CLIMATE ACTION PLAN IMPACT

2019 SUSTAINABILITY ANNUAL REPORT

BOSTON UNIVERSITY

Boston University Sustainability

Chris Cook, Chief of Environment, Energy & Open Space for the City of Boston, visits the geothermal test well site for BU's forthcoming Center for Computing & Data Sciences in August 2019. Photo: Aaron Ye (COM'19)

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EXECUTIVE SUMMARY

This has been the most transformative year in the decade-long history of Boston University Sustainability. The Board of Trustees' approval of the Climate Action Plan in December 2017 set in motion a series of events designed to support the plan's implementation. With a structural move out of Facilities Management & Operations and a physical move to a more visible, central location on campus, the Sustainability@BU office, henceforth Boston University Sustainability, is strongly positioned to serve as a collaborative catalyst for sustainability on campus and beyond. The team has grown as well—to six full-time staff, enabling us to expand and deepen our work with operational and academic initiatives and our engagement with the campus community, the City of Boston, and the broader world.

As we act to meet our climate commitments, I would like to highlight several major projects and initiatives that are underway. BU Wind is under construction in South Dakota to meet 100% of the University's electricity demand and will be completed in December 2020. The largest fossil fuel free and carbon free building in Boston, the Center for Computing & Data Sciences, is also under construction and is already serving as the leading example for how buildings can be designed and built to operate without a carbon footprint. We are preparing our campuses for the impacts of climate change and developing plans for Zero Waste and the electric vehicle fleet transition. In January 2020, faculty from across the University convened a workshop to explore interdisciplinary collaboration on the development of sustainability and climate change curriculum. To execute solutions needed to advance the Climate Action Plan, in March 2020 we launched the Campus Climate Lab. This new research initiative funds student-faculty research related to campus operations.

The metrics in this report reflect Fiscal Year 2019.

Boston University Sustainability

Dennis Carlberg, AIA, LEED AP BD+C
Associate Vice President for Sustainability

Rendering of BU Center for Computing & Data Sciences. © Norm Li 2020

PREPARING FOR CLIMATE CHANGE

The Climate Action Plan (CAP) recommends the University prepare for the impacts a changing climate will bring to our campuses. This begins with new construction standards to minimize construction below what the Climate Action Plan defined as Elevation of Resilience (2'-0" above the top of the Charles River Dam) and a more complete vulnerability assessment of the Medical Campus, which was found to be particularly vulnerable to flooding. The Climate Action Task Force also recommends a deeper analysis of impacts from heat waves and development of strategies to address the urban heat island effect.

The Center for Computing & Data Sciences, scheduled for completion in 2022, has been designed for climate resilience. The first floor elevation is 1.25' above the Elevation of Resilience. Openings vulnerable to flooding are confined to a small area where temporary flood barriers will provide adequate protection.

The Climate Action Plan recommends prioritizing the Medical Campus for studying the University's vulnerabilities to climate change and sea level rise. This work is well underway, and in summer 2020 the SmithGroup is expected to complete its vulnerability assessment for the Medical Campus, which will help Campus Planning & Operations integrate risk mitigation into the campus planning process.

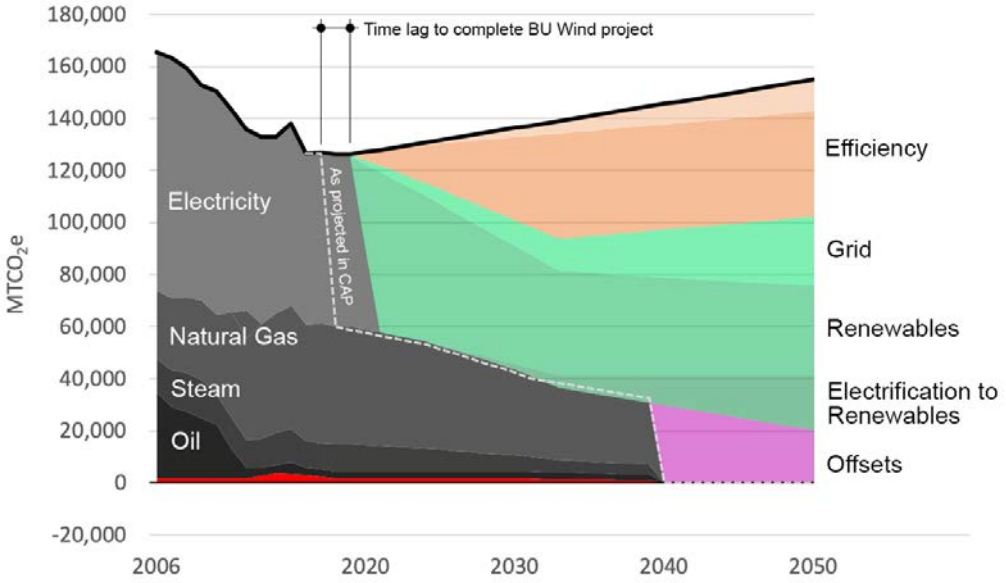
Even before the Climate Action Plan was approved, the University began preparing for climate change in new building design. The Rajen Kilachand Center for Integrated Life Sciences & Engineering, which opened in fall 2017, was designed and built with no basement. The mechanical and electrical rooms were elevated to the second and third floors.

NET-ZERO DIRECT EMISSIONS

The Climate Action Plan set a goal to be net carbon neutral by 2040. To accomplish this, four emissions reduction strategies are needed in the near term. These include:

1. Reducing energy demand by 31% by 2032
2. Shifting away from fossil fuel use to electricity for heating and cooling to enable a transition to renewables
3. Sourcing renewable energy to match 100% of the University's electricity demand, and
4. Beginning the transition of BU's fleet of vehicles to electric

PROGRESS ON CLIMATE ACTION PLAN EMISSIONS REDUCTIONS



REDUCING DEMAND

The University has reorganized Facilities Management & Operations (FMO) to allow more effective development of energy efficiency projects to meet the CAP goals. The University hired an Energy Program Manager, who over the past several months has engaged the FMO team to identify specific opportunities for improving energy efficiency, as envisioned in the CAP. Our LED lighting upgrade program helps to maximize the value of utility incentives.

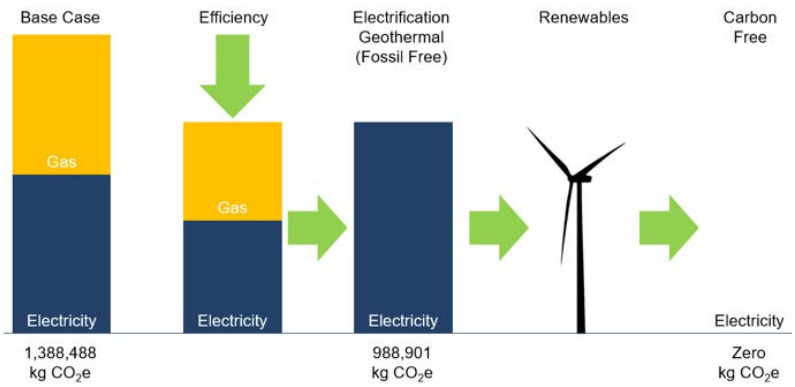
With compressor-based ultra-low-temperature (ULT) freezers using more energy per year than the average American home, a new partnership among the School of Medicine, Operations, Sustainability, and Sourcing & Procurement enabled BU researchers to apply for freezer replacements for their labs. In addition to the incentives provided by Eversource, the School of Medicine, Operations, and Sustainability offered additional funds to encourage involvement and successfully met the goal of 30 participants. This initiative will help to reduce the energy and electricity use in BU labs.

Climate Action Plan (CAP) Project Work Flow Chart

CARBON FREE BUILDING

The Center for Computing & Data Sciences is a leading example for how buildings can be designed and built to operate without a carbon footprint. Energy-efficient design is a necessary first step. Then, rather than burning natural gas for heating and cooling, fossil fuel free energy will be provided using the thermal mass of the Earth as a source for heat exchange. This will enable the building to source its energy from BU Wind and be carbon free.

ACHIEVING A CARBON FREE CENTER FOR COMPUTING & DATA SCIENCES



ENERGY EFFICIENCY

Energy efficiency begins with the building enclosure. The Center for Computing & Data Sciences is designed with external shading to keep the sun's heat out in the summer. Additionally, the windows have three layers of glass to retain heat in the winter. The next step is maximizing the energy efficiency of the systems used for heating and cooling the building. The center is designed with an enhanced HVAC system using water, rather than air, to move heating and cooling through chilled beams. This technology is used because water has a much greater capacity to hold thermal energy than air can provide.

SHIFTING FROM FOSSIL FUELS

The Climate Action Plan recommends electrification of the energy source used for heating buildings, then sourcing that energy from renewables.

The Earth's temperature remains stable between about 55° and 57°F year-round. The geo-heat exchange system takes advantage of the temperature difference between the Earth and the building's heating and cooling by circulating water from the building into a closed-loop system in the ground. This system takes heat out of the building in the summer in exchange for the Earth's cooler temperature. Then in the winter, it does the opposite and pulls heat out of the ground in exchange for cooler temperatures from the building. This groundbreaking project will be Boston University's most sustainable building yet, and demonstrates our climate action leadership to the City of Boston.

Geothermal well drilling for the Center for Computing & Data Sciences. September 2019. Photo: Dave Green Photography.

RENEWABLE ENERGY

A 53% reduction in BU's greenhouse gas emissions is anticipated through BU Wind, a Power Purchase Agreement (PPA) designed to match 100% of the University's electricity demand of 205,000,000 kWh/year. This wind farm is located in South Dakota, where it will have two to three times more impact on greenhouse gas reductions than would a project in New England. This is because the wind-generated electricity will eliminate the need for coal-fired power plants to come on line.

When the project is energized at the end of 2020, it will provide a 53% emissions reduction and lock in those reductions over the longer term. Construction began in August 2019 and as of February 1, 2020, 45% of the foundations were complete and 96% of the wind turbine components were delivered.

As part of the BU Wind project, the University has arranged for two paid internships per year for students to gain experience by working with ENGIE, the developer of BU Wind. In addition, BU Sustainability is working with Associate Professor of Mechanical Engineering Michael Gevelber to organize a directed study for a group of a dozen students to visit the BU Wind turbine farm in South Dakota and the General Electric wind turbine factory in Florida.

LEED GOLD

The Climate Action Plan calls for pursuing LEED (Leadership in Energy & Environmental Design) Gold certification for new construction. To date, the University has over 1.1 million square feet of LEED certified space, of which 89% has achieved Gold certification. Myles Standish Hall and Dahod Family Alumni Center at The Castle achieved LEED Gold certification in 2019 and 2020, respectively. Projects currently LEED registered, pending project completion or certification include:

- Joan & Edgar Booth Theatre and College of Fine Arts Production Center
- 910 Commonwealth Avenue
- WBUR CitySpace
- College of Fine Arts
- Howard Thurman Center
- Center for Computing & Data Sciences

ELECTRIC FLEET

Beginning the transition to an electric fleet in the near-term, followed by expansion over time as appropriate replacements become available, are goals within the Climate Action Plan. Currently, the electric vehicle (EV) fleet pilot study is underway, with data being collected on approximately 40 vehicles. Working closely with BU Sustainability, Sourcing & Procurement, and fleet managers, Master of Science in Management Studies students at Questrom School of Business built upon the Climate Action Plan to develop preliminary recommendations for the EV fleet transition. BU Sustainability followed up on that work by engaging the Center for Sustainable Energy, a national consulting firm expert in the EV markets and incentive programs. The center is developing a timeline with recommendations on specific vehicles in the fleet to transition to EV based on age, performance requirements, use patterns, and availability of appropriate replacements.

Blades arriving at the BU Wind project site. November 2019. Photo: Courtesy of ENGIE.

INDIRECT EMISSIONS

ZERO WASTE

The Climate Action Plan recommends that the University establish a Zero Waste Sustainability goal (90% of our waste would be diverted away from landfills and incineration, including 90% of construction waste). The focus of fall 2019/winter 2020 was forming the Zero Waste Implementation Task Force and engaging with the campus community, including more than 400 online survey respondents and over 100 campus forum participants. Report recommendations will be released this year.

AIR TRAVEL

The Climate Action Plan proposed piloting strategies to encourage the voluntary purchase of carbon offsets for business travel. BU Sustainability has begun to design such a pilot in collaboration with the School of Public Health, Sourcing & Procurement, and partners in higher education sustainability. BU is working to identify shared opportunities to leverage our engagement in this field.

Faculty and staff gather to explore opportunities to collaborate on climate change and sustainability curriculum. January 2020. Photo: Dave Green Photography.

CURRICULUM & RESEARCH

The Climate Action Plan proposes that every undergraduate be exposed in some way through their educational program to issues of climate change and sustainability before they graduate. The plan highlights the opportunity for the BU academic community to propose curricula that would delve more deeply into the scientific, economic, governance, engineering, social, and ethical challenges that climate change and sustainability pose to current and future generations.

SUSTAINABILITY CURRICULUM

In January 2020, faculty members Cutler Cleveland (Earth & Environment), Emily Ryan (Mechanical Engineering), and Neta Crawford (Political Science) convened a workshop to incorporate energy, climate change, and sustainability into every student's education. Approximately 60 participants from across disciplines gathered to explore how to integrate sustainability throughout campus life. Team projects within the BU Hub's Cross-College Challenge present an additional opportunity for interdisciplinary groups of students to work on developing solutions to sustainability issues.

CAMPUS CLIMATE LAB

As called for in the Climate Action Plan, in spring 2020, the University launched a Campus Climate Lab. Led by Associate Professor of Earth & Environment Lucy Hutyra, Vice President & Associate Provost for Research Gloria Waters, and BU Sustainability, this initiative uses the BU campuses as living laboratories to advance sustainability practices and implementation of the Climate Action Plan. The Campus Climate Lab provides funding to support student research projects as well as increase interdisciplinary collaboration among students, staff, and faculty.

STRATEGIC PLAN

In order to increase the University's commitment to and focus on sustainability across teaching, research, and operations, the Climate Action Plan recommends that the University develop and incorporate the CAP into its Strategic Plan. The Strategic Planning Task Force launched in fall 2018. Throughout 2018–2019, there were 42 listening sessions with faculty, staff, and students. The task force established strategic priorities and key initiatives and has solicited feedback from the University community. The University-wide effort in sustainability proves relevant to four of the five strategic priorities, as laid out in the forthcoming Strategic Plan. These priorities are as follows:

1. Vibrant academic experience
2. Research that matters
3. Diversity, inclusion, and access
4. Community, big yet small
5. Global engagement

COLLABORATIVE CATALYSTS

Wiley Hundertmark (CAS'20) conducts research to measure greenhouse gas emissions associated with BU campuses. Photo: Cydney Scott for Boston University Photography

ON CAMPUS

Central to the implementation of the Climate Action Plan is the awareness and involvement of our campus community. BU Sustainability uses a number of channels to work interdepartmentally to engage with the University's wide array of students, faculty, and staff. The following programs and activities engage thousands of people each year.

- **Resident Sustainability Leaders:** An environmental peer educator program launched in 2019 in Warren Towers and will expand into West Campus in 2020.
- **Orientation Outreach:** The Sustainability Ambassadors program launched in 2016 to welcome and inform new students during Orientation.
- **Environmental Leadership Network:** There are now 23 sustainability-related student organizations on campus.
- **Sustainability Liaisons:** Currently, 89 representatives from multiple departments across BU campuses are engaged in championing sustainability practices.
- **Sustainability Innovation Partnership:** BU Sustainability and Innovate@BU partnered to launch a Sustainability Innovation Seed Grant Program; 15 student teams were selected for funding in fall 2019.

Additional highlighted events and presentations on campus include: Annual fall Sustainability Festival and spring Earth Day+, which involve many campus partners; Town Hall meetings for the Center for Computing & Data Sciences; Climate Communicators Chat events; Urban Mobility Chat events co-hosted with Disability & Access Services; Graduate Orientation sessions throughout BU Medical Campus and Charles River Campus; Commuting for Wellness events co-hosted with Employee Wellness, Parking & Transportation, and TranSComm; and presentations for Alternative Service Break Coordinators, BU Energy Club and BU Cleantech Club, Student Health Services, and BU Women's Guild.

CROSS-SECTOR COLLABORATION

LEADERSHIP

The Climate Action Plan recognizes that how BU prepares for the impacts of climate change is closely tied to the climate resilience of the broader community, and that adaptive strategies by government agencies and other key stakeholders in Boston and Brookline have an immediate impact on the University.

Boston Green Ribbon Commission (GRC): BU's Institute for Sustainable Energy released the Carbon Free Boston report series. Associate Vice President for BU Sustainability Dennis Carlberg was named to GRC Higher Ed Working Group Executive Committee, together with Harvard's Office for Sustainability Associate Director Jaclyn Olsen.

University Climate Change Coalition (UC3): As one of the 21 Tier 1 research institutions, BU participates in emerging and best practice sharing on place-based, cross-sector action on climate resilience and mitigation.

City of Boston Zero Waste Plan: On behalf of BU, Dennis Carlberg served on the Zero Waste Advisory Group, which released its plan in June 2019.

BU/Boston Properties (BXP) Best Practices: In fall 2019, BU hosted BXP for our annual best practices workshop. Local thought leaders BR+A, Arup, and The Green Engineer were invited to share emerging strategies being implemented in high-performance building design. Senior leadership from BU and BXP attended the Chatham House Rules workshop.

BU/MIT/Harvard Best Practices: The sustainability offices meet three times each year to share best practices and explore collaborative opportunities.

Community Engagement & Thought Leadership: BU Sustainability staff have led presentations for a variety of audiences such as the Climate Adaptation Forum at the UMass Club, the Sustainability Student Leadership Symposium at Boston College, Boston Area Campus Sustainability Professionals Networks, an international group from the American Meteorological Society, and the First Annual Sustainability Day at Newton North High School. Through the Center for Computing & Data Sciences, BU's leadership is demonstrating that carbon free at scale is possible. After an exciting groundbreaking event with Mayor Walsh, highlighting the city's forthcoming largest carbon free building, the Mayor signed an executive order that all new municipal buildings will be carbon free.

Renewable Energy Best Practices: With the Power Purchase Agreement (PPA) completed for BU Wind to match 100% of Boston University's electricity demand, Sustainability has run workshops and forums to demystify how to execute similar contracts and share the lessons we've learned. Through these efforts, the 17 institutions, corporations, and cities indicated in the figure below are pursuing large-scale renewable energy PPAs with ongoing guidance from BU. In particular, Washington University in St. Louis is using the marginal emissions model BU developed with WattTime to maximize greenhouse gas reductions.

National Best Practices Sharing: The BU Sustainability team engages in workshops, panels, and other activities to share best practices. Examples include: the "Campus as a Living Lab" event sponsored by the Association for the Advancement of Sustainability in Higher Education (AASHE), and presentations given by the Society for College and University Planning (SCUP), University Climate Change Coalition (UC3), and Sustainability Student Leadership Symposium.

ENABLING PPA BEST PRACTICES

Knowledge Sharing Hub

BY THE NUMBERS

CAMPUS GROWTH

From FY2006 to FY2019, BU campus facilities grew 12%, to a total of 15 million square feet.

METRIC	% CHANGE	FY2006	FY2019	UNIT
RESOURCES				
CO_2 Emissions (Scopes 1&2)	-25%	165,435	123,897	$MTCO_2e$
Energy Use	-3%	1,794,256	1,739,861	MMBtu
Oil	-93%	444,113	32,436	MMBtu
Natural Gas	+77%	487,998	861,654	MMBtu
Steam	-8%	178,326	164,481	MMBtu
Electricity	0%	683,819	681,290	MMBtu
Energy Use Intensity (EUI)	-14%	150	129	kBtu/sf
Water Use	-7%	435	405	MMgal
WASTE				
Generation	-8%	10,961	10,041	tons
Diversion	130%	3	42	%

All changes are in relation to an FY2006 baseline.

Mayor Martin J. Walsh joins BU leaders at the Center for Computing & Data Sciences groundbreaking. December 2019. Photo: Cydney Scott for Boston University Photography.

Boston University Sustainability

bu.edu/sustainability

Fall Sustainability Festival on
Marsh Plaza. September 2019.
Photo: Dave Green Photography