8

Greenprint Performance Report™

VOLUME 8

ULI Greenprint Center for Building Performance

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Berkshire Communities

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Strategic partners

2030 Districts Network

City Energy — A Joint Project of NRDC + IMT

ENERGY STAR

IMT Institute for Market Transformation

NRDC

nbi new buildings institute

BBP Better Buildings Partnership

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Introduction

ABOUT THIS REPORT

For the real estate industry, improved environmental performance can reduce operating expenses, increase tenant demand, lead to more efficient management of natural resources, and increase property value. This report tracks industry progress on improved performance using Greenprint-member and strategic-partner properties as a proxy to demonstrate the progress that can be achieved industrywide. Greenprint members have been working together on sustainability strategies for over eight years and offer a unique view into the best practices that drive performance and create financial value, as well as trends that will have a positive impact on real estate in the years ahead. The content of this report can be leveraged by any real estate owners, investors, or operators interested in creating property value through improved environmental performance.

ABOUT THE URBAN LAND INSTITUTE

The Urban Land Institute is a global, member-driven organization comprising more than 40,000 real estate and urban development professionals dedicated to advancing the Institute's mission of providing leadership in the responsible use of land and creating and sustaining thriving communities worldwide.

The extraordinary impact that ULI has on land use decision making is based on its members sharing expertise on a variety of factors affecting the built environment, including urbanization, demographic and population changes, new economic drivers, technology advancements, and environmental concerns.

ABOUT THE ULI GREENPRINT CENTER

The ULI Greenprint Center for Building Performance is a worldwide alliance of leading real estate owners, investors, and strategic partners committed to improving the environmental performance of the global real estate industry. Through measurement, benchmarking, knowledge sharing, and implementation of best practices, Greenprint and its members strive to reduce greenhouse gas emissions by 50 percent by 2030.

Greenprint is a catalyst for change, helping real estate owners and investors take meaningful and measurable actions to advance environmental performance and overcome market barriers. Greenprint and its members develop and implement sustainability best practices and help lead the real estate industry toward harmonized global standards for environmental performance metrics and benchmarking. Members use the Greenprint Environmental Management Platform to track, report, benchmark, and analyze energy, emissions, water, and waste performance for properties, funds, and portfolios. The platform supports comprehensive data management and analysis, which enables members to take actions toward improving performance and reducing cost. On an ongoing basis, Greenprint endeavors to demonstrate the correlation between environmental performance and enhanced property value.

GLOBAL REACH OF GREENPRINT MEMBERS AND STRATEGIC PARTNERS

OVER €868.8 BILLION
($1,021 BILLION)
IN REAL ESTATE ASSETS UNDER MANAGEMENT

8,684 PROPERTIES
IN THE GREENPRINT PORTFOLIO

OVER €30.6 MILLION
($36.4 MILLION) ANNUAL
ENERGY AND WATER COST SAVINGS

175 MILLION M²
(1.9 BILLION FT²)
COVERED

28 COUNTRIES
REPRESENTED IN THE PORTFOLIO

Introductory Letter

For the seventh year in a row, members of the Greenprint community have improved the environmental and financial performance of their properties, exceeding annual targets needed to achieve their goal of reducing carbon emissions by 50 percent by 2030! Since 2009, the Greenprint community has demonstrated great leadership in its commitments and actions. They have shown that improving environmental performance can not only reduce operating costs, save natural resources, and reduce pollution, but can also positively impact investor relations, tenant demand, and asset value.

This year, the convergence of dynamic market drivers (including investor mandates, tenant demand, and regulation) and recent extreme weather events has shed new light and broadened interest in climate change, resource efficiency, and long-term resilience. The year 2017 is on track to be the warmest since record keeping started over a century ago. Earth's temperature is rising, and if this trajectory continues unchecked, we can expect to see even more dramatic increases in the frequency and intensity of heat waves, floods, and droughts. Climate change is a global issue: true progress can only be achieved if all cities, companies, and individuals are engaged and committed to act.

> "Climate change is a global issue: true progress can only be achieved if all cities, companies, and individuals are engaged and committed to act."

Public and private sector leaders are reaffirming their carbon emissions reduction commitments. Real estate owners, investors, and tenants, like those in the Greenprint community, continue to see the value in working together to achieve the environmental performance targets set nearly a decade ago. In the public sector, nearly 7,500 cities have signed on to the Global Covenant of Mayors, which helps local governments become active contributors to a global climate solution. Similarly, 168 countries have ratified the Paris Climate Accord. To adapt to evolving environmental and climate-related vulnerabilities, building owners and policy makers are thinking about ways to protect against the possibility of eroding asset value. Leaders in the real estate industry that have committed to mitigation and adaptation strategies are already benefitting from asset value preservation and creation.

To support city-scale sustainability programs and because many environmental programs and challenges are local in nature, Greenprint has committed to partnering with the City Energy Project and the 2030 District Network. Through strong public/private relationships the real estate industry can establish stronger city-specific benchmarks and address local climate risk strategies. We can also create a network effect, where local organizations like 2030 Districts, City Energy Project participants, ULI District Councils and others can share resources to elevate our collective knowledge base and impact.

To help Greenprint members and the industry generate lasting asset value, ULI is continuing to integrate sustainability and responsible investing concepts into some of its traditional areas of expertise, such as capital markets and infrastructure. The ULI Center for Sustainability and Economic Performance, which includes ULI Greenprint, the Tenant Energy Optimization Program, the Building Healthy Places Initiative, and the Urban Resilience Program, is focused on defining the business case to address the opportunities and challenges surrounding responsible property investment. By providing broad content and innovative programming, ULI and Greenprint will continue to be a resource for the real estate community.

We would like to acknowledge the outstanding leadership of our members, partners, and collaborators. Thank you for your contributions and inspiration. We look forward to working with you in the years ahead.

Charles B. Leitner III
Chairman Emeritus,
ULI Greenprint Center

Helen A. Gurfel
Executive Director,
ULI Greenprint Center

Executive Summary

Greenprint Performance Report™, Volume 8, is the largest global collection of transparent, verifiable, and comprehensive property data, providing aggregate benchmarks and performance trends for the real estate industry. This report is based on analysis of data Greenprint and its members collected on 8,684 properties across 175 million square meters (1.9 billion square feet) of building area in 28 countries.

Highlights from this year's report:

For the seventh year in a row, properties participating in Greenprint achieved reductions in energy consumption, carbon emissions, and water use. For those buildings participating in Greenprint **since its inception in 2009, energy consumption decreased by 13.9 percent, greenhouse gas emissions by 17.9 percent, and water use by 12.1 percent.** (See page 12.)

From 2015-2016, Greenprint members decreased same building:

- **energy consumption by 3.4 percent**
- **greenhouse gas emissions by 3.3 percent**
- **water use by 4.3 percent**

(See page 14.)

In 2016, Greenprint members invested in projects that saved over $36 million in utility expenses, **creating more than $500 million in property value.** (See page 15.)

These results put the Greenprint portfolio on track to outperform Greenprint's long-term goal of reducing carbon emissions by 50 percent by 2030. (See page 13.)

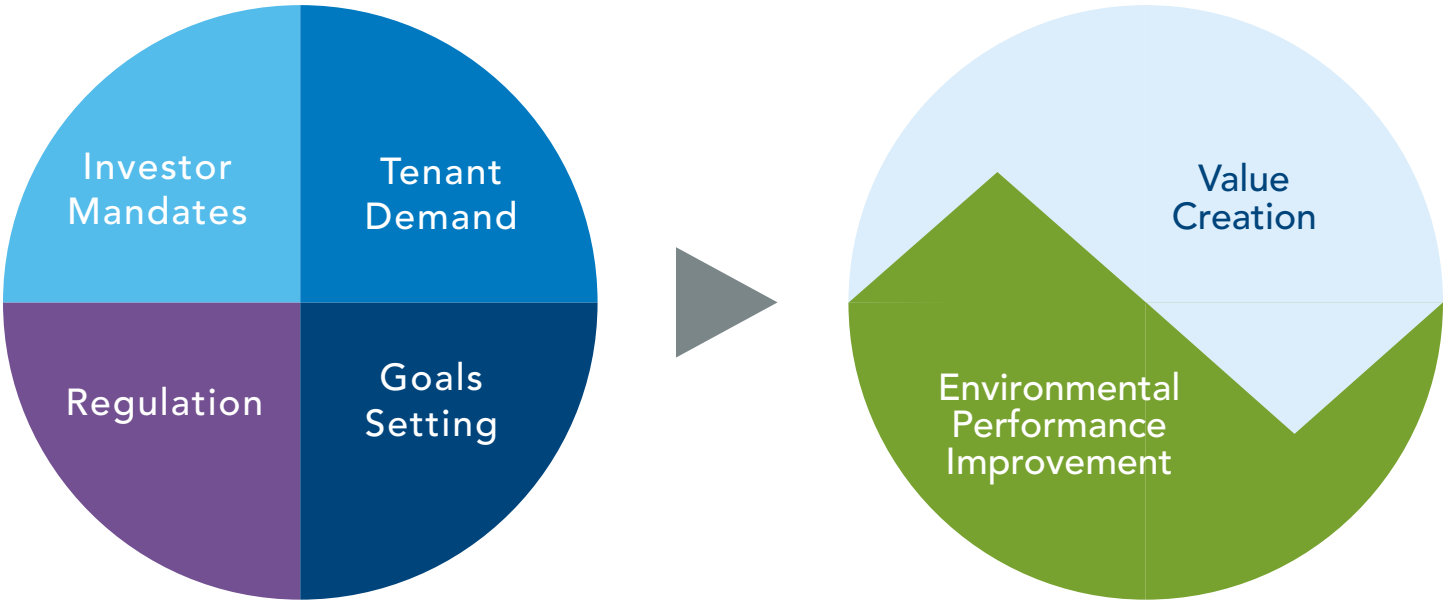
Market drivers, including investor mandates, tenant demand, goal setting, and regulation, motivate owners to improve environmental performance and create financial value through the implementation of best practices. (See page 7.)

This year's **emerging trends** highlight new opportunities to capitalize on ongoing market and technology trends, including the future of the energy grid, efficiency legislation, and resilience. (See page 17.)

Market Drivers

ULI's industry engagement provides a unique vantage point from which to identify market drivers that are leading to the improved environmental performance of the real estate industry. These drivers include investor mandates, tenant demand, regulation, and goal setting. The best practices identified in this section show how responding to market drivers has created economic and environmental value for organizations in the real estate industry.

ENVIRONMENTAL PERFORMANCE MARKET DRIVERS



INVESTOR MANDATES: DRIVING THE MARKET FORWARD

Investors across the world are increasingly asking fund managers and prospective partners about their environmental, social, and governance (ESG) programs and performance. Many of the largest investors see value in managing ESG metrics to further financial performance.

Focus on sustainable and responsible investing has grown significantly over the past several years, with investment in the United States surpassing $8.5 trillion in 2016 and accounting for over 20 percent of the value of professionally managed assets. The number of asset managers who apply ESG criteria to their investment philosophy has nearly doubled, growing from $4.8 trillion in 2014 to over $8.5 trillion today.[1]

> "At companies where ESG issues are handled well, they are often a signal of operational excellence. BlackRock has been undertaking a multiyear effort to integrate ESG considerations into our investment processes, and we expect companies to have strategies to manage these issues."
>
> — Larry Fink, chief executive officer of BlackRock, in a letter sent to CEOs of companies in which BlackRock is invested (BlackRock has over $4.6 trillion in assets under management)

Investors are looking for ways to identify sustainable real estate portfolios and managers. To that end, investors are asking managers to participate in programs and benchmarks such as Greenprint.

> "CalPERS and our core managers work with Greenprint to identify opportunities to reduce energy usage and operating costs as part of our overall effort towards more sustainable investments."
>
> — Theodore Eliopoulos, chief investment officer, CalPERS

Other programs, tools, and reporting systems include:

- The United Nations Principles for Responsible Investment (UNPRI) Initiative works with more than 1,000 investors representing over $70 trillion in assets under management to incorporate six key ESG criteria into their investment processes.
- The Global Real Estate Sustainability Benchmark (GRESB) is engaged in assessing the sustainability performance of $3.7 trillion in real estate companies and funds. This includes scoring ESG performance in order to provide transparency to investors interested in gaining insight into their real estate investments.
- The Global Reporting Initiative (GRI) helps businesses and other organizations capture and communicate the impacts of business on critical sustainability issues such as climate change, human rights, and corruption, among others. This is accomplished through a standard reporting framework used by 92 percent of the world's 250 largest corporations to communicate their sustainability performance.

Although these initiatives all have slightly different focus areas and implementation methodologies, they all have a similar goal—ensuring that investments are creating value by considering long-term ESG risks, such as the impacts of climate change.

TENANT DEMAND: NEXT-GENERATION TENANT SPACES

While investor demand shapes the evolution of sustainable real estate development from the top down, tenant demands are driving it from the bottom up. Many major tenants incorporate sustainability as part of their leasing criteria, including TD Bank, PwC, and the General Services Administration. To improve the performance of tenant spaces, ULI's Tenant Energy Optimization Program helps owners and tenants work together by offering a returns-based approach to integrating energy efficiency into tenant space design and construction that leads to reduced energy use and costs. This program also aligns with the U.S. Environmental Protection Agency (EPA) Energy Star Tenant Space recognition, helping tenants receive acknowledgement for their investments in more-efficient spaces. In addition, owners and tenants are embracing other programs that embody next-generation tenant areas, like health and wellness initiatives, which continue to gain traction as stakeholders in the built environment recognize their importance and potential value. One recent example is real estate developers in Singapore that emphasize indoor air quality expect property values to increase by 1.3 to 4 percent, reinforcing their focus on tenant health and satisfaction.[2] The following profiles provide additional examples of tenant-focused projects that add property value.

Net-Zero Multifamily Property Drives Returns

Global real estate company GID combined the focus on tenant wellness with energy efficiency in the recently completed Hanover Olympic multifamily development in Los Angeles. Beyond formaldehyde-free thermal insulation, Green Label carpet and cushions, low-VOC adhesives, sealants, and paints, the community includes 20 net-zero-energy solar-powered homes, where 4,500 square feet of solar panels provide 65.5 kilowatts of emissions-free electricity capacity. LED lighting, Nest learning thermostats, and Energy Star appliances were some of the technologies employed to reduce the total energy needed to power the homes. The net costs to GID per unit after rebates was $23,000, with a total annual utility bill savings of $13,705 ($685 per unit). These higher-cost but tenant-focused features ultimately created value for GID, resulting in a rent premium of 4.8 percent.

Daylight and Views Boost Tenant Satisfaction

Tenant desire for unobstructed views, daylighting, and a modern aesthetic has made large windows one of the most desirable design elements today. At Lake Union, a 45-year-old office building in Seattle owned by Henbart LLC, the lakefront views are a major selling point, but the sun reflecting off the water often required the blinds to remain closed. In addition, the windows transferred solar heat, making tenants uncomfortable and increasing use of ventilation and air-conditioning equipment and energy costs. To address these issues and help reposition the building for modern tenants, Henbart replaced the windows with View Inc.'s Dynamic Glass, which automatically tints in response to outside conditions using a sophisticated intelligence engine. The window upgrade reduced building energy use by 18 percent, saving almost $28,000 annually, and eliminated the need for shades. "We are delighted our work environment helps our people be more productive and excited to come to work," said Mark Spagnola, president of Portfolio Communications, a building tenant. "We were thinking about moving out, but now we've decided to extend our lease."

Transforming Underused Space into a Tenant Amenity

At PGIM Real Estate's Energy Star and LEED Gold certified 1015 Half Street office building in Washington, D.C., 15,000-square-feet of green roof was converted into an urban farm, transforming an under-utilized landscape into productive farmland while enhancing compliance with local stormwater regulations. The roof yields four tons of produce annually – including lettuce, eggplants, peppers, cucumbers, carrots, flowers, and herbs – that is primarily used by office building tenants and local restaurants. The retail value of this produce is around $40,000. With the development of the rooftop farm, the building has a desirable rooftop event space and tenants can subscribe to a weekly fresh produce delivery. Property management has also eliminated all roof maintenance costs, saving PGIM Real Estate an estimated $10,000 per year. Beyond operations savings, the farm also strengthens PGIM Real Estate's community ties by engaging local school-children in the food growing process.

REGULATION: WHAT'S WORKING?

Around the world, cities, states, and national governments have passed building ordinances and codes in an effort to reduce emissions from the global real estate sector, which accounts for about 40 percent of global emissions.

To achieve local and national targets for emissions reductions, a wide range of policies have been implemented, including energy codes, mandatory energy benchmarking, required emissions targets, and financing for new technologies. These policies aim to improve building efficiency, reduce air pollution, and reduce climate risk.

Global adoption of energy efficiency regulations for commercial buildings, including Energy Performance Certificates across the European Union; mandatory benchmarking in 26 U.S. cities and states, as well as in Tokyo and Singapore; and mandatory energy codes for most countries in North America, Europe, and Asia are already driving change. Among organizations investing in energy efficiency, 23 percent listed compliance with government mandates, policies, or guidelines as a top reason for making improvements.[3] While the impacts of this legislation are still being measured, some have already achieved success.

Building energy codes

Mandatory building codes set a baseline for performance and can influence a building's environmental impacts and financial costs from construction through maintenance and operation. While bringing a building up to code requires an upfront investment, every incremental dollar spent to comply with building energy codes has been shown to yield $6 in utility savings.[4]

Building codes, appliance standards, and vehicle standards accounted for over 20 percent of the energy efficiency investments in 2016, estimated to be over $20 billion.[5]

Building ratings/ certifications

In Australia, the National Australian Built Environment Rating System (NABERS) evaluates the environmental performance of commercial buildings. In 2010, NABERS assessments became mandatory during the sale or lease of office properties with over 2,000 square meters of space. Since then, over 75 percent of office properties have been rated.[6] NABERS integrates environmental performance into property management, influencing investment decisions and becoming a key metric for tenants. Ratings are assigned annually and based on a building's performance in relation to its peers, creating constant pressure to improve environmental performance in order for a building to remain an attractive asset. NABERS office buildings report annual reductions of 8.5 percent in energy use and 11 percent in water use. Offices with high NABERS ratings (four to six stars) consistently achieve higher annualized returns.[7]

Benchmarking

In the United States, an early Environmental Protection Agency (EPA) study of benchmarking effectiveness identified a 7 percent reduction in energy use at properties consistently tracking their data over a three-year period.[8] In New York City properties, data show that benchmarking legislation led to a 6 percent reduction within three years and a 14 percent reduction by the fourth year of the policy.[9] Across four cities with benchmarking and disclosure laws, energy expenditures in benchmarked buildings are 3 percent lower than those in buildings not covered by the law, clearly adding value by lowering net operating costs.[10] In a survey of facility managers with buildings that are required by the local benchmarking ordinance to report data, 77 percent made operational changes because of the law. For managers compliant with the legislation who also made capital investments in new equipment, 79 percent did so specifically to reduce operating costs, and 35 percent did so after receiving their benchmarking results.[11]

GOAL SETTING: PORTFOLIO-WIDE INNOVATION

Many private sector leaders have taken the initiative to publicly state sustainability goals because they want their commitment to match that of their tenants and investors, as well as of the cities and countries in which they operate, many of which have joined such programs as "We Are Still In," RE100, and Science Based Targets. To achieve their ambitious goals, many real estate owners have begun implementing multi-property retrofits, technology upgrades, and operational improvements. By considering their goals across a portfolio, building owners can use investment capital responsibly, ensuring that each dollar spent achieves the maximum return in financial and environmental value. The following examples show specific goals set and the strategies implemented to achieve them.

Goal: 200 Megawatts of Solar Energy and a 20 Percent Reduction in GHG Emissions by 2020

Prologis, a leading provider of sustainably designed warehouse and distribution centers, continually invests in improving rooftops across its portfolio. This investment in a previously overlooked space results in economic and environmental benefits, including reduced greenhouse gas (GHG) emissions.

Across its portfolio of more than 3,000 rooftops in 19 countries, Prologis has implemented rooftop solar energy generation, well-insulated roofing for maximum thermal performance, cool roofs to reduce the heat-island effect, skylighting to enhance daylight harvesting, and rooftop parking to accommodate commuters in dense environments. By 2016, 36 percent of Prologis rooftops had implemented cool/reflective roofing.

Prologis rooftops also host more than 165 megawatts of solar energy generation, enough to power 24,500 average-size U.S. homes, generating additional revenue from the property and helping the company meet its renewable portfolio goals.

Goal: Reduce Energy Use by 50 Percent across a Portfolio by 2023

Grosvenor's 300-acre London estate has a wide range of heritage buildings. To achieve Grosvenor's sustainability goals, the company was obligated to find a way to maintain the historic fabric of the estate while ensuring that each home, office, or retail unit has a positive impact on the environment and is pleasant to occupy.

Grosvenor's estate-wide retrofit program upgraded 150 residential units in 2016, for a total of 300 properties since 2013. The conversion of one hotel into three apartment buildings earned the first listed residential BREEAM "outstanding" certification. Grosvenor estimates that by looking for retrofit opportunities across its residential portfolio, instead of on an asset-by-asset basis, it achieved a 4 percent reduction in energy use in an extremely cost-effective manner from 2015 to 2016.

Goal: 20 Percent Reduction in Energy Use Intensity by 2020

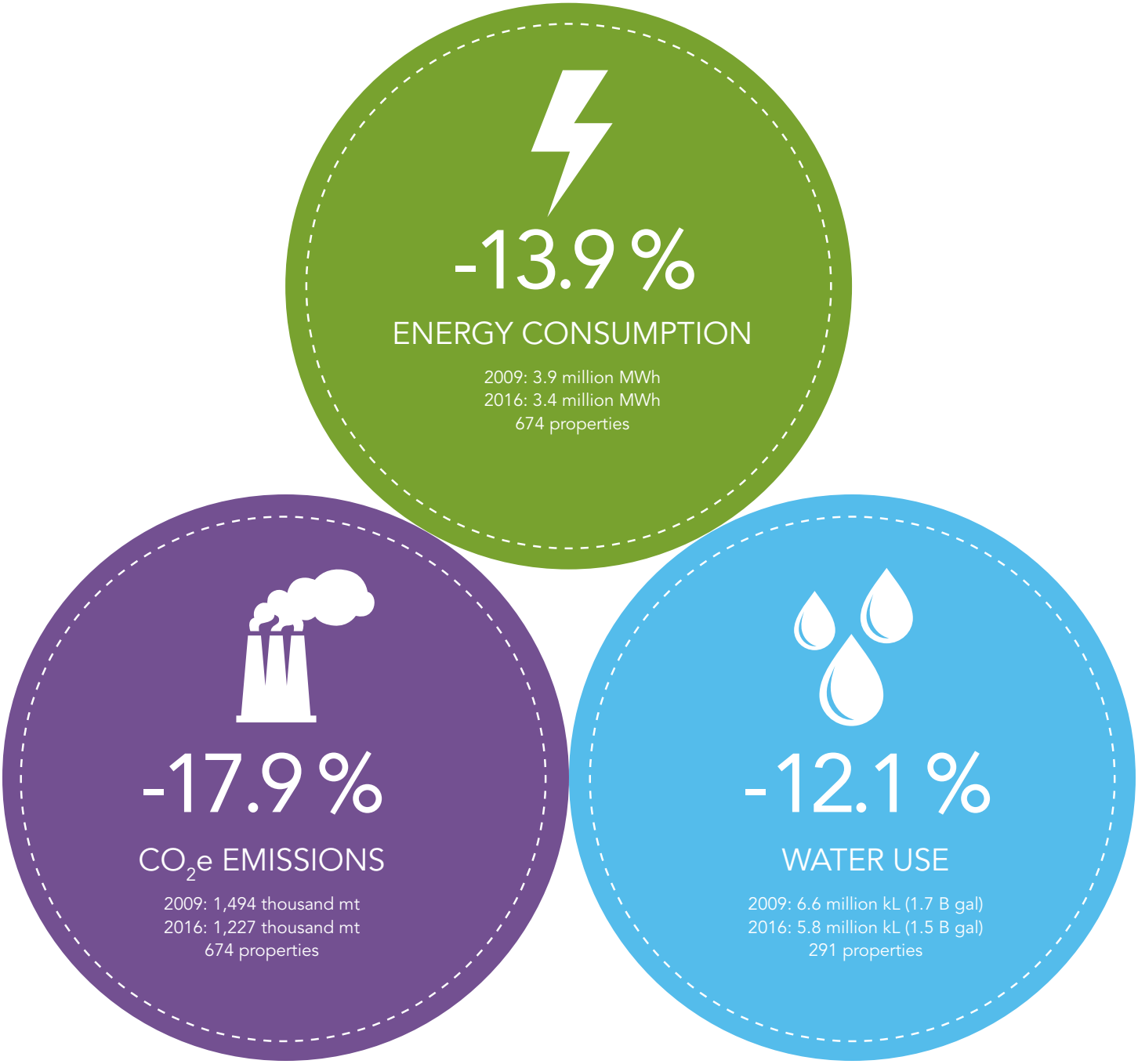
Beyond implementing energy projects like LED conversions and HVAC improvements, CommonWealth engages tenants to help them make smarter choices and provides property managers with resources and awards to recognize their efforts. By taking this approach, CommonWealth Partners achieved its 2020 GHG emissions-reduction goals four years early.

Performance-goal guides and tools help property managers track progress as well as address the health and wellness of tenants. Property managers are also eligible for awards like "Conserving Innovator" and "Most Enthusiastic," promoting competition and honoring specific individuals for their contributions. Proving that competition can create value, three CommonWealth properties that entered the EPA's industrywide Battle of the Buildings Bootcamp competition achieved $390,041 in cumulative savings over three months by reducing energy use by 20,061 megawatt-hours and water use by 367 million gallons.

Results Since Inception

ULI GREENPRINT PERFORMANCE, 2009–2016

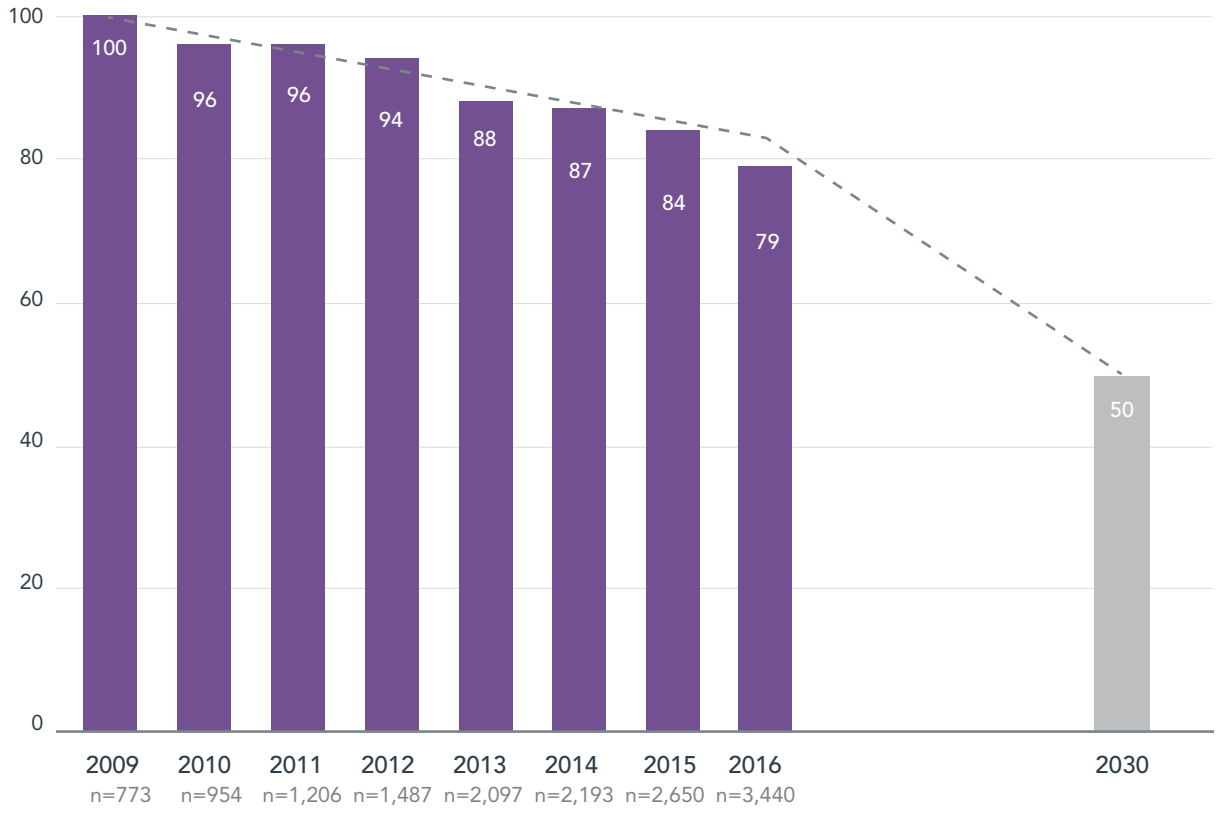
Since Greenprint was formed in 2009, its global portfolio of properties has achieved consistent improvements through benchmarking and the implementation of operational and technological best practices. Greenprint members have reduced GHG emissions from properties tracked over the past seven years by 17.9 percent, supporting its mission to reduce emissions by 50 percent by 2030.



CARBON REDUCTION COMMITMENT

Greenprint's mission is to lead the global real estate community toward value-enhancing carbon-reduction strategies that support global greenhouse gas stabilization by 2030 in line with the goals of the Intergovernmental Panel on Climate Change (IPCC) and ratified by the Paris Climate Accord. The Greenprint Carbon Index™ (GCX) was created to track progress toward this goal. As illustrated below, properties in the index are ahead of schedule in achieving this goal, demonstrating the leadership and efforts of Greenprint members in the area of sustainability.

GREENPRINT CARBON INDEX



The GCX—with the base year of 2009 equaling 100—is calculated by dividing property type–specific greenhouse gas emissions by the associated total gross floor area of submitted properties. The results are measured in kilograms of carbon dioxide equivalent per square meter (kg CO_2e/m^2).

Because the size and composition of properties in the Greenprint portfolio have changed over time, the index is weighted by a property-type mix sourced from a recognized global index company.

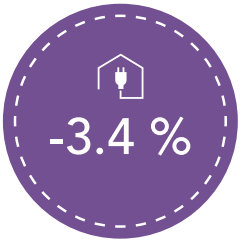
Annual Results

ULI GREENPRINT PERFORMANCE, 2015–2016

In 2016, Greenprint-member properties experienced reductions in energy use, water use, and emissions. Rates of annual improvement continue to be consistent with those of previous reporting periods, indicating the continued implementation of substantial and cost-effective efficiency strategies to advance the environmental performance of these properties. The only metric to rise in 2016 was spending on water, even with an overall reduction in water use. These results match the global increase in water costs, which are rising more than twice as fast as electricity costs.

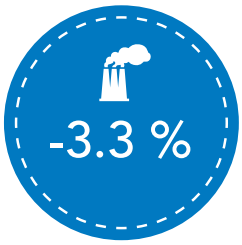
ENERGY CONSUMPTION

2015: 8.76 million MWh
2016: 8.47 million MWh
2,656 properties



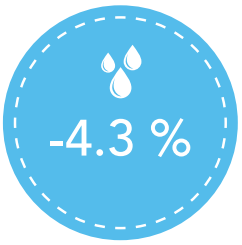
ELECTRICITY USE

2015: 6.69 million MWh
2016: 6.47 million MWh
2,579 properties



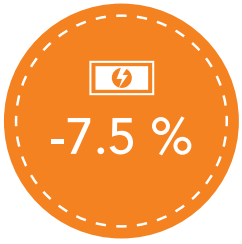
CO_2e EMISSIONS

2015: 3,158 thousand mt
2016: 3,056 thousand mt
2,656 properties



WATER USE

2015: 43.66 million kL (11.5 B gal)
2016: 41.85 million kL (11.1 B gal)
1,953 properties



ENERGY SPEND

2015: $518 million (€441 million)
2016: $482 million (€410 million)
1,630 properties

WATER SPEND

2015: $53.3 million (€45 million)
2016: $57.1 million (€49 million)
1,198 properties

2015–2016 EMISSION REDUCTION EQUIVALENTS

236,000

BARRELS OF OIL NOT CONSUMED

10,800

HOMES NOT CONSUMING ENERGY

21,500

CARS TAKEN OFF THE ROAD

2.6 M

TREES PLANTED

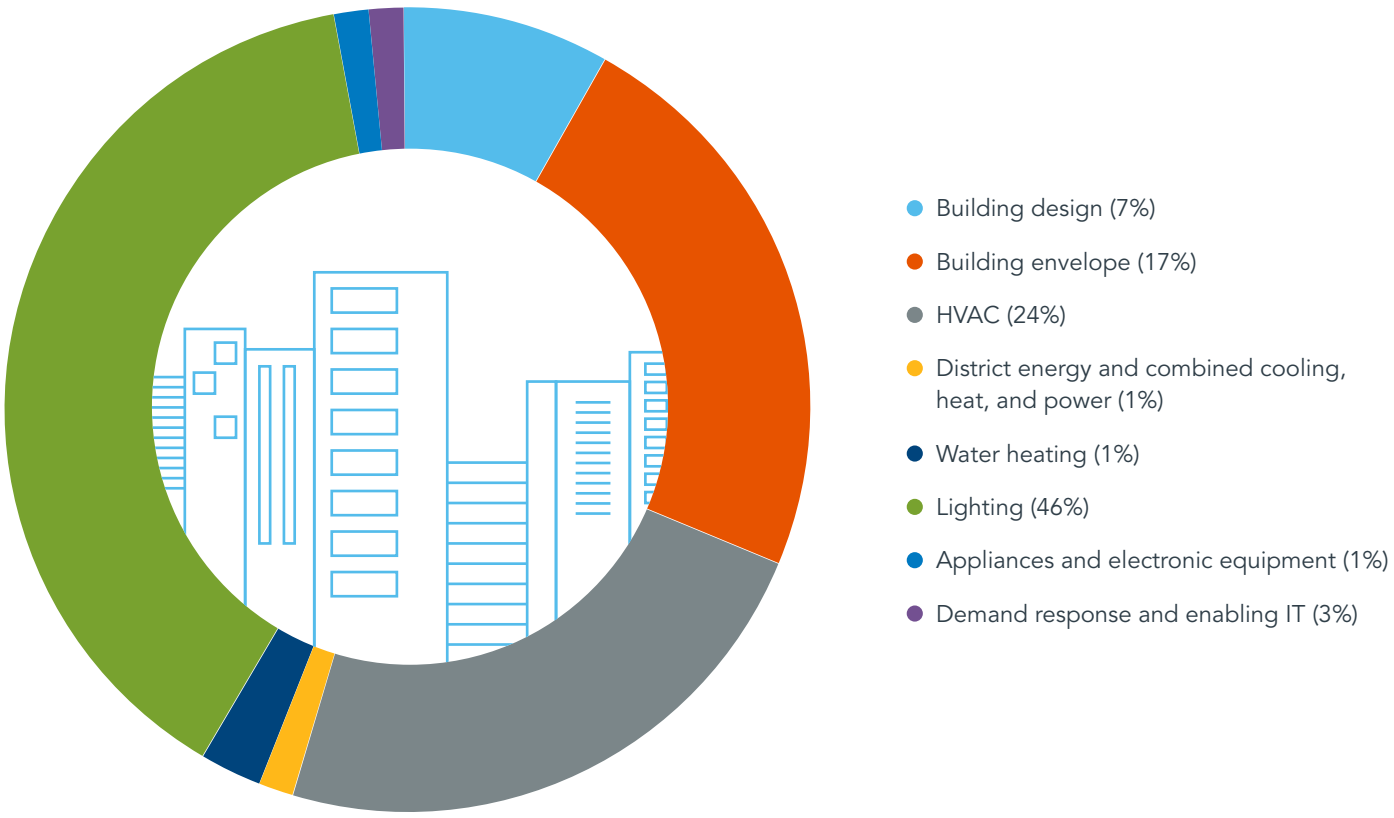
Best Practices: Projects

Sustainability-focused market drivers, such as tenant demands and investor mandates, create opportunities to boost property value and returns through investment in projects that improve environmental performance. This section explores different types of tactical projects being implemented across the real estate industry.

Ninety-one percent of commercial real estate development and property management organizations rate sustainability and conservation as important or very important to their business[12] and are making big investments in efficiency technology. Global investment in the building efficiency market reached $271.6 billion in 2016, up 15 percent from the previous year.[13]

The largest segment of the global building efficiency market was lighting, accounting for $124 billion in spending; HVAC was the second largest, accounting for $65.8 billion. The two fastest-growing segments globally were building envelope, and appliances and electronic equipment, both of which have increased by more than 50 percent since 2015.

GLOBAL SPEND ON BUILDING EFFICIENCY, BY TECHNOLOGY



PROJECTS

In line with market trends, the Greenprint community has been undertaking efficiency projects that support improved performance and add value. Table 1 outlines the distribution of project types implemented across the 963 building-level projects submitted to Greenprint in 2016. For projects reporting cost data, members reduced their energy consumption by 0.05 kilowatt-hour per square foot, representing savings of 26 cents per square foot with an average payback period of 5.1 years. If similar projects were implemented across the entire Greenprint portfolio, it would yield $90 million in utility savings and be equivalent to creating over $1.5 billion in property value.

TABLE 1:
BUILDING-LEVEL EFFICIENCY PROJECTS IN GREENPRINT MEMBER PROPERTIES

Project type	Total	Aggregate payback (years)
Behavioral change — enegy	102	2.0
BAS / EMS upgrades/replacements	80	5.7
Building envelope	23	1.7
Appliances and electronic equipment	137	5.7
Lighting and controls	129	2.9
Other energy projects	129	>10
Transportation projects	6	n.a.
Waste projects	54	0.6
Water projects	123	>10
Total/average	**963**	**5.1**

Consistent with global trends, properties in the Greenprint portfolio are investing heavily in lighting technologies.

Brighton Management, a hospitality management company, implemented interior LED lighting in 18 California hotels, totaling about 3,000 guest rooms. Since 2015, $1.8 million has been invested in LED lighting. Government and utility rebates covered $1.6 million, while the LEDs saved the hotels $380,000 annually in utility costs, conserving 1.06 million kilowatt-hours. With a simple payback in six months and an internal rate of return of 192 percent, this project is a prime example of the financial benefits available to owners that focus on energy management.

For **Sonae Sierra,** a retail real estate company, the key to selecting the right project for the right property starts with identifying the largest resource-consuming systems, including water features, lighting, and HVAC. In the enclosed parking structure at the LeiriaShopping shopping center in Leiria, Portugal, lighting was upgraded from T8 lamps to LED lamps, and controls were added to keep lights off in unused areas. After an investment of €26,000, and annual savings of €15,000, the expected payback period is 1.7 years. Sonae anticipates an additional €2,200 in savings from the longer lamp life, requiring less maintenance and a lower replacement rate.

While lighting upgrades require investment in new technology, some efficiency projects exclusively involve operations changes and require no initial investment. At Sonae's Le Terrazze shopping center in La Spezia, Italy, an energy audit performed in 2015 found that no-cost adjustments to fan speeds and temperature set points achieved a 35 percent reduction in rooftop HVAC unit energy use, saving about €45,000 annually.

For more specific examples of best practices, including behavioral change and water projects, see past volumes of the *Greenprint Performance Report* at *uli.org/greenprintperformance*.

Trends: Connecting Buildings, Infrastructure, and Cities

As a consortium of leading global real estate owners, investors, and strategic partners, Greenprint has insight into the trends leading the real estate industry toward improved efficiency and environmental performance. Many of these trends are familiar to the industry but are now being reimagined and built upon to expand the scale of impact. Forward-thinking owners are optimizing their use of distributed generation, operationalizing resilience, and participating in defining legislation to drive building efficiency and improvements.

REIMAGINING THE ENERGY GRID

For decades, electricity has primarily been generated in large power plants and distributed long distances to consumers. This paradigm is slowly changing as real estate owners become increasingly focused on the security and reliability of the grid and as storage technologies become more viable and cost-effective,[14] leading the way to more distributed generation and consumption models, including microgrids.[15]

A microgrid is a discrete energy system that has a network of electricity users with a local source of supply. This supply can be attached to a centralized power grid or operate independently.

Microgrids differ from traditional electricity grids in that they provide greater proximity to power generation and consumption, resulting in efficiency increases and reduced losses through transmission and distribution. Microgrids can integrate with renewable energy sources such as solar, wind power, hydropower, geothermal, waste-to-energy, and combined heat and power (CHP) systems. Benefits that extend to utilities and the community at large include lower GHG emissions and reduced stress on the current transmission and distribution system.[16]

REIMAGINING THE ENERGY GRID

Buildings owners can further benefit from microgrids in some of the following ways:[17]

Financial opportunities

There are several ways in which owners participating in microgrids can benefit financially:

- By renting underused space, including rooftops, basements, or outdoor areas, for on-site power generation or storage to an energy services company. The energy services company contracts with the local utility to manage energy flows, using distributed generation or stored power when the grid is under stress.
- Through feed-in tariffs and net-energy metering (which provide a credit on utility bills at the retail price of electricity).
- By integrating with a demand response program, energy consumption can be reduced from the primary grid during peak hours.

Under certain programs and legislation, these incentives make investments in energy storage, on-site renewables, or demand response highly lucrative.

A more resilient and reliable grid

As many larger power plants are retired due to their age or new environmental regulations, utilities are searching for new ways to supply reliable electricity to their customers. Climate change is expected to boost the number and intensity of extreme weather events throughout the world. In 2012, Superstorm Sandy caused about $65 billion in damage and power outages throughout the northeast United States.[18] Buildings or portions of the grid that were able to disconnect from the main grid and generate power independently were able to maintain power and limit the financial damages associated with downtime.[19] New York as well as other states and cities have begun incentivizing distributed solar installations and community microgrid development to advance investment in clean energy opportunities.

Smart buildings

Microgrids work to optimize the performance of the electricity grid, lowering costs for consumers and boosting reliability. Last year, Volume 7 of the *Greenprint Performance Report*™ identified evolving technology, or "the internet of things," as a key trend. Creating a microgrid and managing power generation and storage also requires investment in smart building technologies. Advanced building technologies are necessary in order to generate and effectively manage power use and track energy consumption, as well as connect that information to grid performance, allowing a property owner to take full advantage of the economic returns. A smarter building allows owners to quickly shift to alternative power sources to alleviate strain on the main grid (or curtail power usage for demand response scenarios), to optimize the use of renewable energy sources, and to store extra power when grid prices are low.

INVESTING IN RESILIENCE

The devastation of recent natural disasters—including the earthquakes in Mexico; hurricanes Harvey, Irma, and Maria; and monsoons in south Asia—have drastically increased awareness of the vulnerability of people, cities, and properties to natural disasters. In 2016, catastrophic losses due to hurricanes and earthquakes globally were around $175 billion, the second highest on record.[20] Climate-related disasters in 2017 (floods, hurricanes, monsoons, and wildfires) caused economic losses topping $300 billion in the United States alone, equal to about 1.5 percent of the national gross domestic product.[21]

While it is impossible to be fully prepared for dangerous storms or other extreme natural disasters, both local governments and investors are increasingly looking for strategies to reduce the likelihood of damage to property and infrastructure from major events. In some markets, governments are making significant investments to ensure that their cities' buildings, infrastructure, and open space is more resilient to extreme weather events. In these cities, governments are also beginning to incentivize resilient development features by providing expedited project approvals, allowing variances to code, or by providing rebates for private stormwater management and on-site power generation. Urban planners have similar concerns about resource scarcity—for example, water supply during extreme droughts or access to reliable energy sources. As climate change drives the frequency and intensity of storms and other environmental threats, strategies to enhance resilience and preparedness will become increasingly important for the safety of communities and the safeguarding of property value and infrastructure.

Resilience is defined as "the ability to prepare and plan for, absorb, recover from, and more successfully adapt to adverse events."[22] In practice, resilient design comprises addressing the risks posed by climate change and better preparing buildings and infrastructure for large storms, rising water levels, and potential scarcity of resources, as well as other shocks and stresses.

Resilient building techniques, therefore, can include the elevation of the ground level and mechanical equipment, water reuse and recycling, and incorporation of passive and backup energy sources, in addition to use of other technologies or strategies relevant to local climate vulnerabilities. Resilience also often includes intervention at the community scale, such as incorporation of natural water management systems across a large area, district heating and cooling, and the cautious management of development in vulnerable areas.

Resilience as applied to the built environment is becoming more focused on risk management: developers and investors are weighing potential losses against the opportunity for value creation. Resilient design can make a property more attractive to owners through lower insurance premiums and creative development incentives that help buildings generate more revenue and attract tenants that value business continuity and sustainability.

An example of designing with resilience in mind is 6 New Street in Boston. The developers invested in elevating the property and mechanical equipment and providing a cogeneration system, saltwater-hardy landscaping, and hardscapes to protect the property against storm surge. The value of these investments is projected to save over $9 million in avoided losses through lower insurance premiums as well as generate an additional 2 to 18 percent in rental premiums.

ULI's Urban Resilience program has produced detailed reports on resilience. Additional material can be found at *uli.org/resilience*.

LEGISLATING EFFICIENCY: RAISING STANDARDS

As governments continue to recognize the impending risks of climate change, they are taking action by setting targets and raising the bar on building performance. The "Market Drivers" section of this report provides a few examples of successful energy-efficiency legislation. Governments around the world are learning from these successes and using them to inform future legislation.

Recognizing the large potential for emissions reductions in the buildings sector, and as a direct result of the Paris Climate Accord (COP21), 88 signatory countries included actions in the buildings sector as part of their plan to address climate change. Sixty-two of the countries plan to implement building energy codes as part of their comprehensive policy, and 84 plan to implement building energy certifications.[23]

Commitments to sustainable buildings are also taking place on a more local scale, with more than 7,400 cities, representing 685 million people, signing on to the Global Covenant of Mayors and committing to set targets for reducing carbon emissions. These commitments are aimed at raising the minimum performance baseline of the building sector.

Building energy codes

Over time, building energy codes are being strengthened and becoming more performance based. In the United States, California has always been at the forefront of building code development. The state's current energy code will require all new residential buildings to be built to net-zero-energy standards by 2020. All new commercial buildings and a significant number of existing commercial buildings will need to meet net-zero standards by 2030.[24]

Building ratings/ certifications

Across the European Union, Energy Performance Certificates rate the energy efficiency of a building (on a scale of A through G), with the ratings required to be publicly accessible for all buildings to be sold or rented. In the United Kingdom starting in 2018, sale or lease of commercial buildings with an F or a G rating will not be allowed. With 26 percent of residential properties and 35 percent of other property types achieving only an E, F, or G rating, significant investment in efficiency will be required before any financial transactions.[25] The European Union is also considering an update to the Energy Performance of Buildings Directive (EPBD) that would require energy efficiency improvements at additional points in the building life cycle.[26,27]

Benchmarking

In Japan, the Act for the Improvement of Energy Consumption Performance of Buildings was passed in 2015, requiring new buildings with more than 2,000 square meters of space to comply with energy conservation standards and report performance data to a government organization. Going further than other benchmarking laws, the Japanese law provides local governments with the power to mandate efficiency improvements.[28]

Leveraging these types of building policies can help property owners improve their net operating income because each boost in energy efficiency results in direct savings in utility costs. In some jurisdictions, high-performance and sustainable buildings also have access to additional financing and support. Greenprint members regularly go above and beyond the baseline building codes and performance standards, yielding additional savings. These owners not only receive current and long-term financial benefits, but also will be well prepared for future legislation as cities and countries move toward net-zero standards.

Industry Benchmarks and Analysis

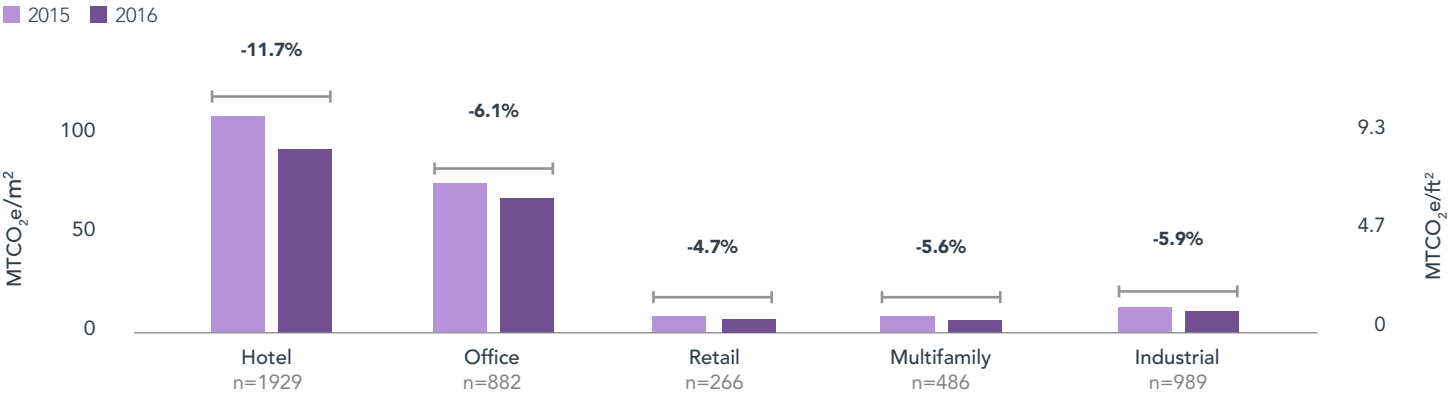
EMISSIONS AND WATER USE

All five commercial property types tracked by Greenprint members achieved reductions in emissions and water use from 2015 to 2016.

Hotel properties showed the greatest progress in reducing emissions, with an impressive 11.7 percent reduction. One reason for this could be the lack of a split incentive at this property type. Because hotels charge guests a standard room rate regardless of utility use, any reduction in utility use or costs goes directly to the hotel owner's bottom line.

ULI's Emerging Trends in Real Estate© 2016 report indicated that industrial properties lead the way in investment and development prospects. This trend is continued in the 2017 ULI Trends report. Greenprint's industrial properties averaged an 8 percentage-point occupancy increase in 2016 while still achieving a 5.9 percent reduction in emissions—a significant achievement.

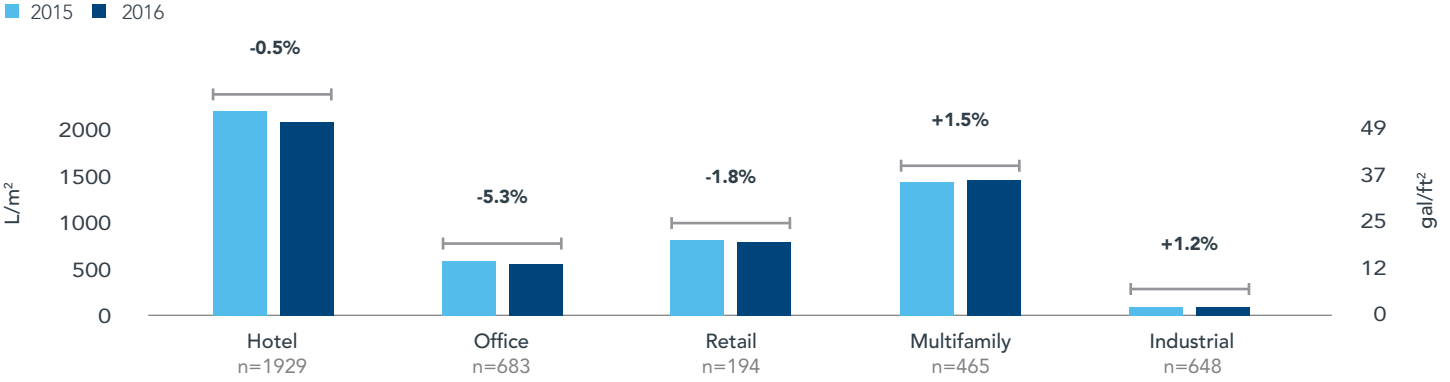
EMISSIONS INTENSITY BY PROPERTY TYPE



From 2015 to 2016, office properties achieved the greatest reduction in water use. Well-established and simple best practices, including low-flow fixtures and the planting of drought-tolerant landscaping, were the most reported water efficiency projects for office properties, and, coupled with enhanced water management strategies, helped drive this improvement in efficiency. Hotels had the highest water use intensities—likely from landscaping, water amenities (like pools), overnight guests, and laundry facilities—but they were also able to achieve significant reductions.

Even with the decrease in water use, water expenses increased across the portfolio from 2015 to 2016, aligning with rising global water costs. In order for real estate owners to have a comprehensive and value-enhancing sustainability program, water conservation strategies should be considered alongside energy projects.

WATER INTENSITY BY PROPERTY TYPE

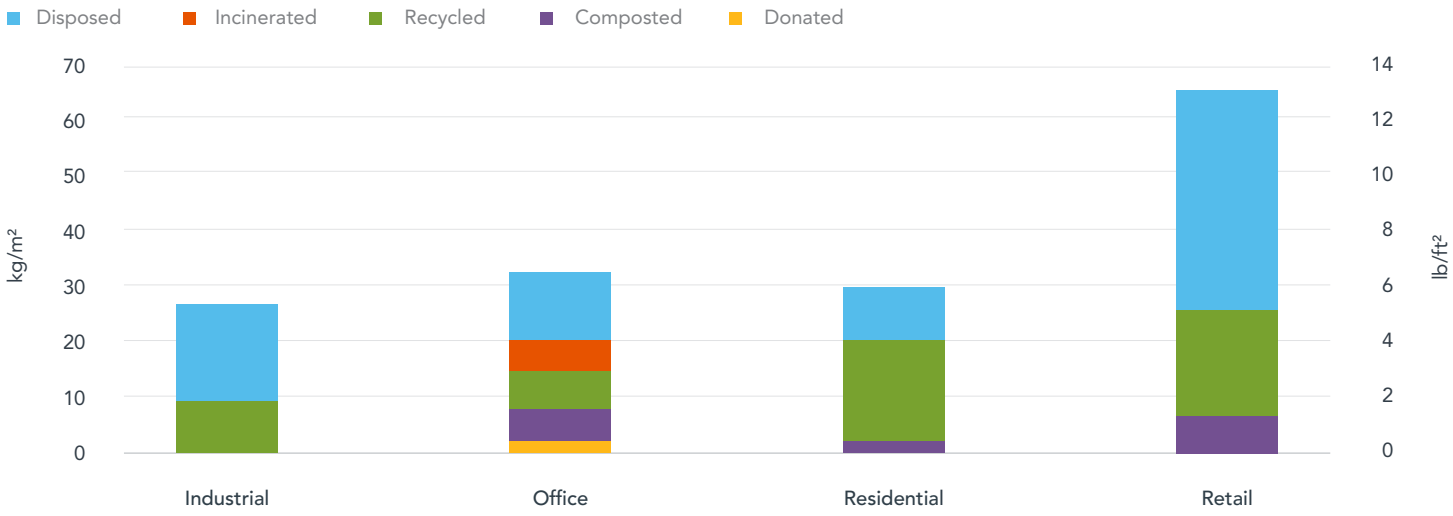


WASTE GENERATION

For real estate owners, waste can come from construction, operations, tenants, and restaurants/cafeterias. Understanding the waste stream from generation to disposal and tracking waste data are key to ultimately reducing waste costs and improving diversion rates. Obtaining accurate data for waste can be a challenge because some waste contracts require the hauler to provide only the number of pickups rather than an exact weight or volume. Working with a waste collector to improve data or developing a method for estimating the amount of waste hauled can improve the accuracy of waste data and inform management strategies. Other ways that diversion rates can be improved and costs reduced at a building are to engage tenants, ensure an organized and well-marked waste room, and leverage technology to streamline the waste management process.

In 2016, 516 properties reported waste data. The data show that retail properties create the most waste per square foot, as well as divert the most waste for recycling and compost. These results are likely attributable in part to restaurants generating food waste for compost and retail shipping containers generating cardboard and plastic for recycling. Industrial properties generate the second most waste sent to landfills; however, much of the waste is likely from distribution-center packaging and item assembly. The potential exists to cost-effectively improve waste diversion rates and increase recycling above its current rate of 34 percent.

WASTE GENERATION INTENSITY BY PROPERTY TYPE



FOOD WASTE: THE THIRD LARGEST CLIMATE POLLUTER

About one-third of food produced is not consumed and ends up being disposed of, wasting water and the outputs from arable land.[29] Much of this waste also makes its way to landfills, leading to the unproductive use of land and the production of methane, a byproduct of anaerobic decomposition. Methane is a greenhouse gas that is over 25 times more potent than carbon dioxide.[30] **Total greenhouse gas emissions from global food waste are estimated to be 3.3 gigatons, which, if considered separately, would make it the third-largest climate polluter after the United States and China.**[31] Legislation and voluntary programs are being developed worldwide to address food waste and its associated emissions. In addition, as public awareness increases, nonprofit organizations, are aiming to prevent food waste, recover food through redistribution, and compost or recycle the waste.[32]

At the **Grand Hyatt Singapore**, 4,000 to 5,000 meals are served daily, generating around 1,000 kilograms of food waste. Working with experienced partners and a $250,000 grant from the National Environment Agency, the hotel installed a food-waste management and recycling system that converts 100 percent of the hotel's food waste into about 300 kilograms of pathogen-free organic fertilizer for the hotel's landscaping. This new infrastructure saves the Grand Hyatt about US$74,000 (S$100,000) annually in waste haulage costs, operational expenses, and garbage bags, resulting in a payback period of less than three years.

RESULTS BY PROPERTY TYPE

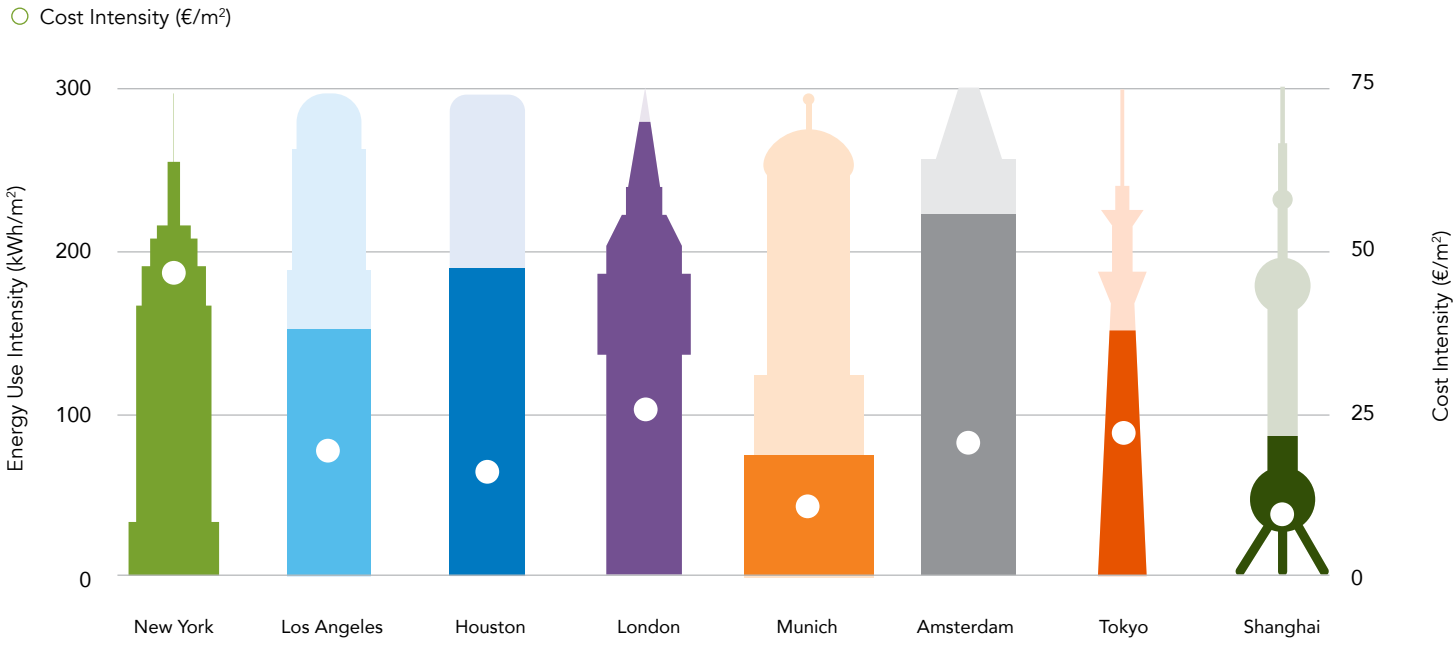
Energy costs account for upwards of one-third of a typical property's operating budget.[33] By managing energy effectively, owners can reduce, in lockstep, utility use, utility costs, and emissions—creating value by reducing operating costs or increasing rent premiums. As sustainability features continue to become more relevant and integrated into corporate performance, real estate owners that are viewed as leaders and supportive of environmental performance can capture higher-quality tenants, increasing rental rates, occupancy rates and leasing velocities. One indicator of this is that 48 percent of Fortune 500 companies have goals for energy use, greenhouse gas emissions, or use of renewable energy.[34]

OFFICE PROPERTIES

Through the first half of 2017, the value of office property transactions accounted for about 40 percent of all real estate investing, totaling $360 billion.[35] Many of these transactions range from $100 million to $1 billion.[36] Given the scale of the investments, owners continuously research opportunities to generate better returns. One method has been to focus on environmental performance, with the goal of decreasing operating expenses while simultaneously making the asset more appealing to desirable tenants.

Geographic trends: Munich leads the way, while London and New York City remain the most energy intensive. Munich office properties use significantly less energy per square meter than do office properties in other cities in the Greenprint portfolio. This likely is attributable to a variety of factors, including efficient design due to strong energy codes, local norms, tenant mixes, and energy economics. The cost of energy in Munich is the highest of any other city in the chart below, creating strong incentives for efficient operations. Conversely, in the United States, energy costs are lower than those in Munich, providing less incentive for investments in efficiency.

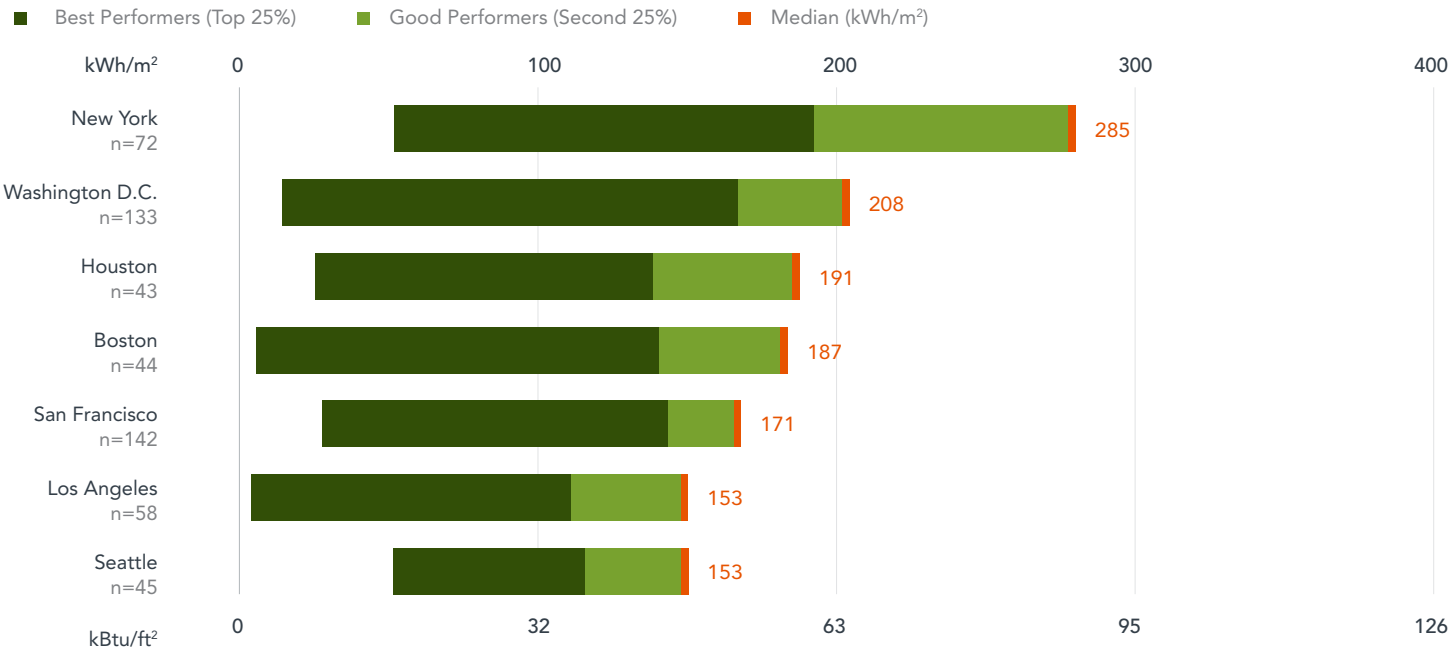
ENERGY USE INTENSITY METRICS BY CITY



OFFICE PROPERTIES

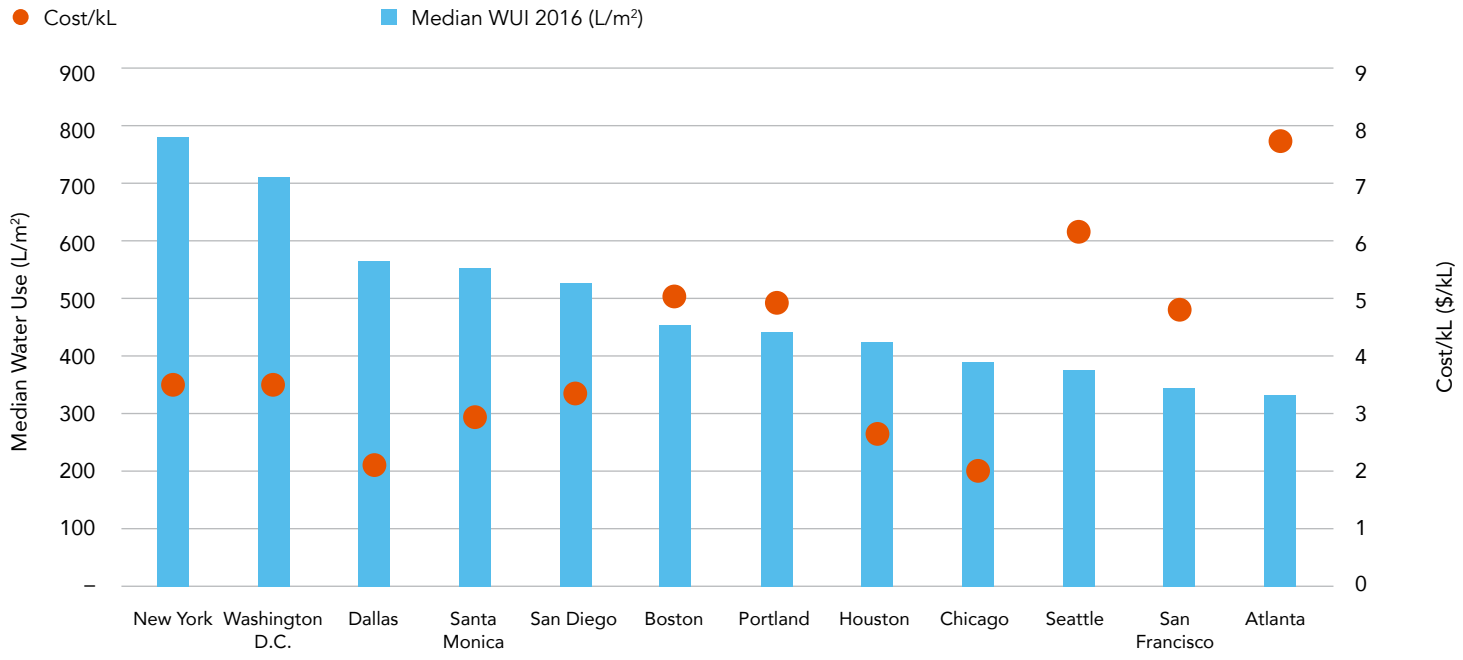
Energy use profiles often vary widely across properties, even within the top half of performers in the office sector in the same city. In some of the strongest office markets in the world (e.g., Chicago and New York City), properties have the highest energy use per square meter. This is likely driven by the types of tenants that occupy the properties (financial and professional service companies that have long operating hours, high plug loads, and high occupant densities), as well as the climates of those cities. In those same cities, it is possible that opportunities to boost financial returns are being overlooked because energy costs, although comparatively high, represent a small percentage of total operating costs.

OFFICE ENERGY USE INTENSITY BY CITY



Water use, though a smaller operating expense than energy, is still an important cost for owners to manage. In markets with high water and sewage rates, property owners appear to use less water per square meter. The chart below, comparing median water use per square meter in each city to its cost, reveals a definite trend of higher water use correlating with lower water and sewage rates.

OFFICE WATER USE INTENSITY BY CITY



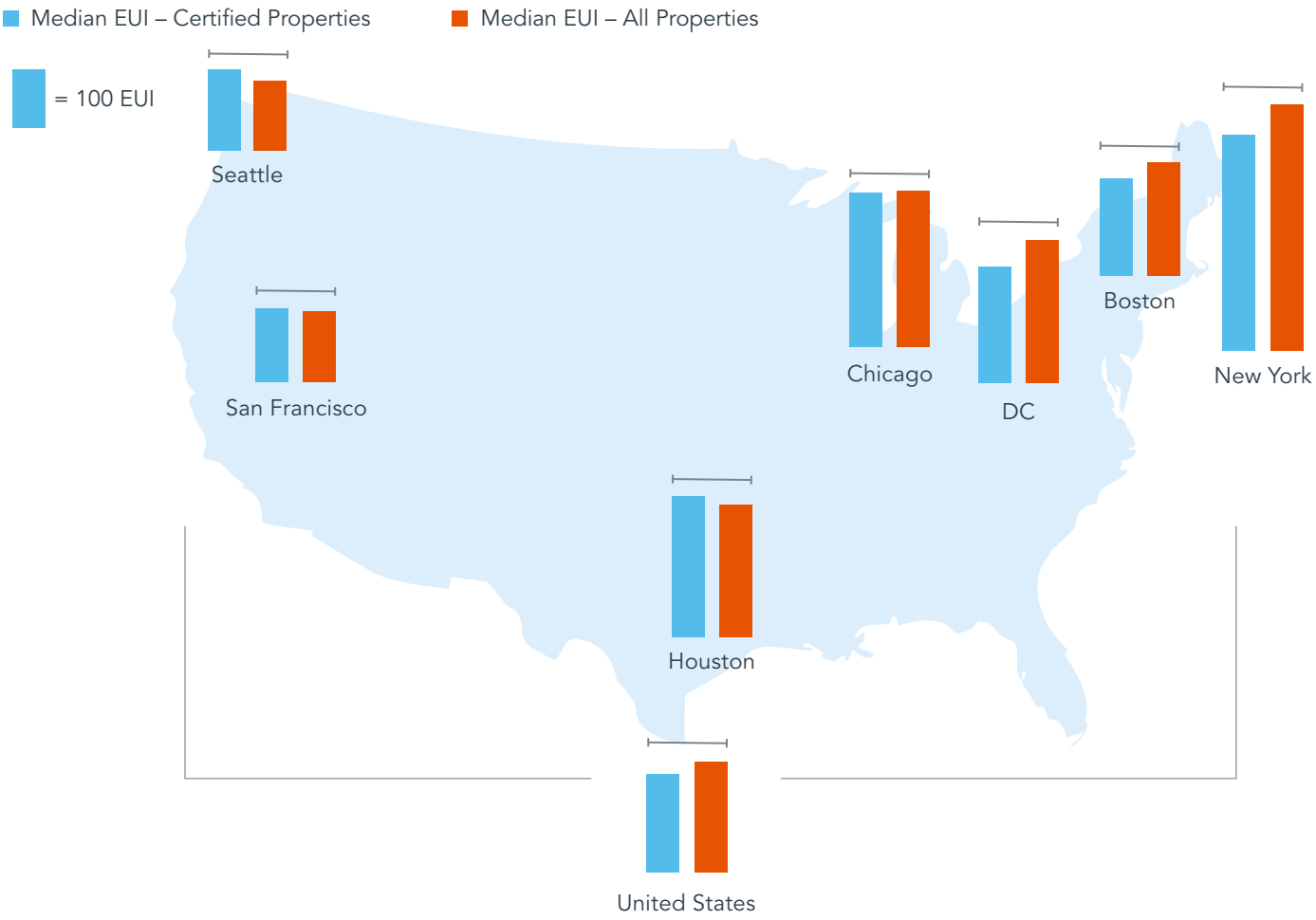
GREEN OFFICE BUILDING PERFORMANCE

Green-certified properties can reduce utility costs, enhance marketability, attract high-quality tenants, and reduce environmental impact. In the United States, 38 percent of the square footage of new construction is green certified, and 4.7 percent of office buildings across the 30 largest office markets are certified under the Leadership in Energy and Environmental Design (LEED) program.[37] Increased adoption of green building practices is driven by demand from potential tenants: 82 percent of surveyed Fortune 200 companies plan to continue using LEED standards for their office construction or retrofit projects through 2018.[38] By 2018, developing countries like Brazil, China, and Saudi Arabia anticipate the largest increases in green building.[39]

Across the Greenprint-member portfolio, 552 properties in 18 countries hold green building certifications, including LEED, BREEAM, CASBEE, HQE, and DGNB. These certifications are applicable to new property construction, retrofits of existing buildings, and operations and maintenance, as well as across all property types. A comparison of green-certified properties to the larger portfolio demonstrates that energy use intensities in the United States were lower for certified properties, achieving an additional 9 cents per square foot in utility cost savings. In New York City, certified properties produced the greatest utility savings, 43 cents per square foot. This analysis does not account for all of the added value from green certifications, such as rent premiums, faster leasing, or higher-credit tenants.

Surprisingly, in a handful of cities (such as San Francisco and Seattle), green-certified buildings do not outperform their noncertified peers. A reason for this could be that certified buildings in these cities attract tenants who desire green-certified space but have high occupant density or long operating hours.

ENERGY USE INTENSITY VS. CERTIFICATIONS BY CITY

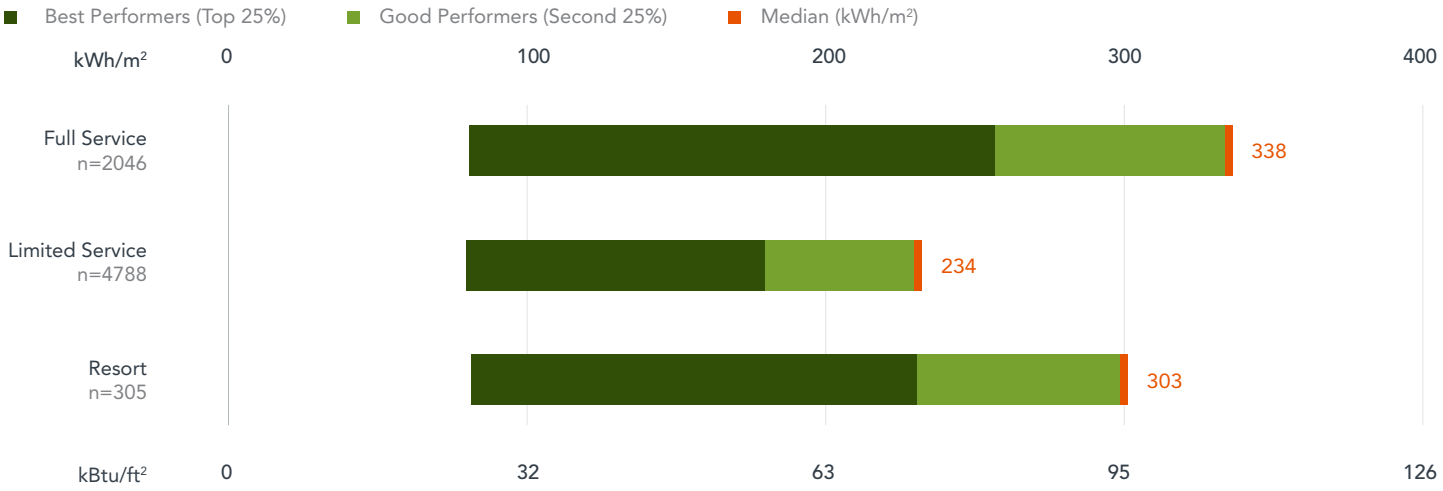


On average, certified buildings saved $86 per 1,000 square feet in utility costs.

HOTEL PROPERTIES

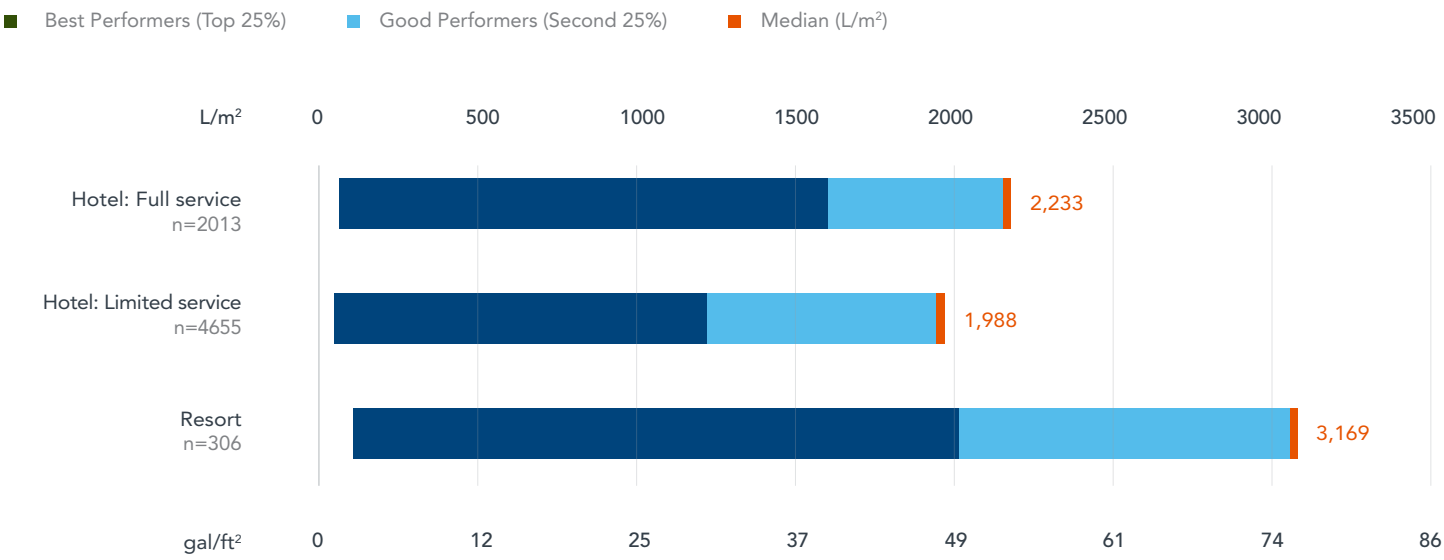
For the second year, Greenprint partnered with the Cornell Hotel Sustainability Benchmarking (CHSB) initiative to present a comprehensive hotel benchmark. The CHSB is a collaborative initiative aimed at developing hotel industry–specific benchmarks for energy use, water use, and carbon emissions.

HOTEL PROPERTIES EUI BY SUBTYPE



Resort hotels are quite energy-use intensive and the most water–use intensive hotel type, in large part because of their amenities and landscaped grounds. Examples of facilities at resort hotels that cause increased energy and water use include pools, spas, decentralized villas, large restaurants, and lobby areas with open-air elements. Not surprisingly, full-service hotels use about 50 percent more energy and 12 percent more water per square meter than do limited-service hotels.

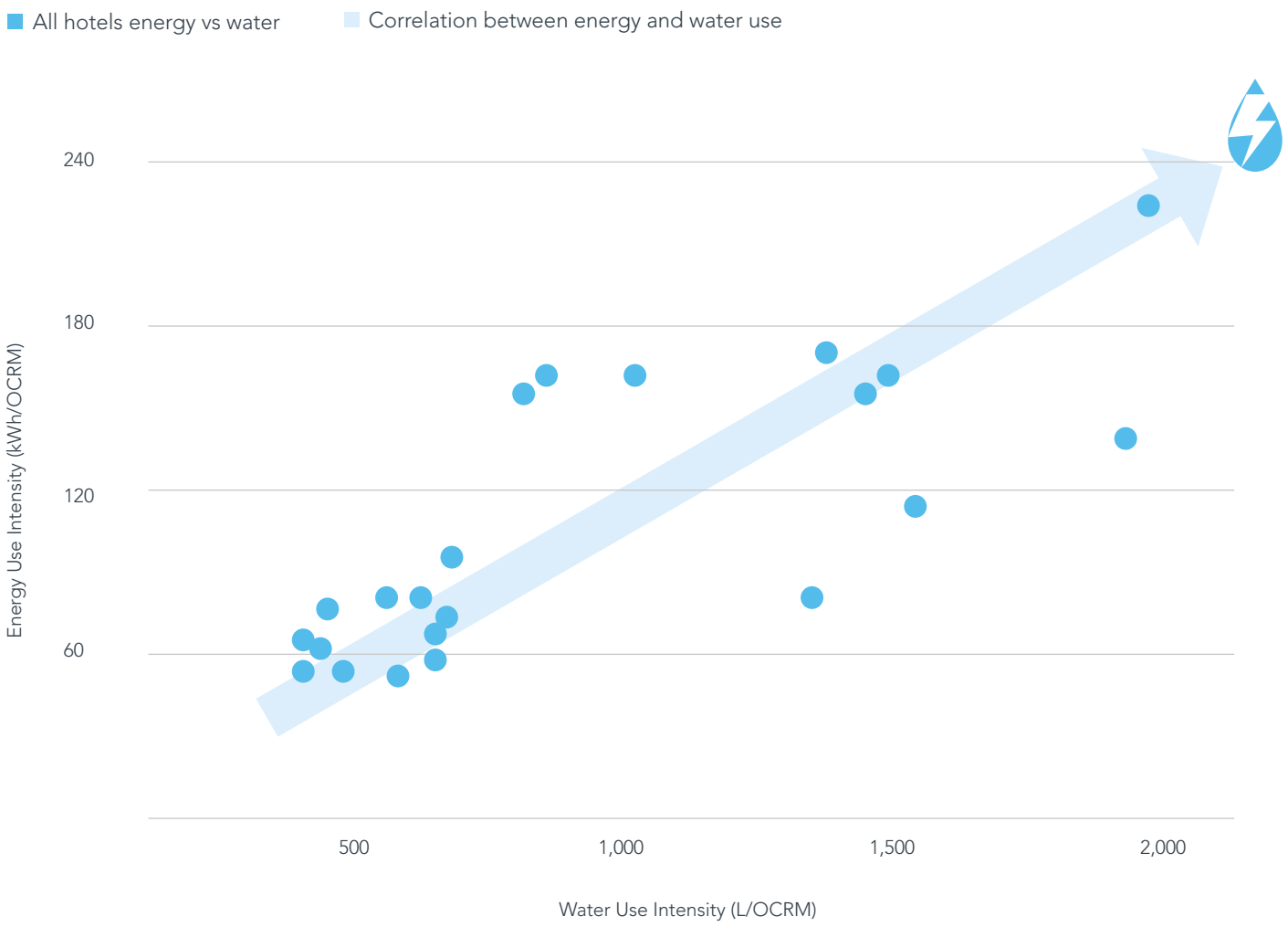
HOTEL PROPERTIES WATER USE INTENSITY BY AREA



HOTEL PROPERTIES

The chart below compares the energy use per occupied room (OCRM) to the water use per occupied room in 23 countries. Interestingly, there is a correlation: energy consumption increases by approximately 80 kilowatt-hours for each additional kiloliter of water used. In addition, hotels in more developed countries appear to perform more efficiently—in general, using less water and energy per occupied room than do properties in less-developed countries. Reasons for this spread in intensities include the fact that construction and operating norms differ by country or city, with developed markets having stronger building regulations and more sophisticated operating practices; hotels in developing countries are often in warmer regions of the world (Indonesia, Thailand, Mexico, etc…), requiring more mechanical cooling and year-round pool use; and hotels in developing countries have fewer occupied rooms, increasing the water and energy use intensities.

CORRELATION BETWEEN ENERGY AND WATER USE

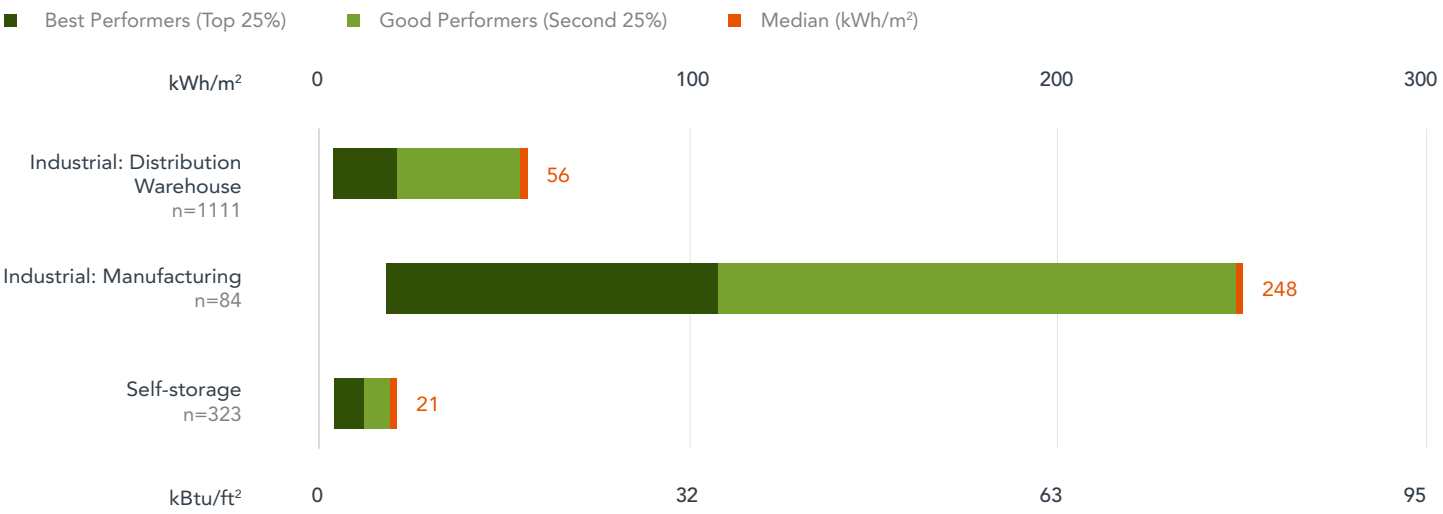


INDUSTRIAL PROPERTIES

Industrial properties continue to be a challenging property type to benchmark, in large part because their use types and energy profiles are so diverse: a self-storage facility, distribution center, and manufacturing are often grouped together as "industrial" properties. Further complicating these benchmarks, it is often difficult for real estate owners to obtain whole-building energy data because many industrial tenants use triple-net leases and manage their own utility bills directly. To address this data availability challenge, some Greenprint members write leases that include clauses on data sharing.

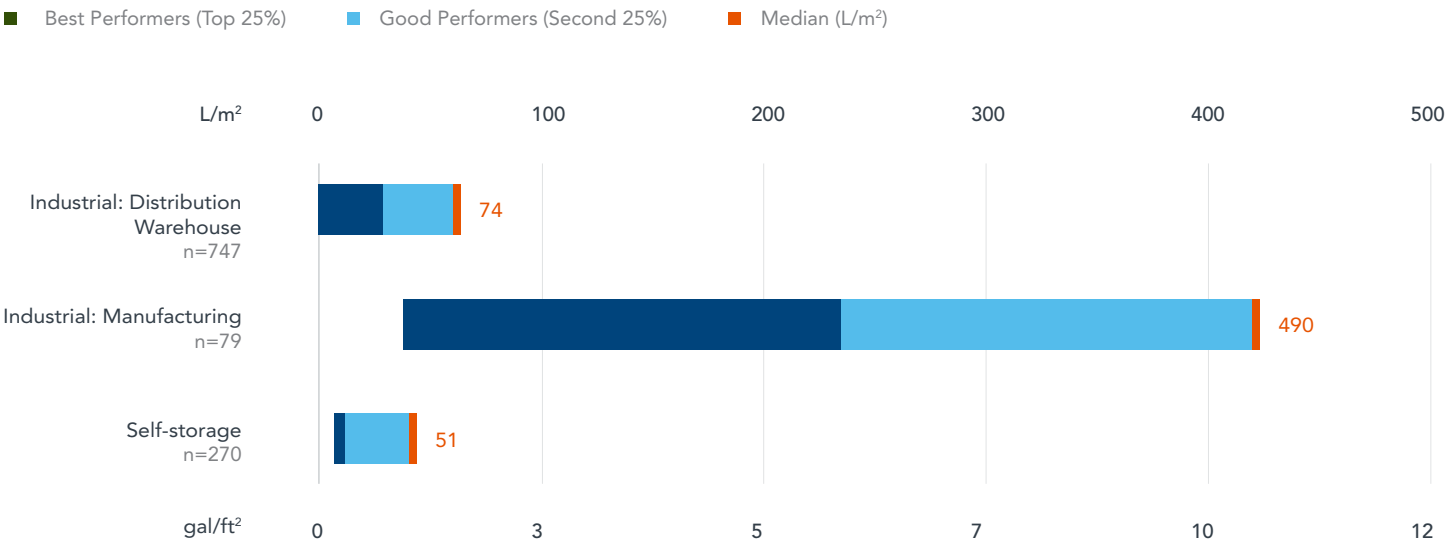
Manufacturing assets have higher energy use intensities than do other industrial properties. This likely is attributable to the processes that occur on site and the high amounts of energy required for operations. Self-storage facilities require the least energy because of limited occupancy and use of lighting and HVAC equipment for infrequent visitors.

INDUSTRIAL PROPERTIES EUI BY SUBTYPE



Similar to energy use, manufacturing assets have higher water use intensities than do other industrial properties. This could be due to the processes that occur on site and the high amounts of water required for operations. Self-storage facilities and distribution warehouses use a similarly low amount of water for basic requirements—landscaping and sanitary purposes.

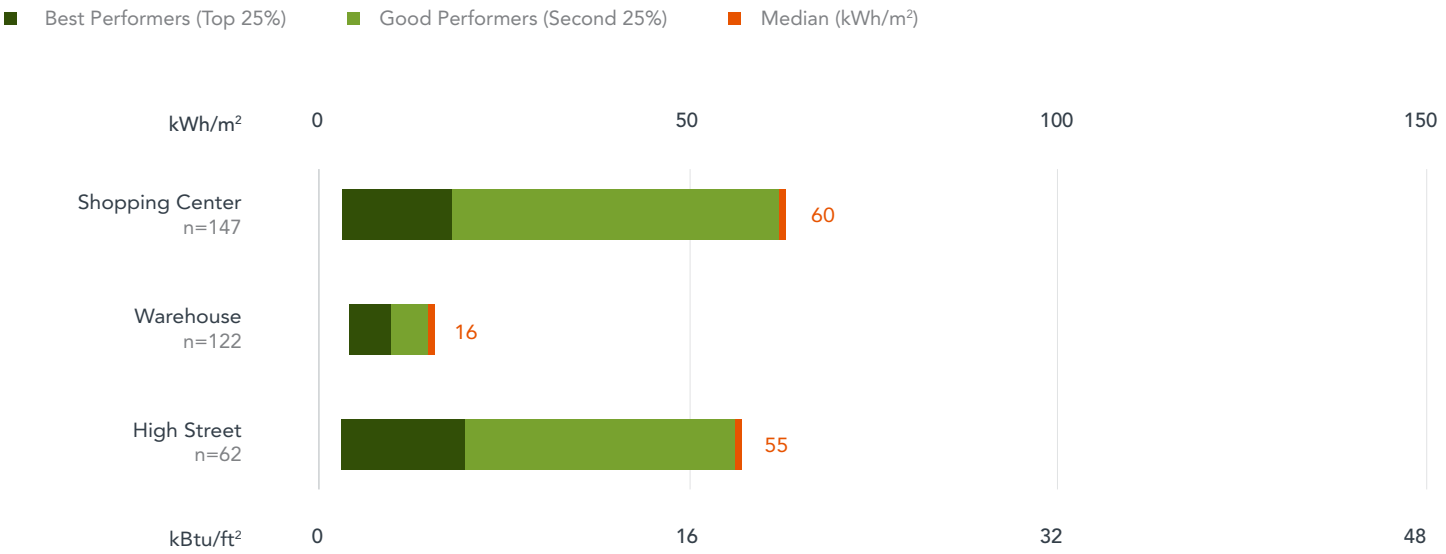
INDUSTRIAL PROPERTIES WATER USE INTENSITY BY SUBTYPE



RETAIL PROPERTIES

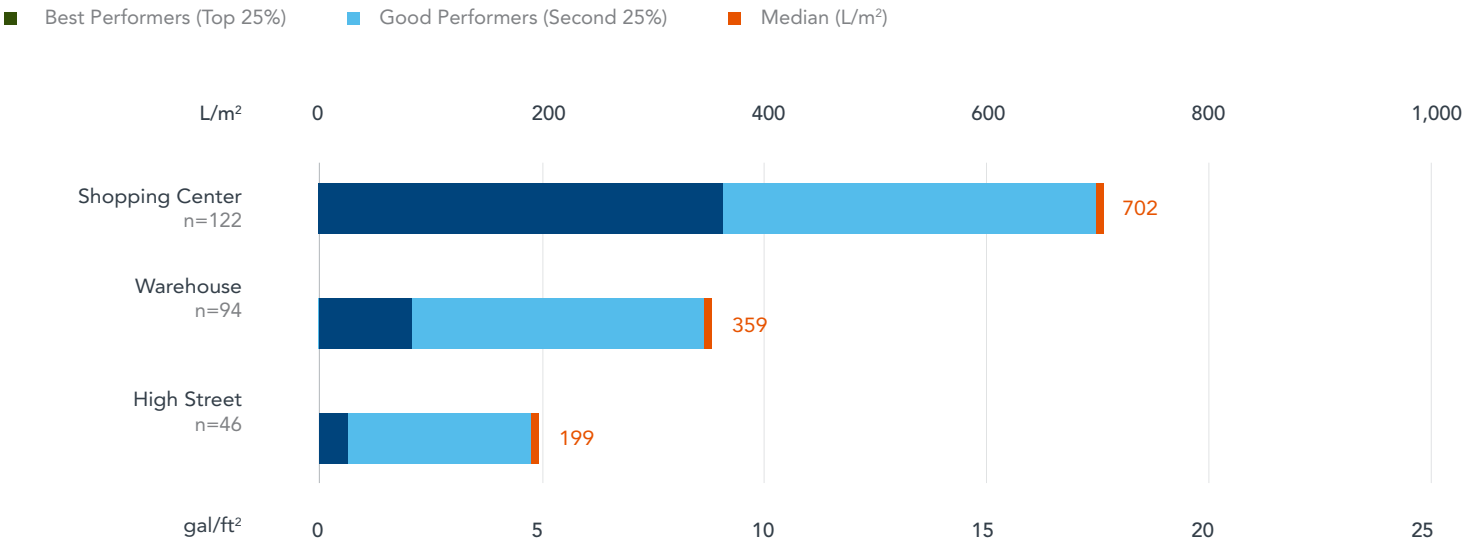
Retail-property energy use is most frequently influenced by operating hours, refrigeration needs, and the number of cooling-degree days. Shopping centers continue to use the most energy among the retail subtypes due to the large amounts of heating and cooling required for enclosed common spaces. High-street retail properties use only slightly less energy per square meter. In the current retail environment, high-street retail has the best investment and development prospects among all retail subtypes. The energy use at such properties may be high as stores compete to attract foot traffic.

RETAIL PROPERTIES EUI BY SUBTYPE



Water use intensity is also highest at shopping centers, which tend to have more elaborate landscaping, water features, and, as shown above, higher use of cooling-tower water. With such high levels of water use—almost twice that of retail warehouses—a substantial opportunity exists for implementation of water conservation measures. Some potential savings opportunities include use of recycled water for fountains, smart irrigation technology, and monitoring of consumption for early leak detection.

RETAIL PROPERTIES WATER USE INTENSITY BY SUBTYPE

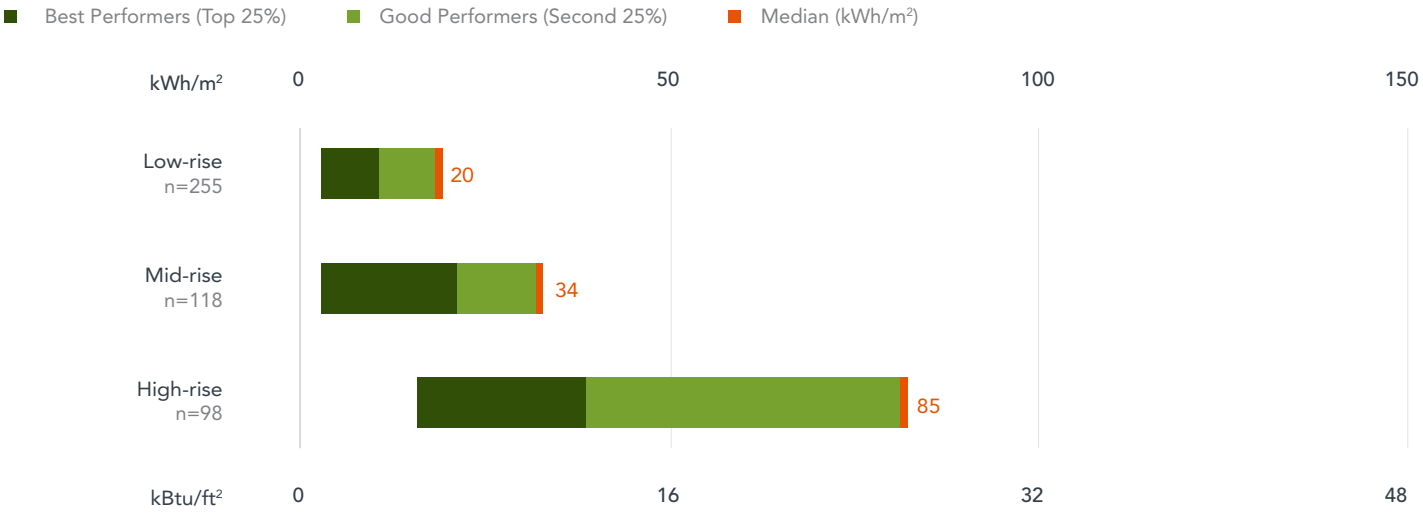


MULTIFAMILY PROPERTIES

One in six Americans lives in a multifamily building, and over half of all multifamily rental units are at least 50 years old, creating a big opportunity for improving energy efficiency.[40] Numerous challenges exist to advancing efficiency in a multifamily building, including a split incentive—the capital investments made by the owner are typically hard to recoup because they result in a decrease in the utility bills for the tenant but not the owner. Multifamily development firms also tend to be smaller organizations that may not have the expertise, capacity, or capital to implement sustainability measures.

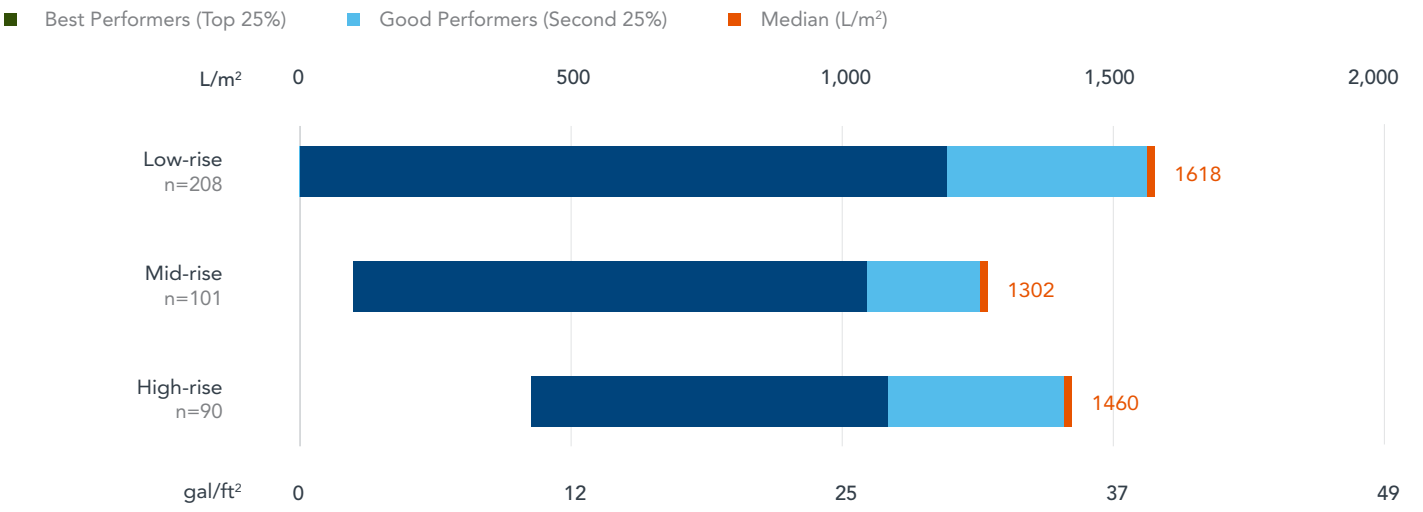
As expected, high-rise multifamily properties have the highest median energy use intensity, likely due to amenities available to tenants (i.e., elevators, fitness clubs, laundry rooms) and common spaces that require additional heating and cooling. Adding amenities, such as health and wellness features, can occasionally lead to a trade-off in efficiency.

MULTIFAMILY PROPERTIES EUI BY SUBTYPE



Low-rise apartments have the highest water use intensities for multifamily properties, due to an increased likelihood of property landscaping. On average, multifamily properties also had higher water use intensities than hotel properties, possibly from more consistent daily use by tenants instead of less frequent use by hotel guests.

MULTIFAMILY PROPERTIES WATER USE INTENSITY BY SUBTYPE



Guide to Report Terms and Charts

ENERGY STAR PORTFOLIO MANAGER
An interactive energy management tool that allows building owners to track and assess energy and water consumption data for a single building or across an entire portfolio.

ENERGY USE INTENSITY (EUI)
Annual energy consumption divided by gross floor area. This report uses site EUI, which is equal to energy used on site divided by floor area.

GREENHOUSE GAS (GHG) EMISSIONS
Carbon dioxide (CO_2) and other gases released into the atmosphere as a result of energy consumption at the property. Emissions are expressed in carbon dioxide equivalent (CO_2e), which normalizes global warming potential of each gas to an equivalent quantity of carbon dioxide.

LIKE FOR LIKE
A year-over-year comparison of properties that have complete data available for each year in the analysis.

MEDIAN
The value lying at the midpoint of a distribution of observed values.

NORMALIZED
A reference to adjusting values on a different scale to a common scale, such as energy intensity that is independent of the size of the building by dividing energy use by corresponding floor area. Normalization in this report generally refers to an environmental metric divided by gross area or FTEs.

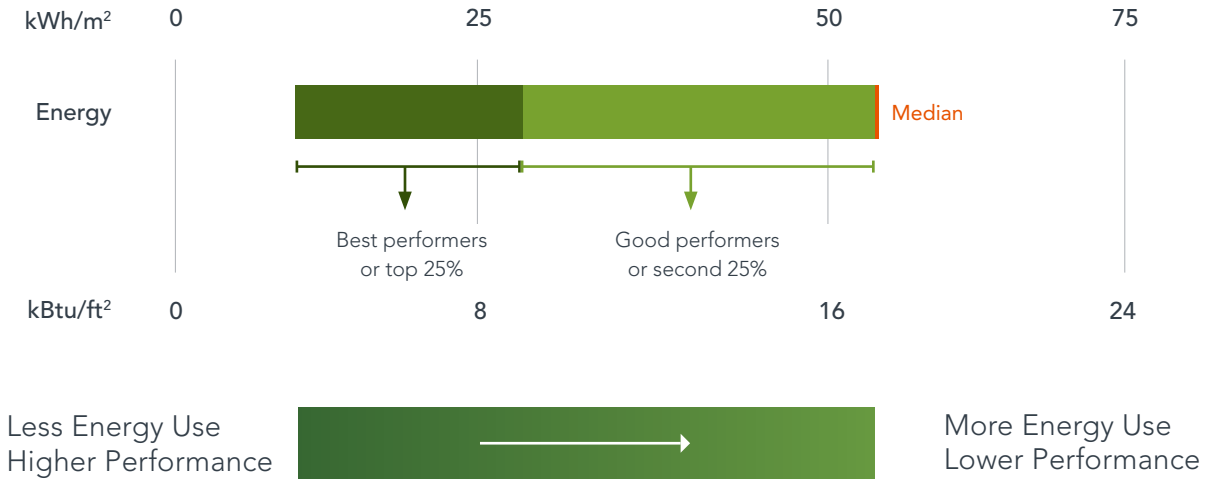
OCCUPIED ROOM
A metric used to evaluate lodging/hospitality performance. It is the number of rooms occupied over the course of the period analyzed—a figure allowing comparison of hotels that have different levels of occupancy and/or utilization.

WASTE DIVERSION
Reducing waste sent to a landfill through reduction of waste generation, recycling, reuse, or composting.

READING THE CHARTS
The data presented in charts throughout this report, unless otherwise noted, are 2016 data median values, and like-for-like comparisons.

HOW TO READ MEDIAN CHARTS

Median charts are used throughout this report to show energy and water use intensities by property subtypes. The furthest right end of the bars indicates the median of the dataset. The darker section of the bars represents the top 25 percent of the range (i.e., the best performance/lowest consumption of either energy or water). The lighter colored bars represent the second 25 percent data range. Where feasible and to support the international nature of Greenprint stakeholders, the median charts provide the data in metric and imperial units. In the example below, the energy use intensity axis labels are provided in metric on the top axis and imperial on the bottom.



Notes

1. US SIF: The Forum for Sustainable and Responsible Investment, "SRI Basics," www.ussif.org/sribasics.
2. Kwame Addae-Dapaah, Tham Kok Wai, Mohd Jaafar Bin Dollah, and Yvonne Foo, "Indoor Air Quality and Office Property Value" Journal of Sustainable Real Estate 2, no. 1, 2010, www.josre.org/wp-content/uploads/2012/09/Indoor_Air_Quality_Office_Property_Value_v2-51.pdf.
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