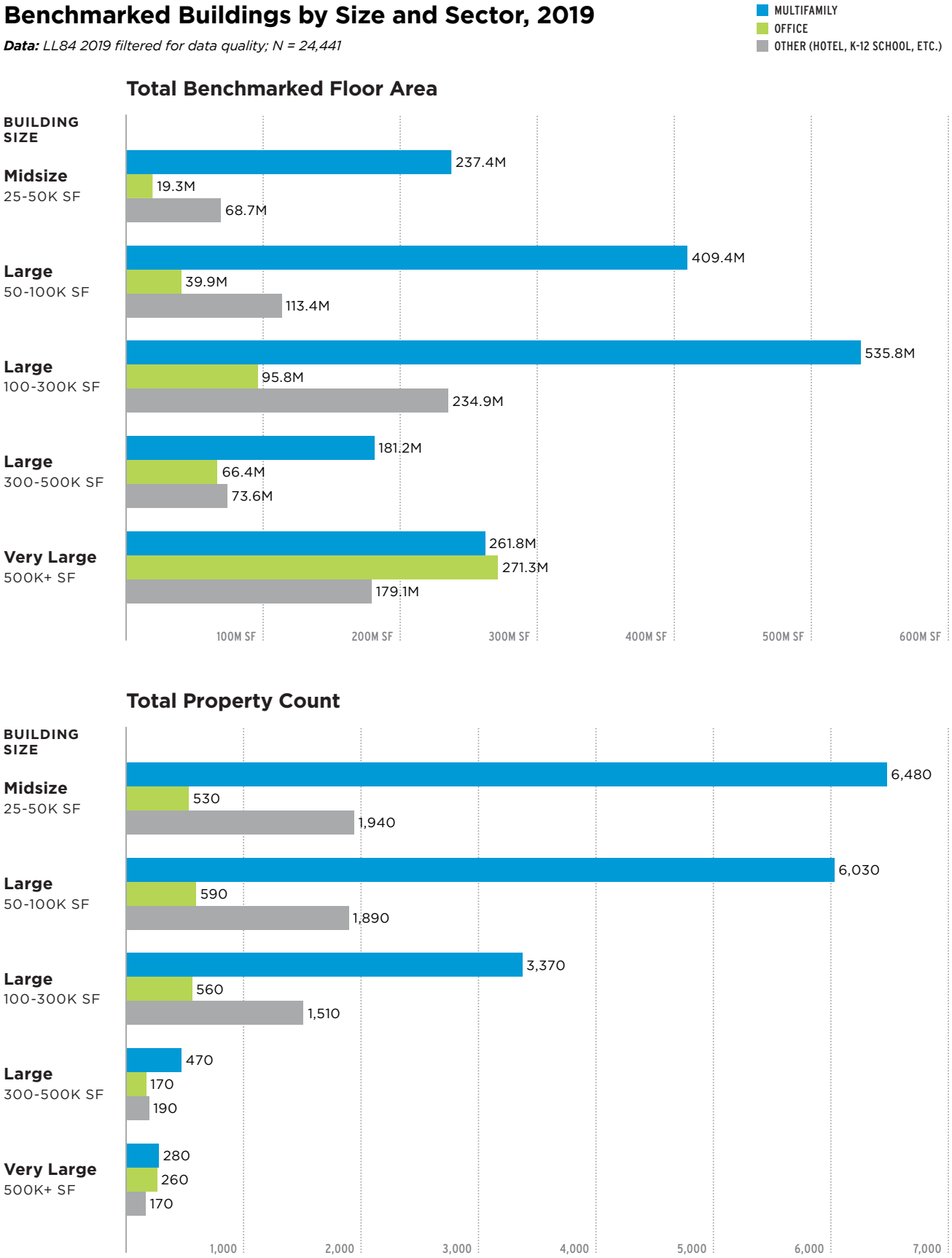
How do midsize and large benchmarked properties compare? While used for many of the same purposes as their larger counterparts, midsize buildings differ in other fundamental ways. These figures look at distinctions in energy use, water use and occupancy as well as the energy mix across building sectors.

After removing duplicates and errors, the 2019 benchmarking dataset includes data for almost 2.8 billion square feet of NYC building floor area. Figure 3 breaks this floor area down by sector and size. The four largest individual sectors by square footage are multifamily housing, offices, K–12 schools and hotels. Multifamily buildings occupy 58 percent of the total benchmarked space, offices 18 percent, K-12 public schools 6 percent and hotels 2 percent. The remaining 16 percent of the benchmarked area comes from other property types such as retail stores and storage facilities. Midsize buildings account for about 15 percent of the floor area in most sectors except K-12 schools, offices and hotels. Midsize buildings make up a majority of the properties used for religious worship, daycare services and city services like libraries and fire stations.

FIGURE 4

Benchmarked Buildings by Size and Sector, 2019

Data: *LL84 2019 filtered for data quality; N = 24,441*



Most midsize properties are multifamily.

NYC annually benchmarks over 25,000 properties that vary in size, type and use. Figure 4 groups them by size (i.e., the square footage of a building) and sector. It's also important to note the difference between properties and buildings. Benchmarking is a requirement for each property, which is a piece of land identified by an address. But a property may report on multiple buildings at the same location. The number of buildings in the benchmarked data varies from year to year, but the count is typically over 30,000 individual buildings.

Multifamily housing makes up 68 percent of total benchmarked properties and 58 percent of total gross floor area. Offices comprise 9 percent of total benchmarked properties and 18 percent of total gross floor area. The addition of midsize properties gives insight into how smaller buildings differ from their larger counterparts.

Seventy-one percent of New York City's benchmarked buildings are smaller than 100,000 square feet; together they account for just one-third of the benchmarked floor area. Very large buildings, larger than 500,000 square feet, represent only 3 percent of total buildings but one-fourth of total floor area. The typical, or median, size of a multifamily building continues to be much smaller than the median size of an office building—59,000 square feet and 92,000 square feet, respectively. Not surprisingly, multifamily buildings make up almost three-quarters of midsize buildings.

FIGURE 5

Total Site Energy Use and Intensity by Building Sector, 2019

Data: *LL84 2019 filtered for data quality, emissions, energy and property type; N = 18,039*

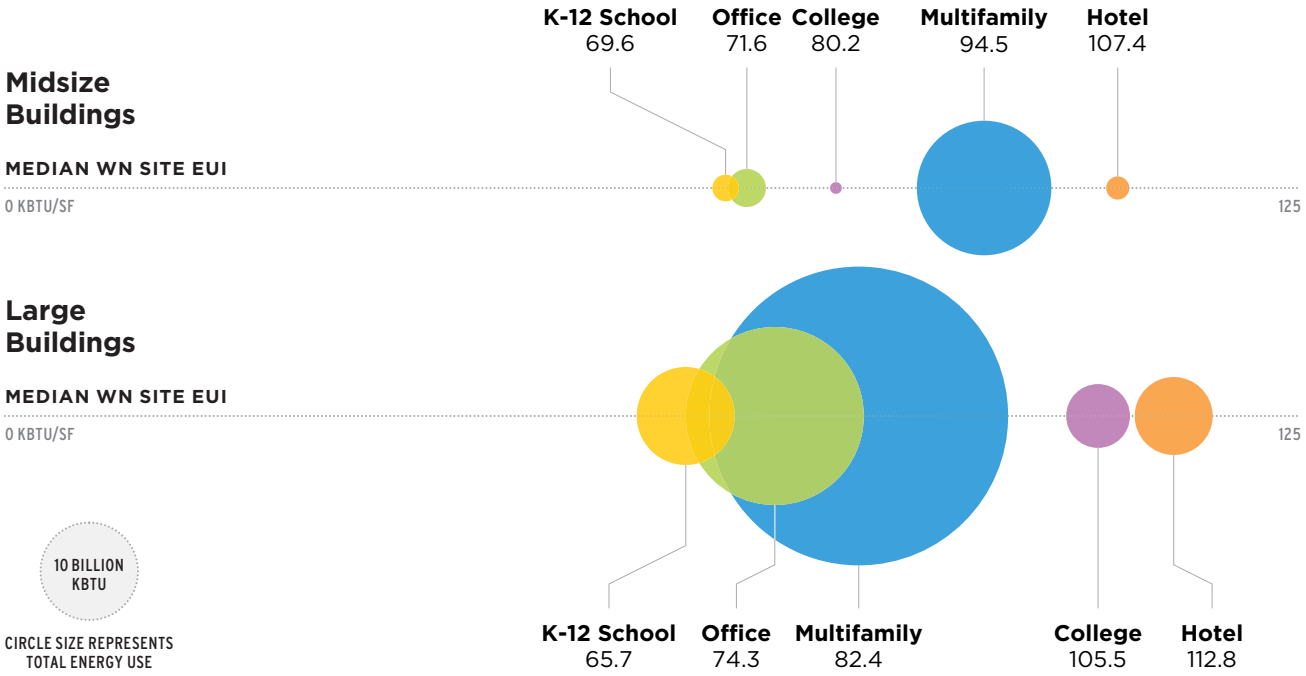
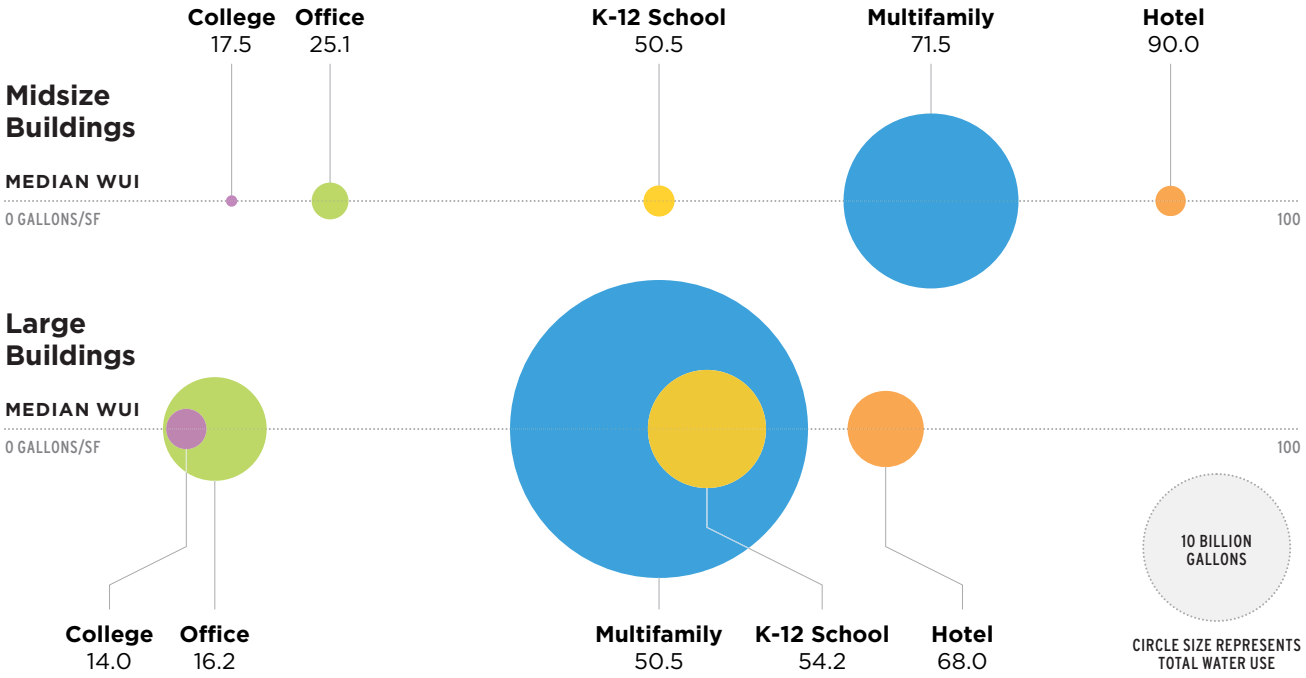


FIGURE 6

Total Water Use and Intensity by Building Sector, 2019

Data: *LL84 2019 filtered for data quality, water use and property type; N = 14,329*



Multifamily buildings collectively use more energy and water than any other sector. Site energy use varies by building type and size. As the above figure illustrates, neither large nor midsize buildings were consistently higher energy users across the major sectors. It's also clear that the multifamily sector looms large in terms of overall energy use in NYC.

Most of New York City's midsize buildings are used for multifamily housing. So it's not surprising that almost 90 percent of both benchmarked water use and site energy use in midsize buildings came from this one sector.

In addition, water use shows a trend: Midsize properties consistently use more gallons of water per square foot except K-12 schools. Large K-12 schools were more water intensive and accounted for 11 percent of benchmarked water use. Multifamily and office buildings are responsible for three-quarters of site energy use and water use across all benchmarked buildings. Hotels have the highest site EUI and WUI of the major building types but only account for 3 percent of total site energy and 4 percent of total water use.

Midsize multifamily buildings are significantly more water and energy intensive than large multifamily buildings. The median WUI for midsize multifamily buildings is 42 percent higher than their larger counterparts, and their WN site EUI is 15 percent higher. This sector also accounts for 10 percent of total site energy and 17 percent of total water use across benchmarked buildings. With expert guidance, midsize multifamily buildings may find easily attainable opportunities for efficiency. As a large contributor to NYC's overall resource use, this sector is worthy of additional attention.

Comparing Tenant Density in Multifamily Buildings

Midsize Buildings
8 PEOPLE PER 5,000 SF FLOOR

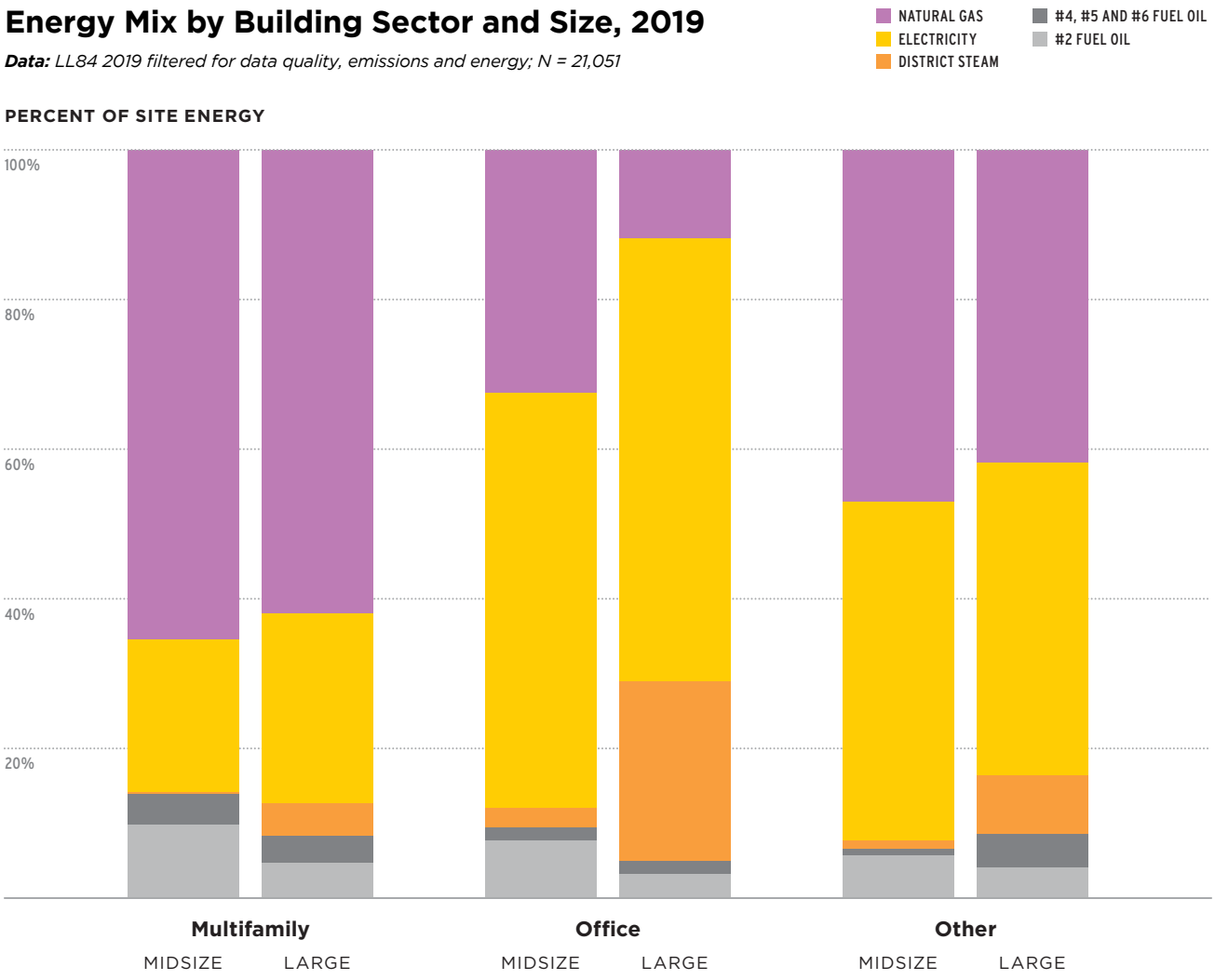
Large Buildings
6 PEOPLE PER 5,000 SF FLOOR

A building's energy and water use are dependent on more than the characteristics of that building, and benchmarking data can help indicate why midsize multifamily buildings are more energy and water intensive. The typical midsize multifamily building packs in 10 percent more bedrooms per area than its large counterpart. At the same time, the typical apartment in a midsize multifamily building is 925 square feet, compared to 1,085 square feet in a large building. This suggests that midsize buildings are more densely occupied, which translates to higher water and energy use.

FIGURE 7

Energy Mix by Building Sector and Size, 2019

Data: *LL84 2019 filtered for data quality, emissions and energy; N = 21,051*



Natural gas makes up the majority of energy used in the multifamily sector, and it accounts for nearly half of all benchmarked site energy. Midsize and large buildings get their energy from a handful of sources. Electricity, district steam, natural gas, distillate fuel oil (Number 2), and residual fuel oils (Numbers 4, 5 and 6) make up over 98 percent of benchmarked energy.

Figure 7 shows the varying proportions of energy sources used in benchmarked properties across sectors. Over half the energy is used to produce heat and hot water (the rest is used for lighting cooling, plug loads, etc.).[6] Traditionally, most of that heat came from burning oil or gas. That trend continued in 2019; however, in multifamily properties, oil use fell below 10 percent, while natural gas made up 62 percent of energy use.

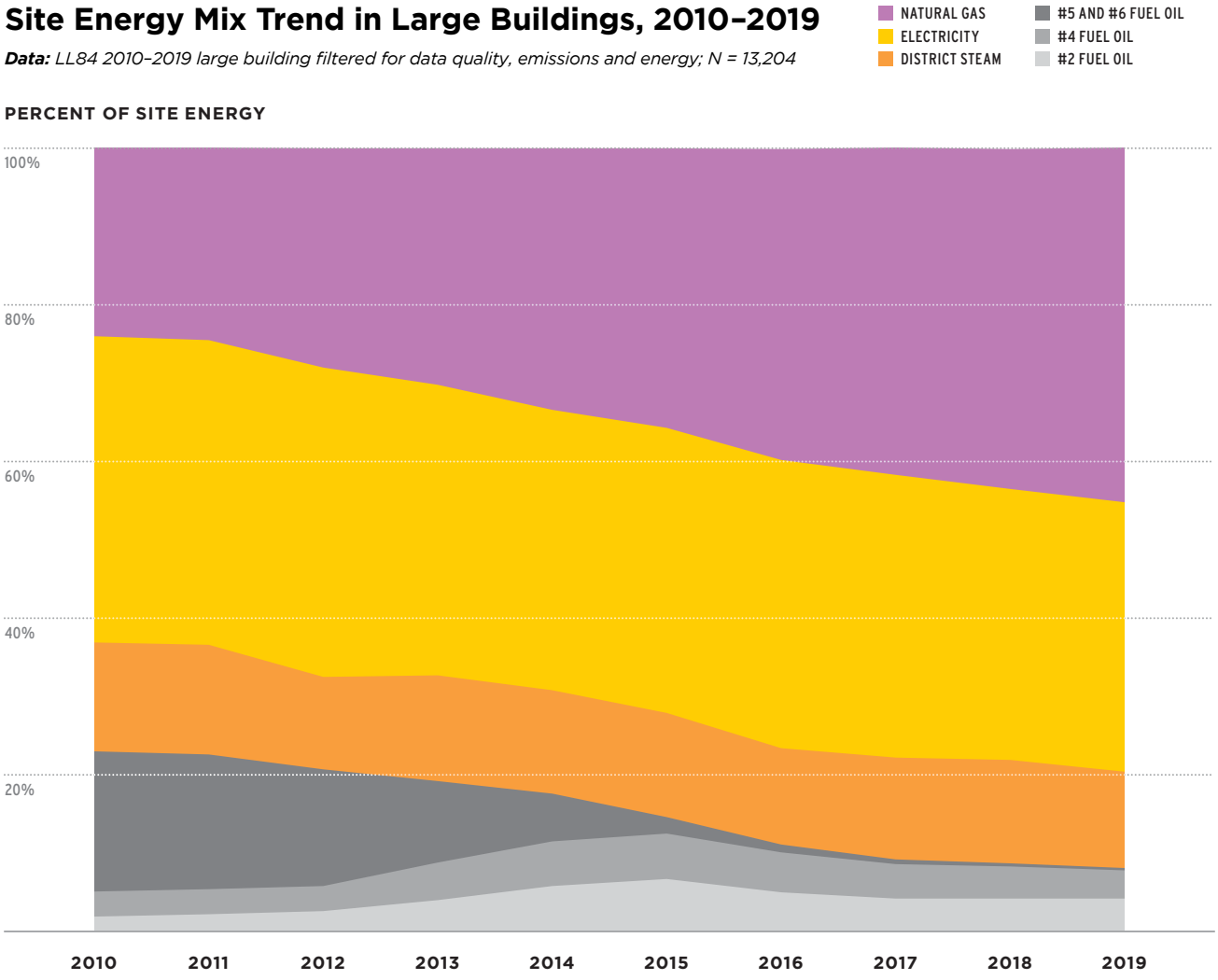
Electricity was the second-largest source of energy in NYC, responsible for about half of site energy in most sectors. In hotels, 42 percent of site energy is electricity, while natural gas accounts for about 40 percent. Electricity continues to dominate the office sector, comprising almost 60 percent of energy use across midsize and large offices.

There is much more variance in heat sources across offices. District steam is used in almost one-third of large offices, where it's the second largest energy source; however, it's used in fewer than 30 midsize offices. Overall, midsize buildings use less than 1 percent of all district steam benchmarked in 2019, instead opting for higher rates of distillate fuel oil. In fact, over 20 percent of all distillate fuel usage was in midsize buildings. This is consistent with citywide studies that show smaller buildings were more likely than large ones to replace heavy oil with distillate oil rather than switching to natural gas.[7]

FIGURE 8

Site Energy Mix Trend in Large Buildings, 2010–2019

Data: *LL84 2010–2019 large building filtered for data quality, emissions and energy; N = 13,204*



Natural gas replaced heavy fuel oil in most benchmarked buildings. New York City buildings have been experiencing an epic transformation in energy sources since 2010. That year, fuel oil made up almost one-quarter of benchmarked energy; most of that was the heaviest oils, numbers 5 and 6, which emit soot, sulfur dioxide and carbon dioxide when burned. Seven years later, fuel oil use overall dropped below 10 percent, and heavy fuel oil nearly vanished from big buildings.

The NYC Clean Heat program, which mandated that buildings switch to cleaner fuels by 2015, was the driving force behind this change. Compliance has been excellent—fewer than 100 properties reported using any heavy fuel oil last year. Overall, natural gas is the replacement fuel of choice, and benchmarked buildings now use almost twice as much of it as they did in 2010.

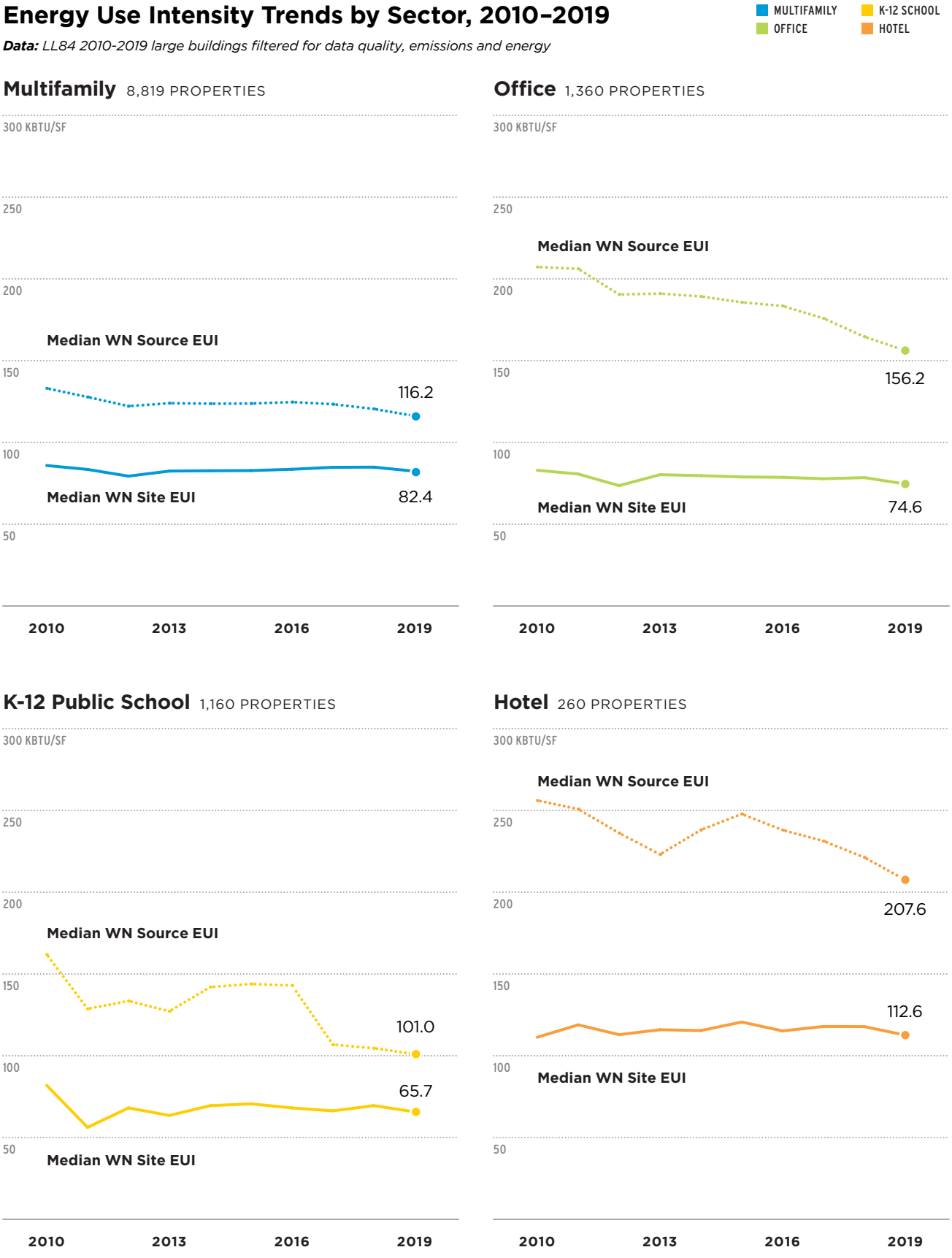
The air got cleaner for some but not all New Yorkers. Switching away from heavy fuel oil has resulted in improved air quality and big reductions in carbon emissions. Emission reduction benefits extend beyond NYC—the benchmarked energy mix in 2019 is 8 percent less carbon intensive than it was in 2010. Fuel switching is responsible for about one-quarter of the carbon cut in regularly benchmarked buildings (Figure 2).

Average citywide levels of particulate matter fell 32 percent between 2009 and 2018, with about half of that drop coming after 2015.[8] That will help improve lung health for many New Yorkers. Unfortunately, these improvements are not evenly distributed across the city. The lingering use of residual fuel is concentrated in Northern Manhattan and Bronx neighborhoods. This is of particular environmental justice concern, given that these areas are predominantly lower income and made up of communities of color.[9]

FIGURE 9

Energy Use Intensity Trends by Sector, 2010–2019

Data: *LL84 2010-2019 large buildings filtered for data quality, emissions and energy*



Source energy use is down thanks to cleaner and more efficient production of electricity and district steam. Most of the major building sectors reduced their energy use intensities over the decade. This is true for both source and site EUI. Median weather-normalized source EUIs decreased across all sectors. That's a reflection of improvements both at the building and utility level.

Median weather-normalized site EUIs stayed fairly consistent over the decade. But last year, site energy dropped between 3 and 5 percent across all four of these sectors. The gap between site and source energy in Figure 9 shows the relationship between each sector and its fuel sources. Offices and hotels are more dependent on electricity and district steam than multifamily buildings and schools.

Site energy use fell in all sectors except hotels, suggesting efficiency investments are paying off. Excluding heavy fuel oil, electricity use saw the biggest drop. It's one of the most expensive forms of energy, so upgrades that save electricity tend to be good investments. And it appears that efforts to trim office electricity use are paying off: The median source EUI in offices fell 21 percent, while the median site EUI fell 10 percent through 2019.

Multifamily housing has struggled to lower energy use. This sector had the smallest source EUI decrease at 9 percent, and their site EUI fell 4 percent. Multifamily buildings use only one-third the electricity that offices use per square foot, so they benefit less from a cleaner grid. However, 2019 offered some hope, as this sector's median source EUI finally fell below 120 kBtu/SF for the first time since benchmarking began.

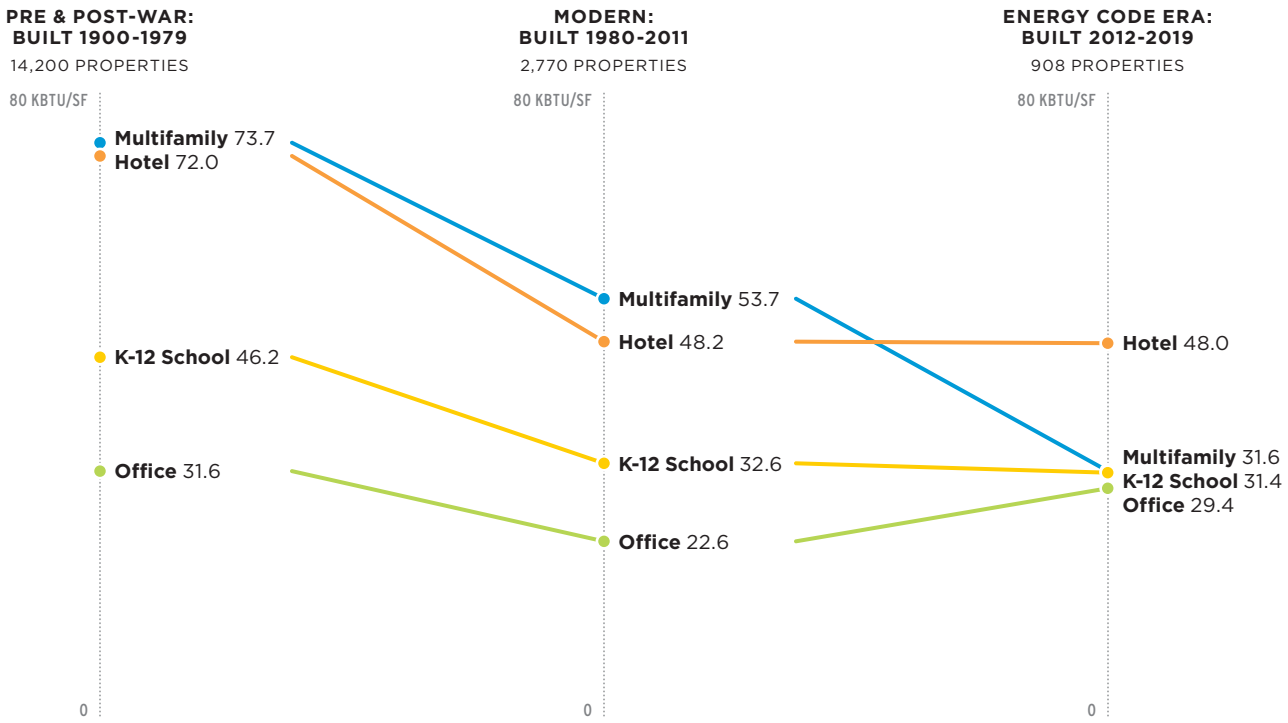
K–12 schools had the largest decrease in both median source EUI and site EUI of all the major building types. Hotels had the only increase in site energy use, and their median EUI went up 1 percent. It is worth noting that a hotel's energy use depends on the number of guests; NYC hotel occupancy steadily rose roughly 8 percentage points from 2010 to 2018.[10]

FIGURE 10

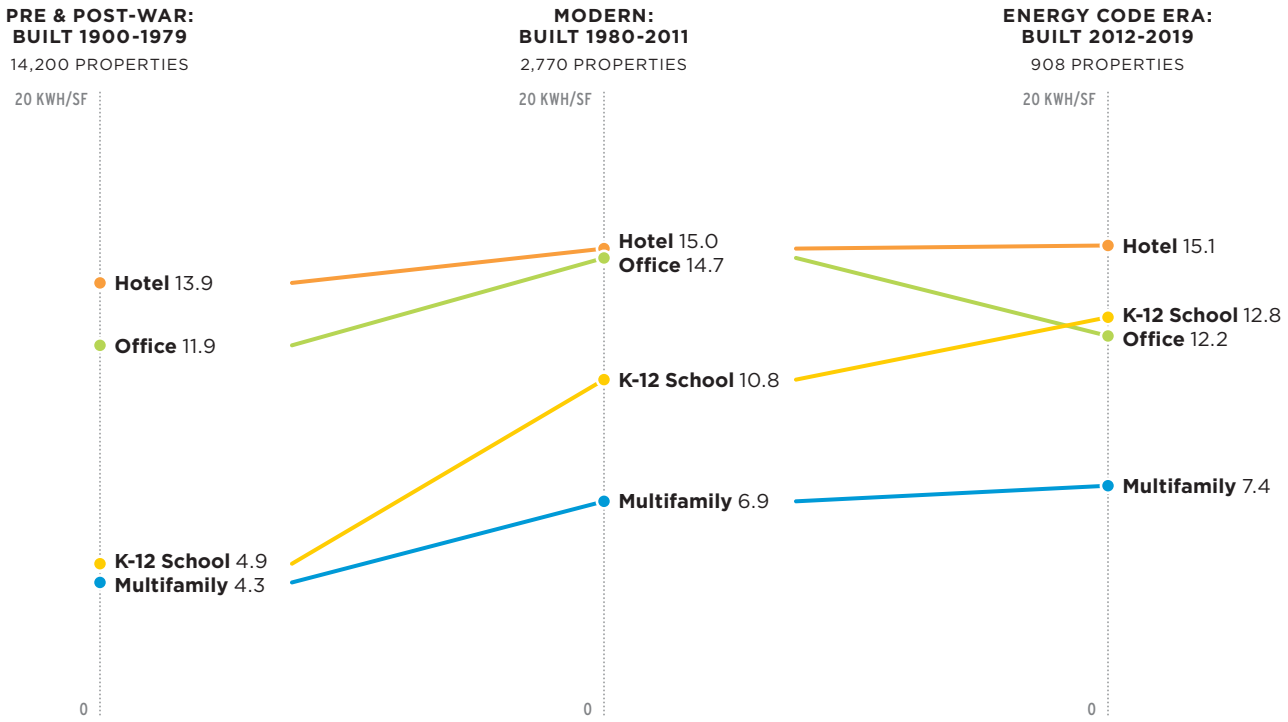
Energy Code Impact on Fuel and Electricity Use

Data: *LL84 2019 filtered for data quality, emissions, energy and property type*

Median Weather Normalized Site Fuel EUI by Year Built



Median Weather Normalized Site Electricity EUI by Year Built



Modern buildings use far less fuel than older buildings. Almost 1,000 large and over 500 midsize buildings have been constructed since benchmarking began in 2010. Constructing 150 buildings annually increased total emissions. But by how much?

Luckily, many of those buildings had to comply with the NYC Energy Conservation Code, first created by Local Law 85 in 2009. The code—which is more stringent than the state code—regulates the design and construction of buildings for the effective use of energy, while providing flexibility to allow innovative approaches and techniques. The NYCECC took effect in 2010; the first buildings fully designed and built under the code were likely finished in 2012. Looking at the 2019 benchmarked data, these new buildings are more efficient, making use of new technology and better design practices. The code has helped continue this trend.

Most buildings completed after 1980 use less site energy than those built before, driven by dramatically lower fuel use (Figure 10). Energy code era multifamily buildings use 57 percent less, K-12 schools use 32 percent less and hotels use 33 percent less fuel per square foot than their pre- and post-war predecessors. It's impressive to see such low fuel use in new buildings. This should serve as the ultimate goal for existing building retrofits.

This improvement in fuel efficiency continued and accelerated after 2016 for multifamily buildings, when an updated code was released and enforcement picked up. Knowledge of the code has also improved. Since 2010, over 10,000 students have taken energy code training from Urban Green. When designers know the code, projects are more likely to comply.[11]

Curiously, electricity use in buildings built after 1980 has been higher; more common area and central cooling may have contributed to this phenomenon. On average, over 85 percent of the area in these multifamily buildings can be cooled compared to only 71 percent in older buildings. That additional area in newer buildings may come from cooling lobbies and hallways.

Data-Driven Policy

Since two-thirds of NYC's greenhouse gas emissions come from energy used in buildings, the city needed reliable building data to track progress. Now we have it. Ten years of benchmarking quantify the carbon contribution from big buildings and reflect the progress of policies aimed at reducing emissions—and reveal where greater focus may be needed.

Legislating for Efficiency

State and local laws will need to encourage both energy efficiency at the building level and decarbonization at the utility level for us to achieve our low-carbon goals. Cleaner electricity is coming, but it may take years for renewable generation to connect to New York City. Energy efficiency now has a big contribution to make in accelerating carbon reductions.

Two new laws aimed at ramping up efficiency were enabled by benchmarking data. The first, Local Law 33 of 2018, seeks to make all New Yorkers aware of differences in building energy use. The theory behind benchmarking is that transparency will galvanize the market to reward better-performing buildings through higher rents and lower vacancies. In NYC, part of that transparency now takes the form of building grades that make renters and buyers aware of a building's energy use. Modeled after similar building rating programs in Europe, LL33 mandates assigning benchmarked buildings energy efficiency grades ranging from A to F; these must be posted near public entrances (similar to NYC's restaurant grades).

Transparency will nudge the market toward better-performing buildings through tenant demand and lower vacancies.

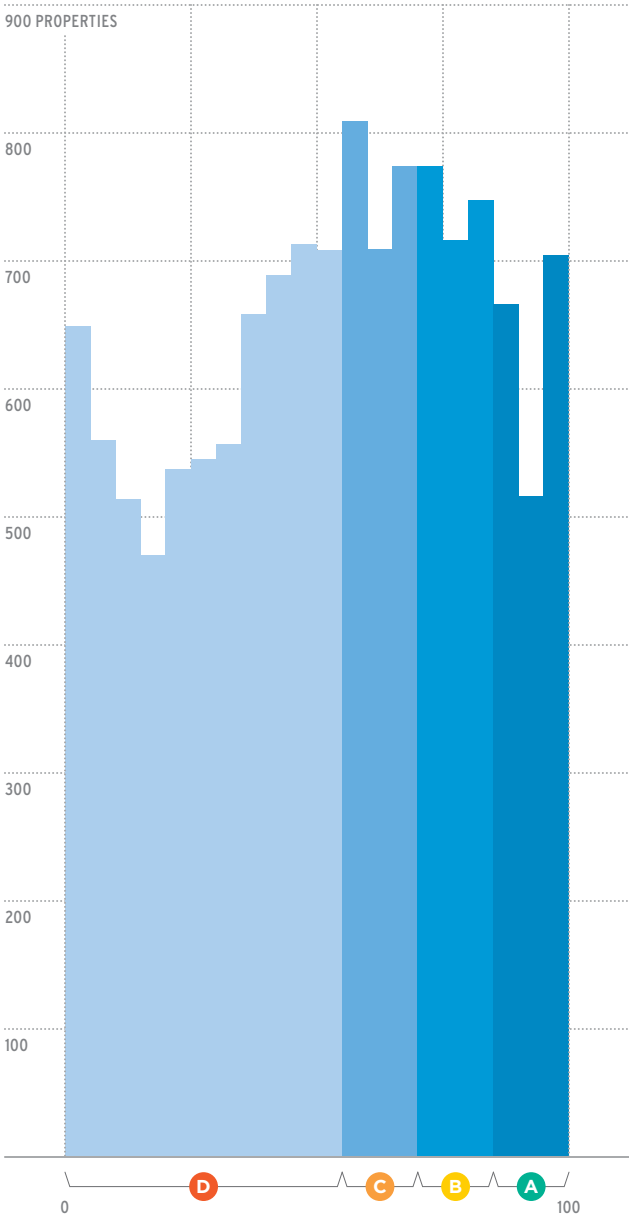
The second, Local Law 97, was enacted in 2019 as part of the Climate Mobilization Act. This groundbreaking legislation places carbon caps on thousands of residential and commercial properties across NYC. Most properties, roughly 80 percent, covered by LL97 will be under the caps that start in 2024. But carbon emissions limits will become more stringent over time. The city's plan is to eventually reduce the emissions of covered buildings 80 percent by 2050. Investing in energy efficiency measures now can help owners lower building emissions, avoid penalties and increase property values.

FIGURE 11

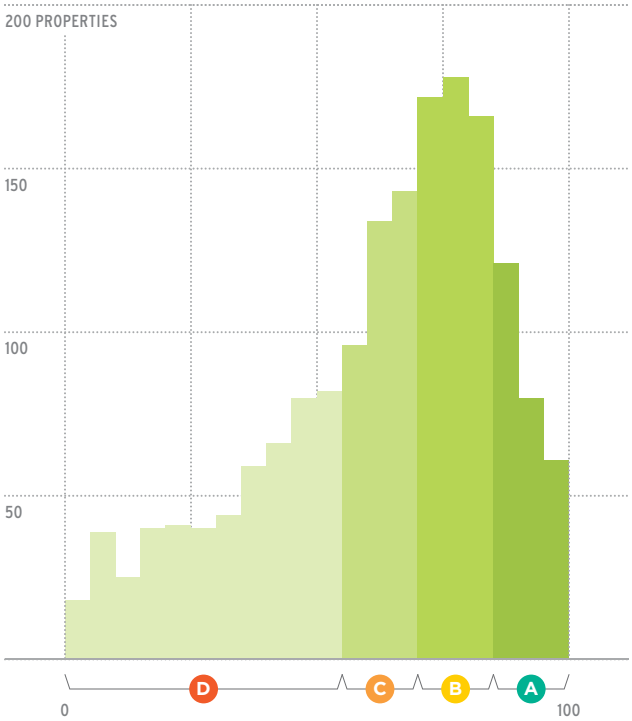
Energy Star Scores by Building Sector, 2019

Data: *LL84 2019 filtered for data quality, emissions, energy and Energy Star reporting*

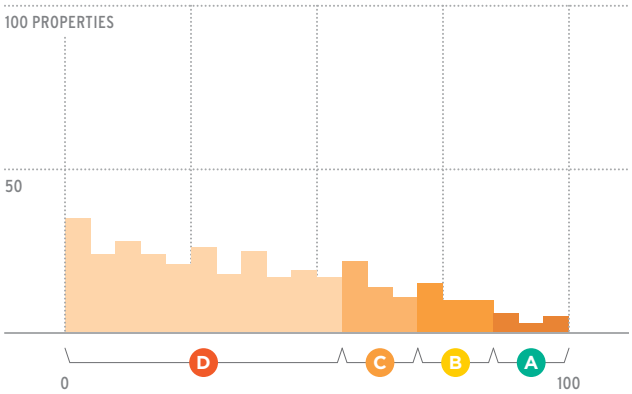
Multifamily 13,015 PROPERTIES



Office 1,685 PROPERTIES



Hotel 350 PROPERTIES



	Multifamily Properties		Office Properties		Hotel Properties	
A 85–100	**1,886**	(14%)	**262**	(16%)	**14**	(4%)
B 70–84	**2,237**	(17%)	**516**	(31%)	**35**	(10%)
C 55–69	**2,292**	(18%)	**373**	(22%)	**47**	(13%)
D 0–54	**6,600**	(51%)	**534**	(32%)	**254**	(73%)

Higher Building Energy Efficiency Rating letter grades correspond to lower carbon intensities in benchmarked properties.

In October 2020, office, multifamily and hotel benchmarked buildings received grades based on their 2019 energy use. Energy Star scores are based primarily on energy use but include additional factors. For example, multifamily scores are adjusted for bedroom density, offices for worker density and hotels for guest room density. In Figure 11, the height of each bar represents the number of properties that received a score within five-point increments. The pattern of grades differs significantly between the three building types.

Offices were the best performers, with almost half of all properties receiving an A or B grade. However, the median ES score for large offices fell to 70 in 2019 from 75 four years prior. This drop was partially due to scoring updates by the EPA in 2018 and 2019.[12]

Half of all multifamily properties, nearly 7,000, received a D grade. Larger apartment buildings fared better than midsize buildings—over one-third of large properties received A or B grades.

Finally, hotels performed the worst of these sectors, with nearly three-quarters of properties receiving Ds. Fewer than 50 hotel properties earned an A or B in 2019.

While a Building Energy Efficiency Rating is not impacted by greenhouse gas emissions, data show that, overall, better letter grades correspond to lower carbon intensities in benchmarked properties. *Specifically, the median carbon intensity of a building receiving an A grade is less than the median carbon intensity of a building receiving a B grade. This was true for every grade tier and property type.*

About the Law

Local Law 33 grades are based on the Environmental Protection Agency's ENERGY STAR program, which ranks the energy performance of buildings by comparing them to similar buildings with the same primary use nationwide.[13] Each building's performance is scored on a scale of 1 to 100; higher scores indicate better performance. The letter grades are assigned by ES scores determined from the benchmarked data and score ranges defined by LL33 and refined by Local Law 95 of 2019.[14]

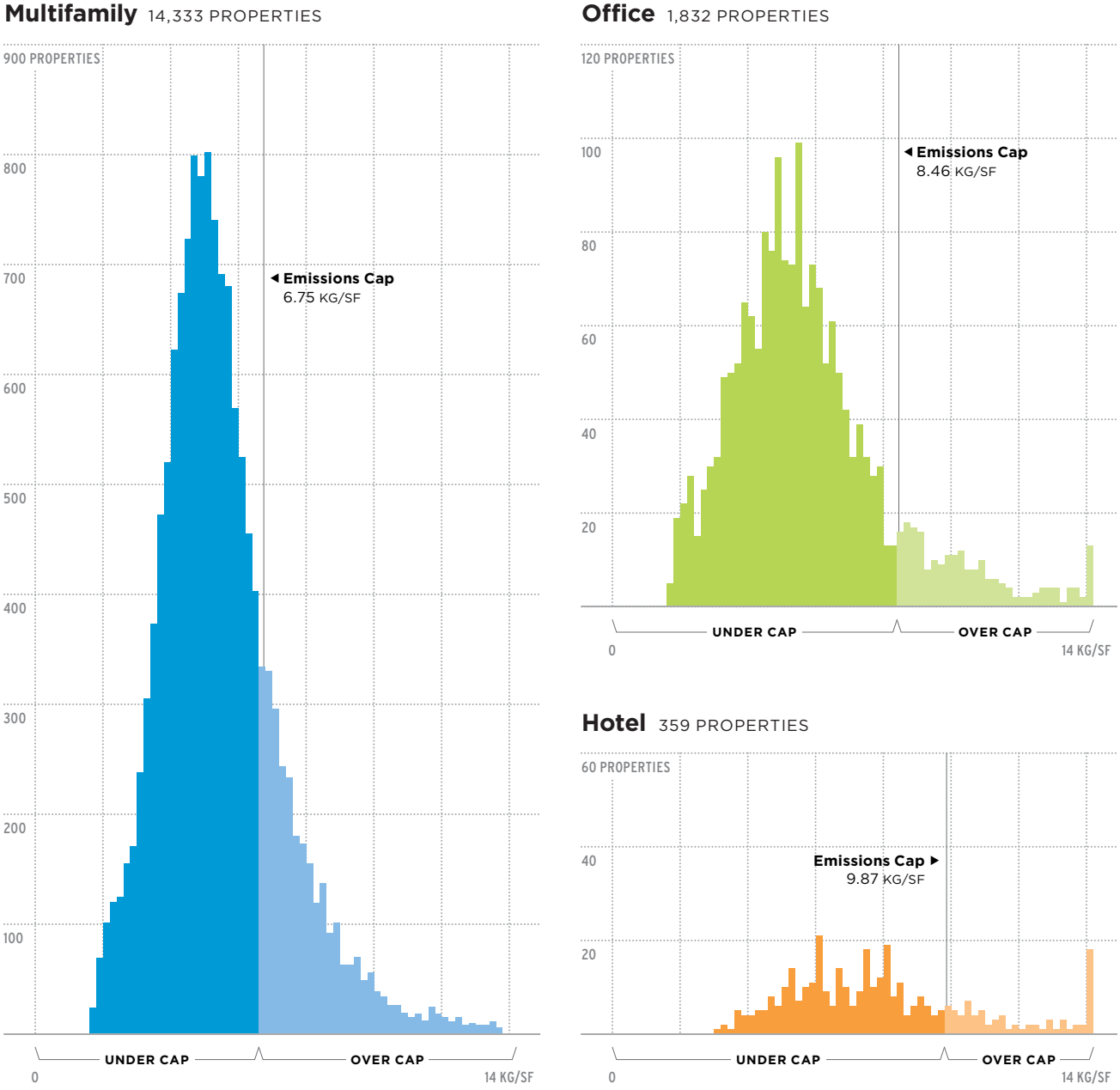
- **A** score is equal to or greater than 85;
- **B** score is equal to or greater than 70 but less than 85;
- **C** score is equal to or greater than 55 but less than 70;
- **D** score is less than 55;
- **F** for buildings that didn't submit required benchmarking information;
- **N** for buildings exempted from benchmarking or not covered by the Energy Star program.

October 2020 marked the first time benchmarked buildings were required to display a Building Energy Efficiency Rating, which includes a letter grade and score.

FIGURE 12

Carbon Emissions Intensities by Building Sector, 2019

Data: *LL84 2019 filtered for data quality, emissions and energy (Emissions recalculated using 2024-2029 emissions factors in LL97)*



	Multifamily Properties	Office Properties	Hotel Properties
CARBON EMISSIONS CAP	6.75 KG/SF	8.46 KG/SF	9.87 KG/SF
PROPERTIES UNDER CAP	**11,384** (79%)	**1,624** (89%)	**283** (79%)
PROPERTIES OVER CAP	**2,949** (21%)	**208** (11%)	**76** (21%)
20%+ Over Cap	1,239 (9%)	101 (6%)	37 (10%)

Approximately 3,000 multifamily properties will need to lower their emissions before 2024. This analysis assumes that properties benchmarked as 'Multifamily housing' would be classified entirely as Residential Group R-2, buildings with more than two dwelling units occupied for permanent resident purposes.[15] Large and midsize apartment buildings are defined by this occupancy group. Last year, large properties were responsible for over half of benchmarked greenhouse gas emissions. Many multifamily properties over their 2024 emissions cap have high occupant density.

Had the emission limits of the law been in effect during 2019, roughly 20 percent of these properties would have been over their cap.[16] Midsize multifamily buildings have consistently been higher emitters than their larger counterparts. Nearly 30 percent of those properties, or approximately 1,700, will need to lower their emissions before 2024.[17]

Occupancy influences energy use and emissions in multifamily buildings—energy efficiency grades take occupancy into account but the carbon caps do not. Both midsize and large multifamily buildings that exceed the LL97 2024 cap often share a trait: high occupant density. This is the case for all of the multifamily properties that earned an energy efficiency grade of A or B but exceed their carbon cap. Those properties have apartments with nearly twice the typical bedroom density in multifamily housing.

Only 11 percent of offices are over the 2024 emissions cap. In 2019, offices were responsible for about one-fifth of benchmarked greenhouse gas emissions. This analysis assumes that occupancy in properties benchmarked as 'Office' would be classified entirely as Business Group B, buildings for office, professional, service-type transactions.[18]

Office emissions have steadily fallen since 2015, and only 11 percent of these properties need to make changes to meet 2024 emission limits. Only seven offices that received an A or B Energy Efficiency Grade were over the 2024 carbon intensity limits, and five of those have data centers that add a large electrical load to their energy use. Efficiency grades take data centers into account, while carbon caps are the same regardless of the presence of data centers.

Hotels are more energy and carbon intensive than offices and multifamily buildings in NYC. Hotels can be benchmarked by one primary property type: 'Hotel.' Last year, these properties were responsible for 5 percent of benchmarked greenhouse gas emissions. This analysis assumes that properties benchmarked as this type would be classified entirely as Residential Group R-1, residential buildings or spaces occupied transiently, for a period less than one month.[19]

Hotels are more energy intensive than offices and multifamily buildings in NYC. They also are more carbon intensive. Over 21 percent of benchmarked hotels will need to cut emissions to get under their 2024 caps. Twenty-one of those properties will have to cut emissions by 40 percent or more. About half of all benchmarked hotel properties have fitness centers, but their presence did not have a measurable impact on their efficiency grades or carbon intensities.

About the Law

Local Law 97 regulates emissions from most midsize and large buildings and sets emissions intensity limits (metric tons of CO_2e per square foot) according to 10 building categories based on Building Code occupancy groups. Properties over their limit are subject to fines. But arriving at a limit for each individual building is complex. Mixed-use buildings, such as a residential apartment building with a ground floor supermarket, will have a limit that reflects its unique blend of occupancy groups.

The table below Figure 12 shows the law's 2024 limits for multifamily apartments, offices and hotels. These are carbon intensities converted to kilograms of carbon dioxide equivalent per square foot.

Contributors

Special thanks to everyone who helped create this report.

Advisors

Bartosz Bonczak
New York University, Marron Institute of Urban Management

Zineb Bouzoubaa
New York City Mayor's Office of Sustainability

David Hsu
Massachusetts Institute of Technology

Richard Leigh
Pratt Institute

Ross MacWhinney
New York City Mayor's Office of Sustainability

Cecil Scheib
New York University

Dana Schneider
Empire State Realty Trust

Danielle Spiegel-Feld
New York University, Guarini Institute for Global Legal Studies

Anna Weingord
CodeGreen Solutions

Urban Green Council Staff

PROJECT LEADS

Sean Brennan
Associate Director, Research

Adam Schiabor
Coordinator, Research

Sheena Thiruselvan
Associate Director, Communications

PROJECT TEAM

Chris Anjesky
Managing Director

Rebecca Elzinga
Coordinator, Education Development

Chris Halfnight
Associate Director, Policy

Melissa Hom
Coordinator, Education

Ellen Honigstock
Director, Education

Izabella Kornak
Intern, Research

John Mandyck
Chief Executive Officer

Danielle Manley
Associate Manager, Policy

Consultants

Jodi Zucker
Editorial Consultant

Rebecca Hume
Graphic Design

Notes

1 This Inventory tracks energy use and emissions from all sources citywide. However, it is based on utility level data, so it does not offer insight into energy use from building to building.

2 NYC Health, "New York City Community Air Survey Neighbor Air Quality 2008-2018". Retrieved from: https://nyc-ehs.net/nyccas2020/web/report

3 "Public disclosure of source energy use and Energy Star scores can lower source energy use by 6% in first three years after implementation."

Meng, Ting, David Hsu, and Albert Han. Estimating energy savings from benchmarking policies in New York City. Energy, 133 (August 2017): 415-423. https://hdl.handle.net/1721.1/123985

4 Figure 2 is based on electricity and district steam carbon coefficients used in the NYC GHG Inventory. These are lower than those used in Portfolio Manager (PM) and more accurate for NYC. This analysis uses the latest information from the Inventory, which was updated in October 2020. This differs from the Figure 1 in NYCEW 2017, which used the PM benchmarked emissions.

NYC Mayor's Office of Sustainability, "Inventory of New York City Greenhouse Gas Emissions". Retrieved from: https://nyc-ghg-inventory.cusp.nyu.edu/

5 Benchmarked categories come from the Energy Star Portfolio Manager tool, which has more than 80 property types. Building owners use it to submit their benchmarking data.

Energy Star Portfolio Manager, "U.S. Property Types, Definitions, and Use Details". Retrieved from: https://www.energystar.gov/sites/default/files/tools/US_PropertyTypesUseDetails_Definitions_Final_KAB508c.pdf

6 Urban Green Council (2017). *New York City's Energy and Water Use 2014 and 2015 Report*. https://urbangreencouncil.org/sites/default/files/energy_and_water_use_report_spreads.pdf?_ga=2.81920086.1143163967.1581448079-470442146.1578596722

7 "Among residential residual fuel burning buildings in 2011, these data reveal no differences in age of buildings or boilers between Uptown and the rest of NYC. However, looking at building size as measured by the total number of units, buildings that converted to cleaner fuels tended to be larger (mean = 89.2) than buildings that continued to use residual fuels (mean = 59.5). This may be a proxy for differences in financial resources available to landlords."

Carrión, Daniel, Lee, W. Victoria, Hernández, Diana. (2018). *Residual Inequality: Assessing the Unintended Consequences of New York City's Clean Heat Transition*. International Journal of Environmental Research and Public Health, 15(117), 10.3390/ijerph15010117. https://www.mdpi.com/1660-4601/15/1/117

8 NYC Health. (2017). *The New York City Community Air Survey: Neighborhood Air Quality 2008–2015*. https://www1.nyc.gov/assets/doh/downloads/pdf/environmental/comm-air-survey-08-15.pdf

9 "Across all building sizes, a total of 1,724 (53%) of all residential residual fuel burning buildings are located in Northern Manhattan and the Bronx."

Carrión, Daniel, Lee, W. Victoria, Hernández, Diana. (2018). *Residual Inequality: Assessing the Unintended Consequences of New York City's Clean Heat Transition*. International Journal of Environmental Research and Public Health, 15(117), 10.3390/ijerph15010117. https://www.ncbi.nlm.nih.gov/pmc/articles/PMC5800216/

10 Hotel occupancy was 80.8 percent in 2010 and 88.3 in 2018.

NYC & Company. (2019). *NYC Hotel Occupancy, ADR & Room Demand: 5 Year Trend Report*. https://assets.simpleviewinc.com/simpleview/image/upload/v1/clients/newyorkcity/FYI_Hotel_reports_February_2019_8607015b-b32a-4c7f-9fbd-84cd2a93cbe6.pdf

New York City Department of City Planning. (2017). *NYC Hotel Market Analysis: Existing Conditions and 10-Year Outlook*. https://www1.nyc.gov/assets/planning/download/pdf/plans-studies/m1-hotel-text/nyc-hotel-market-analysis.pdf

11 "Process evaluations on the code training provided during the legacy Advanced Energy Codes Program found that **NYSERDA's training had a positive impact on compliance**. Additionally, a majority of the more than 7,000 code officials, architects, engineers, and other participants in NYSERDA's training activities have indicated that NYSERDA's training on code compliance helped them grapple with the complexities of the energy code and improve compliance."

NYSERDA. (2020). *Clean Energy Fund: Codes Chapter 22.1*. https://www.nyserda.ny.gov/-/media/Files/About/Clean-Energy-Fund/CEF-Codes-Chapter.pdf

12 Commercial property Energy Star scoring is calibrated against data from the Commercial Building Energy Consumption Survey (CBECS) data updated in August 2018. Newer and more efficient buildings drove down median site and source energy use intensities, and that led to lower Energy Star scores nationwide.

Energy Star Portfolio Manager, "Updates to ENERGY STAR metrics with new market data" Retrieved from: https://www.energystar.gov/buildings/facility-owners-managers/existing-buildings/use-portfolio-manager/update-energy-star-scores-cbecs

13 Annual energy used on a property is normalized for weather and adjusted according to factors that differ by primary use. Energy Star Scores are based on these uses and adjustments.

Energy Star Portfolio Manager, "How the 1-100 ENERGY STAR score is calculated" Retrieved from: https://www.energystar.gov/buildings/facility-owners-and-managers/existing-buildings/use-portfolio-manager/understand-metrics/how-1-100

14 LL95 *redefined* the grades with ranges shown on page NN, but LL33 originally had different ranges: As were given for scores greater than or equal to 90; Bs were given for scores greater than or equal to 50 but less than 90; Cs were given for scores greater than or equal to 20 but less than 50; and Ds were given for scores below 20.

Local Law of New York City for the Year 2019 No. 95: Retrieved from: https://www1.nyc.gov/assets/buildings/local_laws/ll95of2019.pdf

15 Building occupancy groups are defined by the NYC Building Code:

NYC Buildings. "2014 Construction Codes: Building Code: Chapter 3: Use and Occupancy Classification". Retrieved from: https://www1.nyc.gov/assets/buildings/apps/pdf_viewer/viewer.html?file=2014CC_BC_Chapter_3_Use_and_Occupancy_Classification.pdf&section=conscode_2014

16 Many apartment buildings, such as those with rent-regulated units, are not subject to emissions limits. A rent-regulated building would instead complete a list of efficiency improvements that include weatherization, steam heat fixes and lighting upgrades. Intro 1947 of 2020 was passed by New York City Council on October 29, 2020. It amends the definition of rent regulated accommodations to include only dwellings in which more than 35 percent of the dwelling units are required to be rent regulated.

Intro 1947 of 2020: Retrieved from: https://legistar.council.nyc.gov/LegislationDetail.aspx?ID=4546846&GUID=B410B4EB-8551-48EE-984A-65D40E9B628A&Options=ID%7CText%7C&Search=1947

17 Lowering emissions through energy efficiency is one pathway to compliance, but properties may also comply by purchasing carbon offsets, renewable energy credits or installing clean distributed energy resources.

18 Building occupancy groups are defined by the NYC Building Code:

NYC Buildings. "2014 Construction Codes: Building Code: Chapter 3: Use and Occupancy Classification". Retrieved from: https://www1.nyc.gov/assets/buildings/apps/pdf_viewer/viewer.html?file=2014CC_BC_Chapter_3_Use_and_Occupancy_Classification.pdf&section=conscode_2014

19 Building occupancy groups are defined by the NYC Building Code:

NYC Buildings. "2014 Construction Codes: Building Code: Chapter 3: Use and Occupancy Classification". Retrieved from: https://www1.nyc.gov/assets/buildings/apps/pdf_viewer/viewer.html?file=2014CC_BC_Chapter_3_Use_and_Occupancy_Classification.pdf&section=conscode_2014

NYC Building Footprint Images

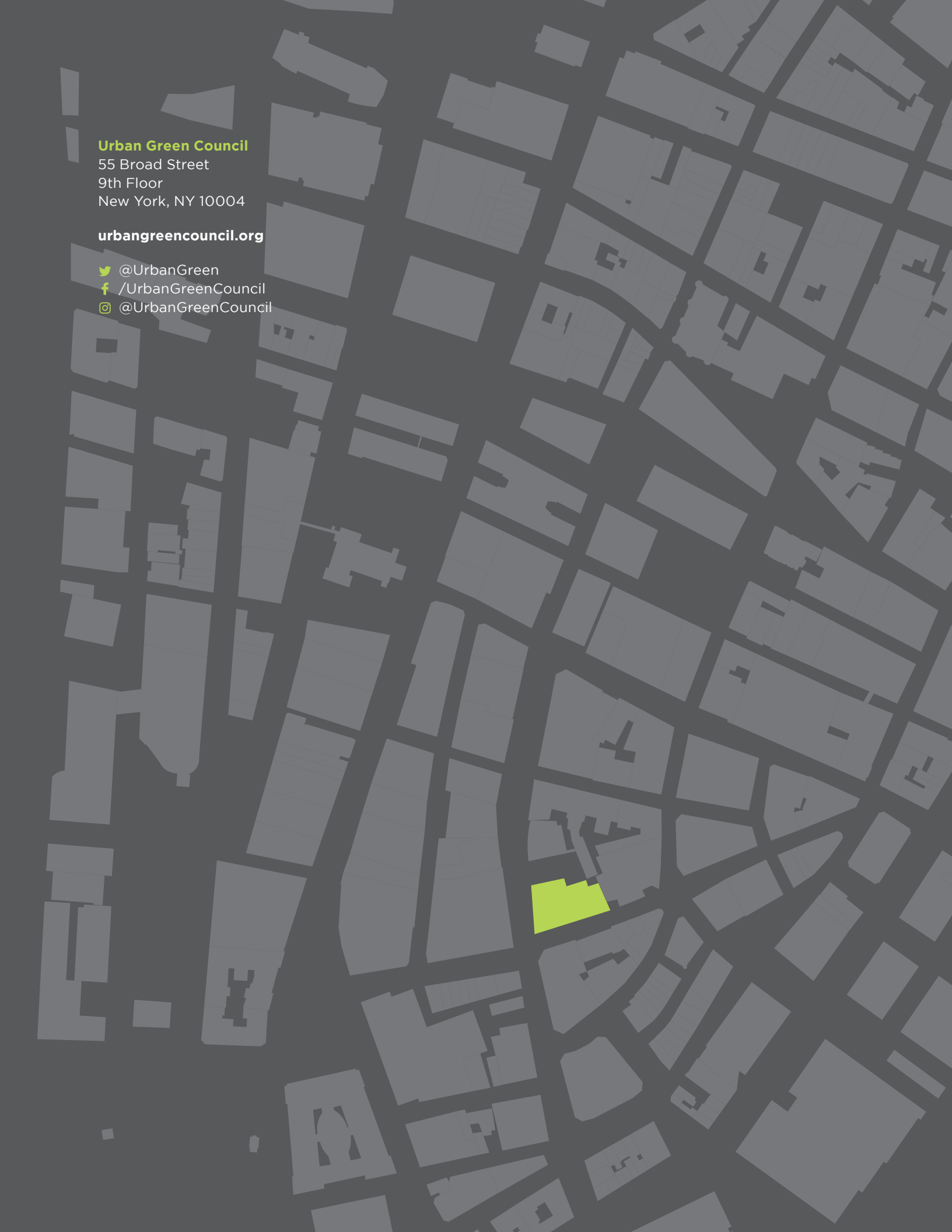
Cover Financial District, Manhattan

Page 4 Long Island City, Queens

Page 8 Crown Heights, Brooklyn

Page 22 Hunts Point, Bronx

Page 28 Graniteville, Staten Island



Urban Green Council
55 Broad Street
9th Floor
New York, NY 10004

urbangreencouncil.org

@UrbanGreen
/UrbanGreenCouncil
@UrbanGreenCouncil