

CADMUS

Report to the Boston Green Ribbon Commission

First Movers Research

September, 2018



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Top 50 Summary

Methodology and Overview

Top 50 Summary

Boston University has been utilizing the City of Boston's tax assessor's database to identify the Top 50* largest property owners in Boston. Cadmus populated an early iteration of this list with key information on **carbon reduction targets of these large property owners**.

The Top 50 analysis captured publicly available organizational targets for:

- **Energy Use**
- **Renewable Energy**
- **Carbon/GHG Reduction**
- **Waste and Recycling**
- **Water**

Organizational-level targets were the primary focus of this research, the accompanying database indicates whether the companies have LEED or ENERGY STAR buildings within their portfolios (in Boston, or elsewhere).

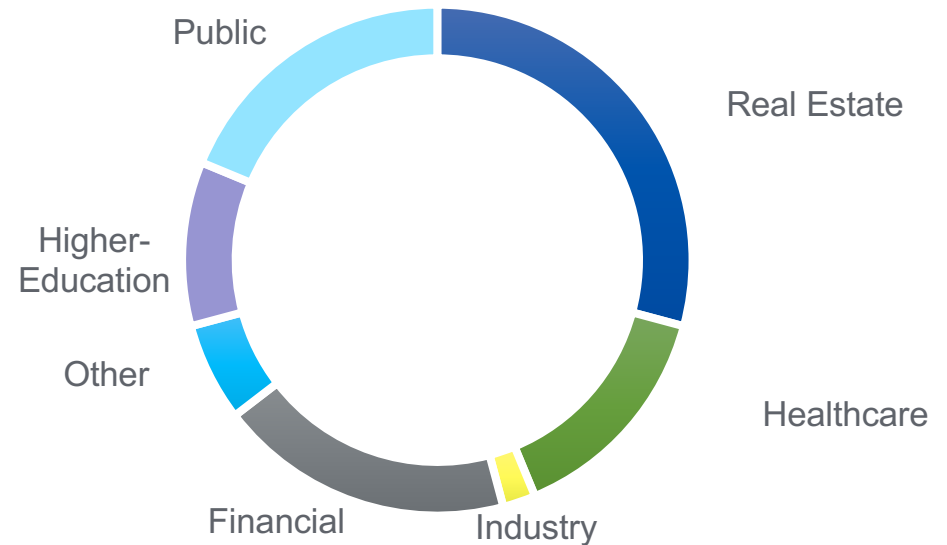
*Cadmus cleaned the initial data provided by BU to remove duplicate entries and the "Religious" category which combined different institutions. For the purposes of this analysis, Brigham and Women's Hospital, and Partners Healthcare were treated as distinct entities. The Top 50 list has since evolved through BU's data-cleaning of the tax parcel information.

Data and Targets of Top 50

Top 50 Summary

- Top 50 organizations own between **1 million square feet and 25.8 million square feet.**
- Represents in total **over 176 million square feet in Boston.**

Representation by Sector
(Number of Institutions)



Sector Representation by Square Foot (Top 50)



5 *Other* includes the Roman Catholic Church, the Museum of Fine Arts, and the Massachusetts Convention Center.

Data and Targets of Top 50

Top 50 Summary

50% of Top 50 organizations have ENERGY STAR-rated buildings in their portfolios

40% of Top 50 organizations have set quantifiable carbon reduction targets

32% of Top 50 organizations have LEED-certified buildings in their portfolios

23% of Top 50 organizations have set quantifiable renewable energy targets



First Movers

Overview

Identification

First Movers Overview

First Movers: Large-scale property owners in Boston that have **set and tracked progress towards quantifiable targets** that lead to carbon reduction and **implemented strategies to reduce carbon emissions.**

In consultation with the Carbon Free Boston team, Cadmus **selected five organizations** from the Top 50 analysis to highlight in the First Movers Analysis. These organizations were chosen based on the following:

- › **Publicly available data** on organizational sustainability initiatives*
- › Presence of **quantifiable targets** related to carbon reduction
- › **Sector** representation

*Reviews were made based on publicly available information, and may not reflect all internal management activities

Organizations

First Movers Overview

Cadmus looked at the sustainability activities of **5 major property owners in Boston that represented a variety of sectors**. These include:



Northeastern

Please note: many other property owners also could be considered "First Movers" within the City of Boston.

Methodology and Analysis

First Movers Overview

Drawing from **publicly available data and interviews** with key stakeholders at each of the First Mover organizations, Cadmus identified the following:

Overall strategies for carbon reduction, including:

- Types of targets and progress towards targets;
- Types of actions;
- Motivations for carbon reduction;
- Enabling factors for implementation and lessons learned;
- Any challenges for carbon reduction noted by interviewees; and
- Next steps and ways they are considering supporting carbon reduction in the future.

Governance and Green Buildings

First Movers Overview

Organization	Square feet of property in Boston	Sustainability Committee or Officer	GHG Disclosure (most recent year)	LEED-Certified Buildings in Portfolio	ENERGY STAR-Rated Buildings in Portfolio
AvalonBay	2,088,549	Yes	2017	Yes	Yes
Boston Medical Center	2,623,892	Yes	-	Yes	-
Boston Properties	5,287,663	Yes	2017	Yes	Yes
City of Boston	25,830,811	Yes	2015	Yes	Yes
Northeastern University	7,036,017	Yes	2017	Yes	-

Greenhouse Gas Emissions Targets

First Movers Overview

Organization	Target	Progress
AvalonBay	No specific GHG reduction target, but has aggressive energy efficiency targets for Boston portfolio and company-wide 2020 goals related to energy and water.	In the process of setting new post-2020 targets.
Boston Medical Center	50% reduction by 2018.	<ul style="list-style-type: none"> Virtual PPA in 2017 estimated to make BMC 92% carbon neutral in 2018. Avoided 5,600 metric tonnes of CO₂e through energy strategy with Eversource.
Boston Properties	45% reduction by 2025 (2008 baseline)	Reached initial 2020 target in 2017. Set new reduction targets for 2025.
City of Boston	<ul style="list-style-type: none"> Community-wide: achieve carbon neutrality by 2050. Municipal targets: 25% by 2020. 80% by 2050 (2005 baseline) 	Met the municipal 2020 carbon reduction target. Reported a 27% GHG reduction in 2015 from 2005.
Northeastern University	80% by 2050, 25% by 2025 (2005 baseline).	Met 20% reduction/gross square foot goal by 2015. Reported 36% reduction CO ₂ e MT/gsf in 2016.

Renewable Energy

Actions for Carbon Reduction



Progress to Date

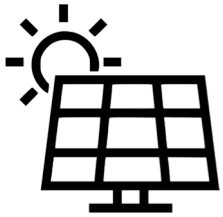
Renewable Energy

While the First Mover organizations **lacked specific targets**, each has invested in renewable energy.

Organization	Progress
AvalonBay	<ul style="list-style-type: none">• Piloting storage in NY facilities• Deploying solar in eight communities with an estimated first year energy savings of \$135,000• Conducting feasibility analyses on additional 39 properties for solar generation (up to 11 MWs)
Boston Medical Center	<ul style="list-style-type: none">• Entered virtual PPA for solar power in 2017, allowing it to offset 92% of its carbon emissions (100% of its electricity use)
Boston Properties	<ul style="list-style-type: none">• Generated 1 million kWh with 5 onsite solar PV projects in 2017
City of Boston	<ul style="list-style-type: none">• Installed 14.3 MW of solar as of 2013 (citywide)• Purchased Renewable Energy Certificates allowing city to exceed its 2020 emissions reduction goal in 2015.• Approved Community Choice Aggregation in 2017.• Participating in RFI process for multi-city large-scale renewable energy procurement.• Conducting studies on microgrids.
Northeastern University	<ul style="list-style-type: none">• Installed a 26-kW solar PV system onsite.

Highlights

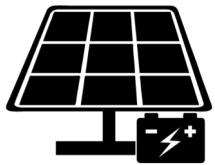
Renewable Energy



City of Boston, Boston Properties, AvalonBay*, and **Northeastern University** have installed sizeable on-site solar PV systems.



The **City of Boston** has entered a RFI process with over 20 cities to explore the feasibility of large-scale joint renewable energy procurements.



The **City of Boston, AvalonBay, Boston Properties**, and **BMC** are looking at ways to increase resiliency through battery storage.

Early and Emerging Activities

Renewable Energy

Early

- Physical Power Purchase Agreements for Onsite Solar PV and Wind
- Purchasing Renewable Energy Credits

Emerging

- Virtual Joint PPAs
- Solar + Storage
- Microgrids
- Competitive Suppliers

Benefits and Challenges

Renewable Energy

Benefits

- Renewable energy is **highly visible**, and a “delight” to tenants and other stakeholders.
- There are **demonstrable energy savings** to make the business case for renewable energy.
- PPAs **enable access to lower cost electricity** supply (joint PPA enable access to further discounts)

Noted Challenges

- Carbon reduction potential from on-site renewable energy is **limited by space availability** on properties and in the City generally.
- **Uncertainty of solar incentives** in Massachusetts pose challenges for organizations trying to understand the business case.
- **Resiliency measures and carbon reduction can be at odds**, for example onsite generation may need to be gas-powered.

Spotlight: Boston Medical Center

Renewable Energy

- Interested in pursuing solar energy – but **few locations on campus** or within the city for hosting.
- Entered into a **25-year Virtual Power Purchase Agreement jointly with MIT and Post Office Square (POS)** from a 60 MW solar farm in North Carolina.
- **Set criteria** with buying group that power had to have **low-risk profile**, and add **new renewable energy** to the grid.
- Solar farm put into operation in March of 2017.
- Generation is expected to be **equal to 100% of BMC's electricity consumption.**



Photo courtesy of MIT Department of Facilities

Energy Efficiency

Actions for Carbon Reduction



Progress to Date

Energy Efficiency

Organization	Target	Progress
AvalonBay	15% reduction in energy use intensity (EUI). Mayor's Carbon Cup: 1MM sq. ft. in Boston committed to 35% reduction in EUI by 2020 from 2013 baseline.	<ul style="list-style-type: none"> Completed LED retrofits for 60% of national portfolio and 100% of MA portfolio Implemented data-driven smart metering and demand response programs in Boston, NY DC, SF, and Seattle facilities.
Boston Medical Center	2012/2013 Goal: 4.5 million kWh energy reduction. Mayor's Carbon Cup.	Avoids 5,600 tonnes of CO ₂ through strategy with Eversource.
Boston Properties	32% reduction from 2008 energy use baseline by 2025. Mayor's Carbon Cup.	Reduced energy use by over 50 million kWh since 2014 throughout portfolio.
City of Boston	20% reduction in energy use by 2015 from 2010 baseline.	Converted 66,000 electric streetlights to LEDs, reducing emissions by an estimated 5%.
Northeastern University	No specific target.	Over \$9.7 million in CAPEX between 2005 and 2014, yielding \$31 million in cumulative cost savings from energy efficiency and conservation initiatives by 2016.

Highlights

Energy Efficiency



BMC's Campus Redesign is estimated to reduce the area of the campus by 10%, increase patients served by 30% and reduce electricity by 40% by creating higher utilization rates of space.



Northeastern University and **BMC** have invested in monitoring and upgrading their steam systems and traps.



Upgrading and replacing HVAC and lighting technologies and implementing variable speed drives to motors were noted as key first steps for the **majority of the First Movers**.



Real estate sector has used tenant challenges and sustainable building practices and operational guidelines to reduce energy through behavior change and building management.



AvalonBay and **Boston Properties** have both invested in real-time smart metering for energy management and demand response.



The **City of Boston** has utilized energy performance contracts.

Trends in Leadership and Activities

Energy Efficiency

Early

- LEDs for lighting
- Steam trap monitoring and replacement
- EnergyStar appliances and HVAC upgrades

Emerging

- Grid demand response
- Smart metering
- Green roofs
- Large-scale recommissioning of systems
- Energy performance contracts
- Net-Zero building studies

Benefits and Challenges

Energy Efficiency

Benefits

- **Demonstrable energy savings**, and availability of utility incentives for some energy efficiency measures.
- Smaller projects with demonstrable savings can help **build momentum for larger projects**.
- Smart metering and demand response controls allow organizations to **reduce load on the local grid** when needed, providing a larger benefit for the community.

Noted Challenges

- **Trainings are necessary** for facility operators and engineers to ensure that the building controls and measures continue to function in a way to provide energy savings.
- **Less visible than renewable energy** technologies, which garners less of a response.

Spotlight: Northeastern University

Energy Efficiency

- Laboratories on campus are **high energy users and highly controlled environments**.
- Northeastern has **invested in retrocommissioning of existing buildings** on campus with a focus on laboratory operations.
- The University first updated the Egan Research Center by **implementing sensors, and creating new building control sequences**. This reduced energy consumption in the facility by 50%.
- Based on this success, NU has invested in these design and operational practices across campus. In the Behrakis Health Sciences Building, **energy consumption was reduced by 35%** using similar methods. This resulted in a \$250,000 annual savings.
- In 2016, NU created its *Sustainable Practices and Operations Guidelines* which **standardizes university policies around construction, renovations, recommissioning, design, recycling, and operations campus-wide**.



First Movers

Lessons Learned

Lessons Learned: Motivations

Overall, interviewees expressed a number of reasons why their organizations have pursued carbon reduction.

- **Operational and cost efficiencies** were noted as a large motivator and way to build support for measures.
- While **marketing is not the primary driver** for any of these organizations, it has been noted as a potential co-benefit of pursuing these actions and leading.

Lessons Learned: Enabling Factors

Despite progress and successes, First Movers identified enabling factors and keys to success that are relatively unsurprising to those familiar with carbon reduction in large properties.

- **“Don’t focus on carbon reduction at all.”** Stakeholders noted that approaching carbon reduction through the lens of carbon reduction itself is not helpful. Instead, organizations should think about these activities as ways to **address multiple issues at once** – such as enhancing resiliency, operations, utilization of spaces, or their bottom line.
- **Demonstrating the business case** for these measures eases the pathway for moving these actions forward.
- Each of the organizations discussed the importance of **dedicated champions within the organization to catalyze these actions**.
- **Presence of sustainability officers or committees** to measure and track progress and **support from executive leadership** in the organizations was noted by interviewees as key ways to drive these actions and target setting.
- **Educating staff at all levels** has proven key to making sure that energy use and carbon should be measured and managed.
- **Energy efficiency incentives and third-party ownership** options are tools to further increase energy savings and reduce capital expenses.
- **Piloting projects in a few facilities** can demonstrate savings and impact from these investments before applying to their entire portfolio.

Lessons Learned: Challenges

First Movers identified a variety of challenges they have encountered through initiating specific projects. At a high-level, organizations identified the following challenges:

- **Securing commitments and support from top executives** of organizations has been noted as key, but can sometimes be a challenge.
- For companies working in multiple regions or cities, **aligning companywide targets with city targets may pose issues** – especially as cities begin to regulate carbon reduction differently.

CADMUS

A blue-tinted photograph of a business meeting in a modern office. Several people are silhouetted against a large window with blinds. Some are seated in white chairs around a table, while others stand and talk. A large, semi-transparent blue circle is overlaid on the left side of the image.

Thank You

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Appendix

First Mover Profiles

A large, decorative graphic on the left side of the page consisting of two overlapping, curved blue bands. The inner band is a darker shade of blue, and the outer band is a lighter shade, creating a sense of depth and movement.

AvalonBay Communities

Profile

Disclosures and Governance

AvalonBay

Disclosure

- Publishes annual corporate responsibility report which includes verified GHG inventory, energy, water, and waste data.

Governance and Leadership

- Corporate responsibility is headed by a Vice President, who leads all of the environmental sustainability and philanthropic programs.
- There is a corporate responsibility committee which meets monthly, and a philanthropy committee.
- In Boston, AvalonBay joined the Boston Mayor's Carbon Cup, committing to a 35% EUI reduction in 1MM square feet of its Boston properties.

Buildings and Targets

AvalonBay

Buildings

- 2,088,549 square feet in Boston
- 10 ENERGY STAR-rated properties
- 770, 780, and 790 Boylston properties reported to BERDO in 2017
- North Station has LEED NC Silver, and two other properties are pursuing LEED

Targets

- **Energy Use:** 15% reduction in energy use intensity (EUI) of the like-for-like portfolio
- **Waste:** 20% reduction in landfill-bound waste across portfolio by 2023 from 2017 baseline
- **Water:** 15% reduction in water use intensity (WUI) of the like-for-like portfolio.

Successes and Initiatives

AvalonBay

Successes

- LEDs for lighting (over 60% of portfolio)
- Reduced water use intensity to 41.7 kgal/unit in 2017.
- Installed cogeneration system in RI facility to reduce 32 MTCO₂e/year
- Installed sensors and real time monitoring technologies in NY and MA facilities for demand response; with gamified element for facility managers

Emerging

- Created a waste reduction goal in 2018 CR Report
- Scoping solar + storage technologies through pilot in White Plains, NY
- Conducting a study on Zero Net Energy buildings
- Continue to expand smart building technology to rest of portfolio

Boston Medical Center

Profile

Disclosures and Governance

Boston Medical Center

Disclosure

- Does not annually disclose GHG emissions or targets.
- Boston Carbon Cup: Committed 2.8 million square feet to 35% carbon reduction by 2020.

Governance

- Has a Sustainability Committee and Green Committee with representatives from various departments and medical campus to develop and track environmental initiatives.
- Safety-net hospital, so large focus on mission and well-being of patients to reduce need for their services.

Buildings and Targets

Boston Medical Center

Buildings

- Owns 2,623,892 square feet in Boston
- Conducted campus redesign to combine campuses and improve utilization rates of spaces.
- The Green Guide for Health Care pursued LEED Silver in 2000

Targets

- **Energy Savings:** Created 2012 and 2013 energy savings goal of 4.5 million kWhs
- **GHG Reduction:** Reduce emissions by 50% by 2018

Successes and Initiatives

Boston Medical Center

Successes

- Upgrades, replacements, system maintenance of HVAC, lighting, controls
- Campus redesign to reduce energy consumption, improve utilization, and increase operational efficiencies.
- Invested in natural gas-fired, onsite cogeneration plant for resiliency
- Virtual PPA with MIT and POS to offset 100% of electricity usage.
- 7,000 sq. ft. Rooftop farm to produce food for patients

Emerging

- Battery storage and resiliency technologies
- Behavior change

Boston Properties

Profile

Disclosures and Governance

Boston Properties

Disclosure

- Discloses GHG inventory annually through corporate reporting, including GRI.
- Boston Carbon Cup: Committed 1.5 mm square feet of property in Boston to 35% GHG reduction by 2020

Governance

- CFO and Sustainability Director oversee the Sustainability Committee which has representatives from different parts of the company.
- Member of the U.S. Green Building Council, National Association of Real Estate Trusts, Real Estate Roundtable Sustainability Policy Advisory Committee, Global Real Estate Sustainability Benchmarking, Building Owners and Managers Association, and Urban Land Institute

Buildings and Targets

Boston Properties

Buildings

- Owns 5,287,663 square feet in Boston (39 buildings)
- Has ENERGY STAR-rated buildings within its portfolio
- Has LEED certified 21 million square feet of current in-service portfolio, of which over 95% is certified at Gold and Platinum levels

Targets

- **Energy Use:** 32% reduction in Energy Use Intensity by 2025 from 2008 baseline.
- **GHG reduction:** 45% reduction by 2025 from 2008 baseline.
- **Waste:** 65% diversion rate by 2025 of 2008 baseline.
- **Water:** 30% reduction by 2025 from 2008 baseline

Successes and Initiatives

Boston Properties

Successes

- Generated over 1 million kWh onsite solar in 2017
- Moved to single stream recycling where feasible (at 60% diversion rate in 2017)
- Implemented composting program
- Reached carbon reduction goal 3 years early
- Real-time monitoring using EnerNOC for demand response
- Upgraded HVAC controls, chillers, variable speed motors, LEDs

Emerging

- Half of new projects are studying renewable energy (solar thermal or PV)
- Solar PV, Solar Thermal, Solar + Storage feasibility
- Net zero at large scale



City of Boston

Profile

Disclosures and Governance

City of Boston

Disclosure

- In 2018 the City updated the GHG inventory data through 2015 for municipal operations.

Governance and Leadership

- Established Carbon Free Boston to explore ways to get the City to carbon neutrality by 2050.
- Similarly, the City has established Greenovate Boston, Zero Waste Boston, and Climate Ready Boston to address many climate and environmental issues.

Buildings and Targets

City of Boston

Buildings

- The City occupies 25,830,811 square feet in the City of Boston (321 municipal buildings).
- Schools, storage facilities, and offices receive ENERGY STAR scores. The median score for schools was 93 in 2016. Schools occupy 68% of all municipal buildings.
- The City has LEED-certified buildings.

Targets

- **Municipal goal:** Reduce GHG emissions 25% of 2005 baseline by 2020, 80% by 2050.
- Reach citywide carbon neutrality by 2050.
- Develop Zero Waste Plan.

Successes and Initiatives

City of Boston

Successes

- Participated in the U.S. Department of Energy's SolSmart and the Better Buildings Challenge programs.
- Purchased RECs to reach 2020 carbon reduction goal
- Emissions from street lights have been cut by 50% due to LED retrofits
- Converting diesel buses to propane engines, reducing 15% GHG emissions per bus per year.
- Finalizing energy performance contract for retrofits on 14 City buildings under Renew Boston Trust pilot

Emerging

- Entered RFI process with 20 cities for virtual PPA
- City Council approved community choice aggregation
- Focusing on implementing second phase of the Renew Boston Trust pilot (\$35 million to save 3.5 MWh of energy (approximately 2,000 ton emissions reduction per year



Northeastern

Northeastern University

Profile

Disclosures and Governance

Northeastern University

Disclosure

- In 2010, adopted a *Sustainable Action Plan: Roadmap towards Carbon Neutrality*. Updated sustainability report through 2025 available.
- Reports GHG inventory on Facilities website.

Governance and Leadership

- The University hired a Sustainability Program Manager in 2009
- Active sustainability committee with different departmental representation and student representation
- Created a commissioning/retrocommissioning department to focus on retrocommissioning of building control systems across campus
- Leads a Green Office Challenge which provides information on office behavior change for environmental benefits
- Created operational policy on sustainable practices for commissioning and operations of existing buildings

Buildings and Targets

Northeastern University

Buildings

- Owns 7,036,017 square feet in the City of Boston
- ENERGY STAR does not currently have a category for mixed use buildings of which the majority of NU facilities are
- 5 buildings on campus have achieved LEED certifications

Targets

- **GHG Reduction:** 80% reduction by 2050 from 2005 baseline, 20% reduction per gross square foot by 2015 (from 2005 levels)
- **Waste:** Increase recycling by 50% by 2025.
- **Water:** Reduce water consumption by 10% by 2025 from 2005 baseline.

Successes and Initiatives

Northeastern University

Successes

- \$9.7 million invested in capital initiatives for energy reduction
- Achieved 41% waste diversion rate in 2016
- Recommissioning of building systems
- Achieved 8% reduction in water use in 2017 since 2005.
- Steam trap monitoring and replacement

Emerging

- Continued recommissioning of existing buildings
- New sustainability website
- More integration with initiatives and student research