



200 CLARENDON STREET TRANSFORMING A BOSTON LANDMARK

Delivering the highest standards in environmental
performance and customer experience

OVERVIEW

200 Clarendon Street is a 62-story Class A office building located in Boston's Back Bay neighborhood.

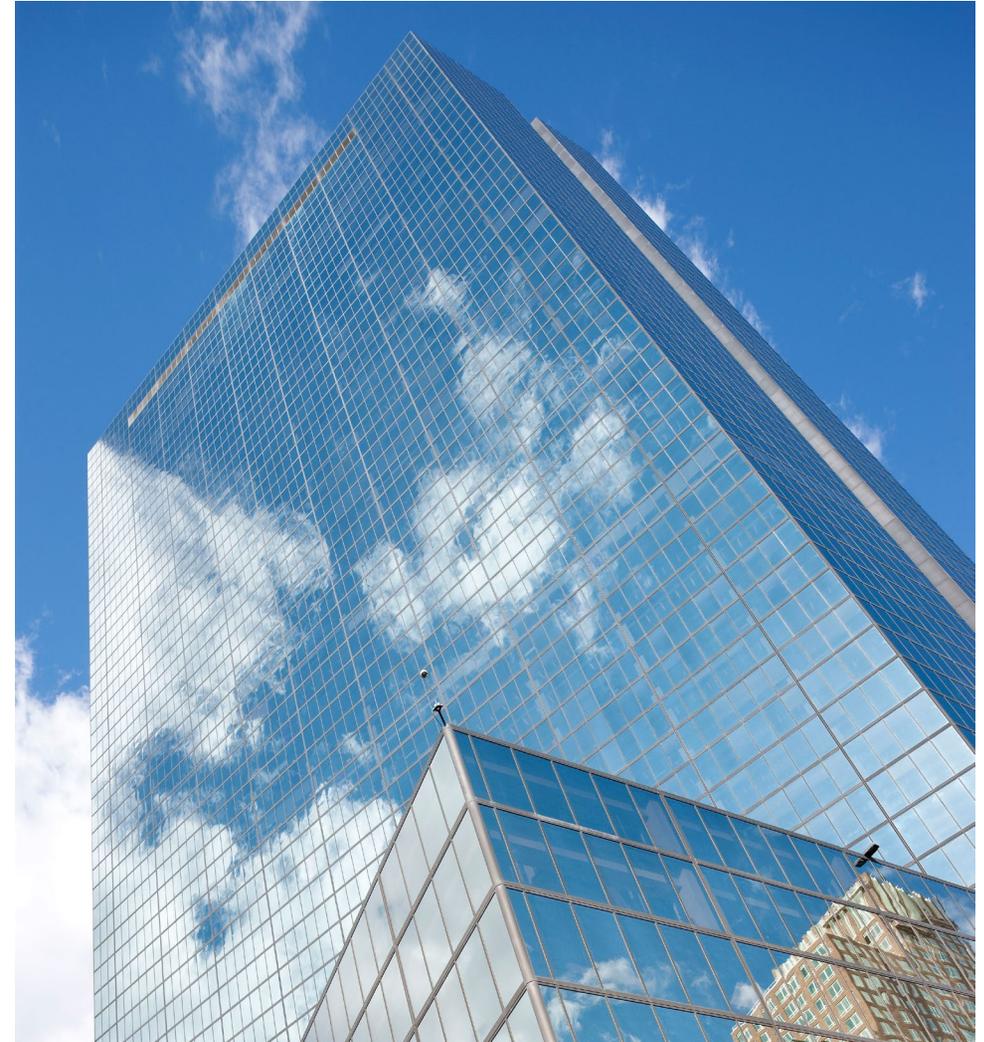
Originally designed by Henry Cobb and I. M. Pei in the late 1960s, 200 Clarendon Street was completed in 1976 and has stood as New England's tallest building and one of Boston's most iconic landmarks for over 40 years. The building offers 1.7M sq. ft. of office space with dramatic views over downtown Boston and the Charles River. Its central location close to public transportation and cultural centers results in a uniquely desirable place to work.

Though the minimalist, modernist project was a true architectural achievement and the design had proven ageless, the original mechanical and control systems had long exceeded their useful life and were in need of replacement. After completing the acquisition in 2010, Boston Properties quickly committed to a multi-year capital improvement and modernization plan to

systematically repair or replace all major mechanical and control systems with a goal of reducing energy consumption and maintenance costs while improving overall operational efficiency and occupant comfort.

The capital improvement plan for 200 Clarendon Street was developed with a focus on both the immediate building needs and the desire to establish a new operating methodology that would effect permanent reductions in utility (electricity and steam) consumption, greenhouse gas generation, and improve the customer experience.

With over \$13M in capital improvements completed since 2012, the building has markedly increased its operational efficiency and customer experience – reflected in the Energy Star Label and the LEED-Existing Building Gold certification awarded to the building in 2017 – to a point befitting its stature as a destination of choice for those seeking commercial office space in the Boston market.



LEED® Gold
(Existing Buildings)

38 to 83

Increase in Energy
Star score (2012
to 2017)

\$13m

Capital improvements
program

\$1.65m

Avoided utility cost
from 2015 to 2016

UPGRADING THE BUILDING

When Boston Properties took responsibility for the management of 200 Clarendon in 2012, capital improvement projects were categorized and implemented in two distinct phases – mechanical system replacement and controls modernization / retro-commissioning.

The first phase consisted of a broad range of mechanical projects that provided much-needed improvements to the low rise (Floors B-34) and high rise (Floors 35-60) chiller plants, secondary chilled and hot water systems, tenant condenser water system, air handler chilled water coils, and supply/return fan motors and variable frequency drives (VFDs). Additionally, free-cooling heat exchangers were added to both chiller plants to allow the building to utilize advantageous outside air conditions when available.

While each of these projects also included a targeted scope of controls work to ensure proper functionality, building staff knew there was untapped value in the energy management system (EMS) that could be unlocked through the review, optimization, and tuning of the sequences of operation for both the new and existing equipment. This mindset came to define phase two of the capital plan – a comprehensive retro-commissioning of the Building Management System (BMS) – and it would reveal the true potential contained within this 40-year-old structure.

The holistic, comprehensive and transparent approach used during the execution of these improvements resulted in the achievement of significant operational and energy efficiencies.

“The numerous upgrades and improvements undertaken to date have enabled 200 Clarendon to perform at a thermal comfort and energy efficiency level comparable to any Class A tower in the city.”

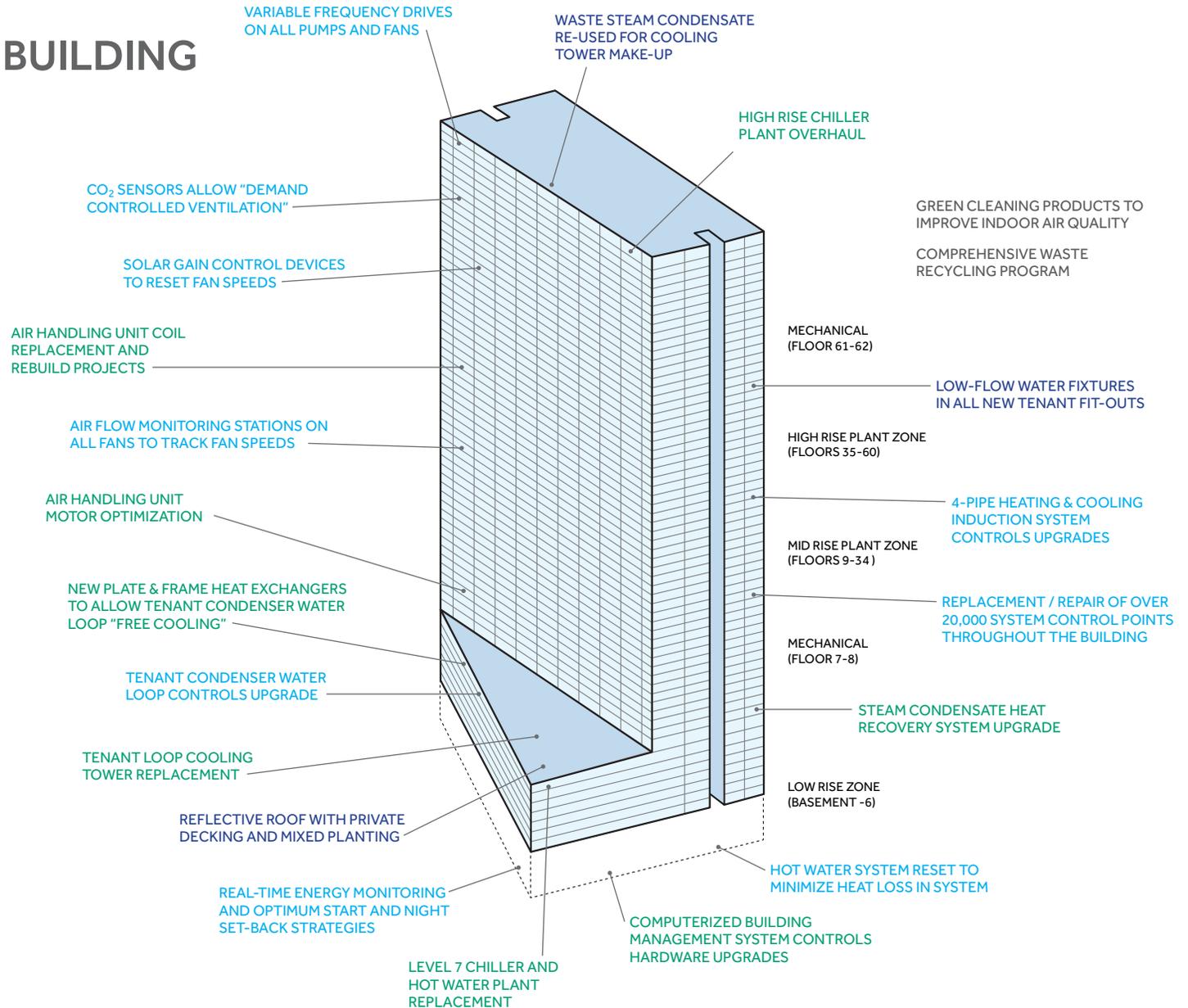
Mike Fitzgerald, Vice President Engineering at Boston Properties



UPGRADING THE BUILDING

Key features and upgrades

- CAPITAL IMPROVEMENT PROJECTS
- SUSTAINABLE OPERATIONS
- CONTROL AND RETRO-COMMISSIONING (RCx) PROJECTS
- WATER EFFICIENCY MEASURES





UPGRADING THE BUILDING

INVESTING TO CREATE A BETTER BUILDING

Plant upgrades with minimal disruption to customers

The major upgrades, which were completed over a five-year period, were coordinated and phased in a way that maintained the functionality of all building systems with only minimal disruption to building occupants. For example, the replacement of the 7th floor cooling plant involved the removal of several windows to enable crane delivery of the new high-efficiency electric centrifugal chillers.

Free cooling: water-side economizer

To take advantage of the favorable Boston climate conditions, new plate and frame heat exchangers were installed to augment the operation of the new central cooling plants. These heat exchangers allow the building to provide cooling to various systems by sending water over the building's cooling towers instead of using traditional mechanical cooling (chillers). This new flexibility has resulted in a 35% reduction in chiller runtime and significant electric energy and cost savings.

Optimizing fresh air and energy conservation

The building's air handling units underwent large-scale mechanical improvements that returned them to their original design specifications and then were integrated into the upgraded building control system.

To maintain the optimum balance between outdoor air ventilation for occupants and system energy efficiency, new temperature and pressure sensors, as well as an air flow monitoring station, were fitted to each air handling unit to complement damper control improvements.

Flexible cooling to suit customer needs

Customers now have access to condenser water loops that operate 24/7, allowing them to add additional cooling equipment to areas such as server rooms, fitness centers, and kitchens as required. The improvements have more than doubled the cooling capacity available to customers while reducing system energy use.

Efficient heating saves energy and water

Heating at 200 Clarendon Street is provided by Boston's district steam system; a by-product of the system is hot water condensate. This water is typically disposed of via the wastewater system and subject to sewer charges.

To maximize the usefulness of this resource, the condensate is captured in a dedicated tank, rerouting it away from the wastewater system, and is used as make-up water in the cooling towers. This make-up water would otherwise have to be provided from the city's domestic water supply.





UPGRADING THE BUILDING

AUTOMATION SYSTEM RETRO-COMMISSIONING

Effective automation and control systems optimize occupant comfort conditions, monitor how well systems are operating, promptly identify faults, and operate equipment as efficiently as possible. The \$1.2M automation system retro-commissioning project at 200 Clarendon Street delivered each of these benefits and has resulted in a large decrease in occupant service calls along with significant energy consumption and cost savings.

Comprehensive energy audit

When Boston Properties took over the management of 200 Clarendon Street, the control of the building systems was overly complicated and inefficient. Partnering with utility provider Eversource, a comprehensive energy audit was performed for the proposed retro-commissioning plan, with Siemens and Engineered Solutions, Inc. being added to the team to assist with its implementation.

A systematic investigation

A deep retrofit of the entire building control systems involved repairing and installing sensors, dampers and motors, recalibrating equipment, and writing a new software program to create an intelligent and fully integrated system.

The Energy Management System (EMS) inherited by Boston Properties had over 80,000 hard and virtual points that it could interface with, clogging the system with redundant code and making it extremely cumbersome to manage. The project team undertook the laborious process of analyzing every piece of connected equipment point-by-point. New sequences of operations were written for each point on every piece of equipment and coded into the new platform. Many sensors and actuators were replaced, and the user interface was completely redesigned.

Optimized operations

A new easy-to-use graphic interface allows operators to instantaneously access critical information about base building and customer systems, and equipment. They can easily monitor or adjust any of thousands of set points to optimize occupant comfort or system operation. The EMS monitors energy consumption in real time, produces daily report logs across a range of operational parameters, and alerts operators to system faults through alarms and warning displays so they can take pre-emptive action.



TRANSFORMING THE CUSTOMER EXPERIENCE

The upgrades have led to marked improvements for occupants of 200 Clarendon Street, helping to enhance wellbeing and improve productivity.

Optimal comfort and productivity

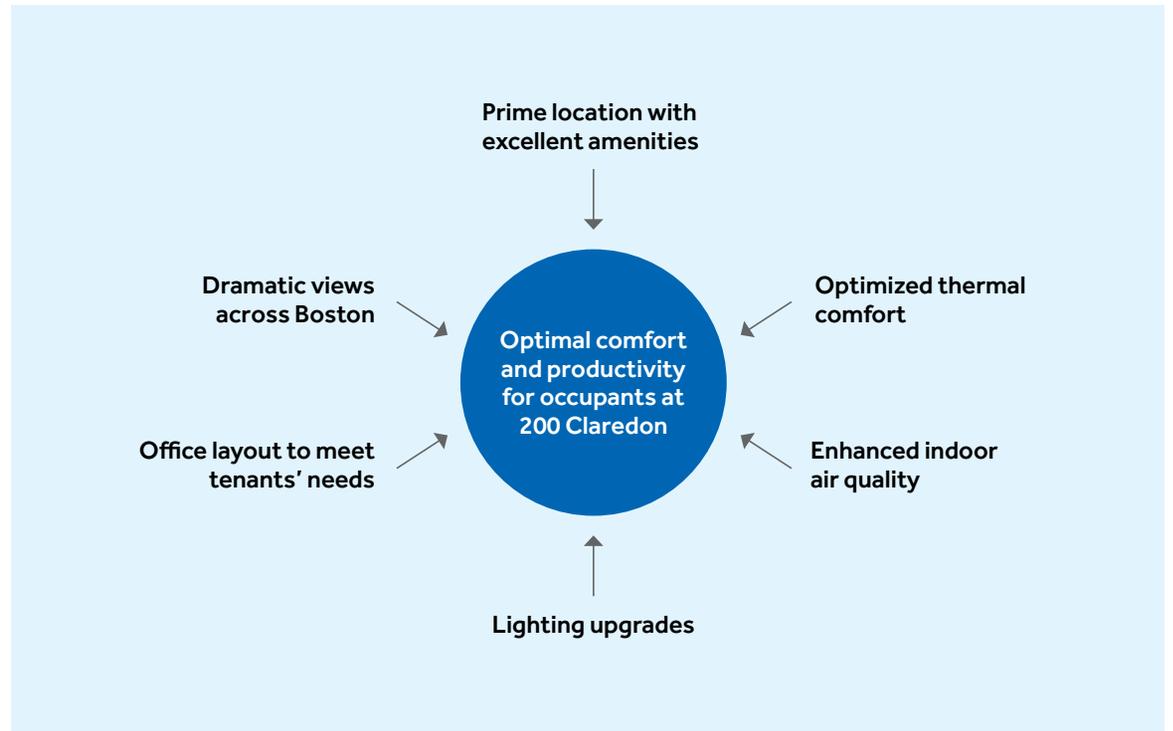
Research tells us that occupant comfort is linked to productivity. The comprehensive retrofit of the building automation and control system now provides precision climate control for customers, ensuring a comfortable working temperature all year round.

Another aspect of the far-reaching improvements saw the installation of CO₂ sensors to all major building fan systems. These sensors monitor the concentration of carbon dioxide in the air and automatically tell the ventilation systems when to respond to changes in occupancy levels in order to optimize air quality. Remote sensors enable staff at the operations control room to monitor the system 24/7.

Enhancing occupant wellbeing

Our upgrades have successfully delivered benefits to both customers and their employees, creating an environment that makes people feel happier and healthier, a place where they want to work and spend time.

The prime location in the heart of Back Bay, proximity to major transportation hubs, and unparalleled panoramic views make 200 Clarendon Street an ideal place to work, and play a key role in helping customers attract and retain the best talent.



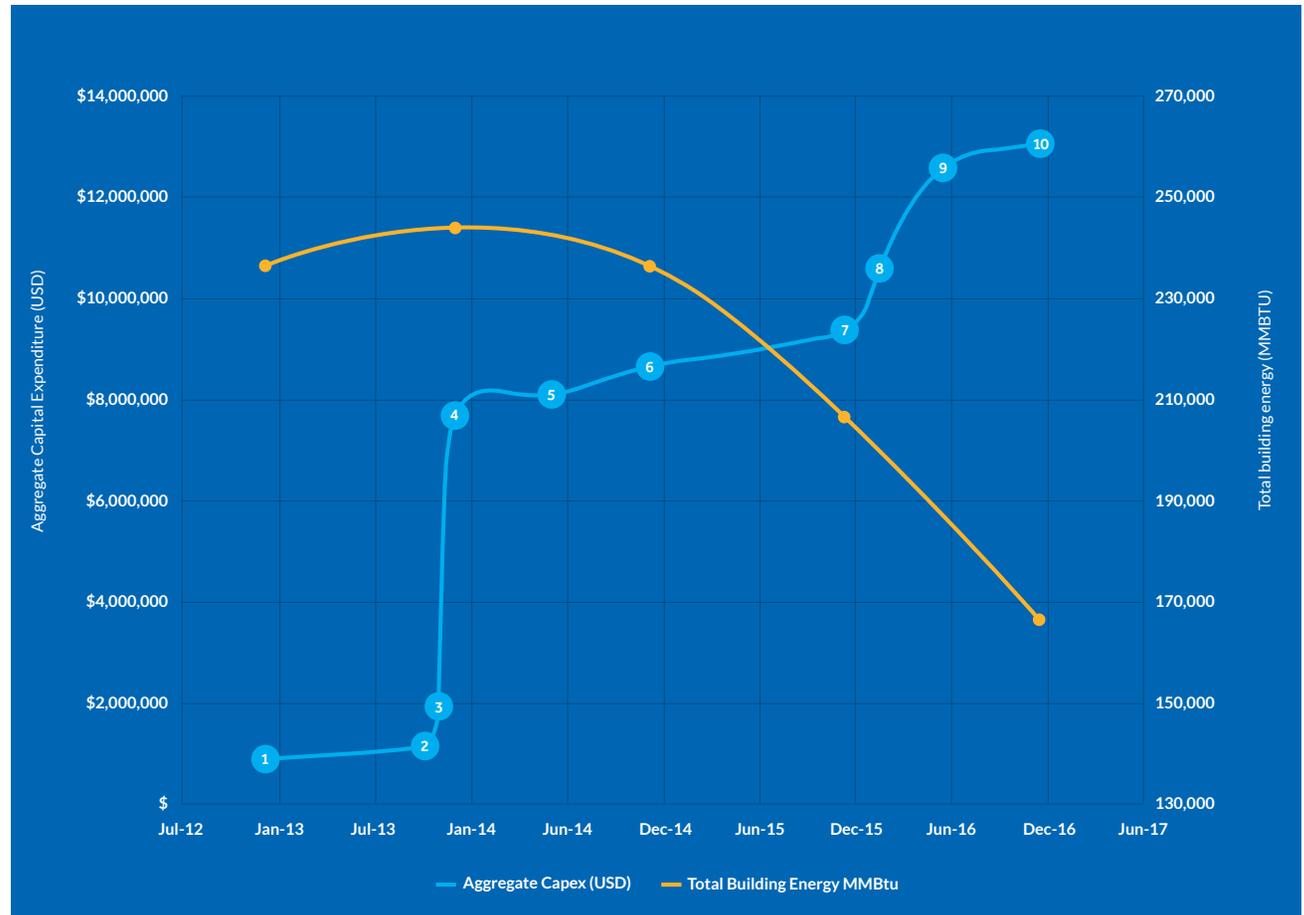
DELIVERING ENVIRONMENTAL BENEFITS

Implementing energy conservation measures and reducing the environmental impact of building operations directly aligns with Boston Properties' objective to provide the greatest benefit to both customers and investors. Boston Properties is also acutely aware that customers care about their impact on the environment and works very closely with them to support and facilitate their efforts in this regard.

Our investment has resulted in significant energy savings

Key

1. AHU Coil / Customer CW Cooling Tower Replacement – \$930,000
2. Steam Condensate Recovery Tank Installation – \$288,000
3. Building Automation System Hardware Upgrades – \$734,000
4. Low Rise Central Heating and Cooling Plant Replacement – \$5,725,000
5. High Rise Free Cooling Heat Exchanger – \$420,000
6. Condenser Water System Upgrade – \$550,000
7. Air Handling Unit Fan Motor Replacement – \$762,000
8. Building Automation System Retro-commissioning – \$1,200,000
9. Air Handling Unit Modernization – \$2,000,000
10. Low Rise Air Handling Unit Replacement – \$460,000



DELIVERING ENVIRONMENTAL BENEFITS



ENERGY PERFORMANCE

The changes to 200 Clarendon have had a dramatic impact on the energy performance of the building. In 2012, before any improvement activity, the building was significantly underperforming the broader market with an Energy Star score of 38. By the end of 2017, 200 Clarendon's Energy Star score improved to 83 and the building was awarded the Energy Star Label signifying superior energy performance and conservation.

Recognized as a Top Performer with an Energy Star score of



Electricity consumption has dropped more than

27%



WASTE

Boston Properties is proud to provide desk-side single-stream recycling services to everyone who works at 200 Clarendon. Blue recycling bins beside each desk make it easy to recycle paper, cardboard, metal and plastic items. In addition, recycling and disposal services are provided for e-waste such as computers, monitors and printers, and for batteries, lamps, bulbs and furniture.

In 2017, 71% of waste was recycled, saving 5,961 trees and 136,761 gallons of oil

71%



TRANSPORT

To promote active travel modes, bicycle racks are provided for occupants and visitors. The building is also conveniently situated within walking distance of all major transportation systems in Boston including Back Bay train station, the MBTA Green Line and many of the city's major bus routes.

In 2016, 15% of occupants walked or cycled to work

15%



WATER EFFICIENCY

Boston Properties recognizes the growing importance of water conservation. The commitment to reducing water usage led the engineers to design a method for reusing condensate from the building's steam system in its cooling towers. Over 30% of the water used in the building's cooling towers is recycled, non-potable water recovered from the steam condensate system.

Water efficient fixtures are used in every new customer fit-out, and all common-area fixtures have been replaced with low-flow models.

Water usage is 45.5% lower than the baseline year (FY2012)

45.5%

"I've been a customer in 200 Clarendon Street since 2001, and I appreciate the sustainability upgrades that have been made by Boston Properties to the building. The upgrades have exceeded our expectations. The building staff is always thorough and responsive to our building-related needs - which have decreased markedly since the improvements. There is a more consistent experience across all seasons and occupant comfort has greatly improved."

COO, Adage Capital Management LP

WORKING IN PARTNERSHIP TO DELIVER RESULTS

ASSEMBLING THE BEST TEAM

An expert team was brought together to work on each of the retrofit projects; in-house staff with intimate knowledge of the existing systems and an understanding of customer needs worked alongside industry experts with specialized knowledge of system design and implementation. This approach optimized the overall operation of the building and prioritized projects that would integrate well with one another to maximize cost and energy savings.

The camaraderie and enthusiasm for “getting it right” that developed during the intensive period of capital improvement work continues today. The building operations team now consists of three management staff and more than 20 field engineers who provide 24/7 engineering and maintenance services to both base building and customer equipment and systems.

20+ engineers and tradesmen provide round-the-clock support to customers



WORKING WITH OUR CUSTOMERS

Achieving the highest level of performance at 200 Clarendon is only possible with the help of building customers, and the building management staff work closely with them to ensure that they have all the information they need to run their businesses efficiently and effectively. This approach empowers customers to optimize their operations, provide a comfortable working environment, and save energy and reduce costs. For example, regular communication with customers maximizes their use of the recycling program, which is also reinforced through several annual events, such as Green Week.

Making it easy for customers to contact us

Good communication is at the heart of customer relationships. An online portal provides a convenient way for occupants to log service requests, or they can use a telephone hotline if they prefer. In addition, members of the maintenance team regularly tour the building, so they are on hand to deal with any issues as they arise. Regardless of the means of contact, there is a formalized process to ensure all issues are logged and tracked through to completion.

Keeping customers informed

The online portal also provides detailed guidance on customer-operated systems, such as how to connect equipment. For day-to-day communication, display boards are used to inform occupants of transport news and local amenities. Regularly published newsletters, in addition to the completion of customer surveys, ensure the building is meeting customer needs.

Highlights of 2016 Green Week

- Transportation Day, including free bicycle tune-up, rider breakfasts and *A Better City* alternative transportation presentation
- Sustainable Food Fair
- Information on Energy Star
- Energy audit presentation
- Recycling information

