Campus Sustainability Council Report

MAY 2013

We need to bring passion and our best ideas to bear on sustainability if we are to effect change.

Anthony P. Monaco
President, Tufts University

MESSAGE FROM THE PRESIDENT

Universities play a crucial role in helping the world adapt to a changing planet and to challenging issues such as climate change and resource depletion. Tufts faculty addresses these issues at the highest level of insight both in their teaching and with our students to break new ground in research. At the same time, our faculty, students, staff, and alumni are all providing leadership in the public and private sector responses.

But it is not only through our teaching and research that we can play an important role in shaping a sustainable future. As members of an educational community with a deep commitment to active citizenship, we have opportunities to address these challenging issues institutionally as well as individually, using evidence-based approaches that are both innovative and effective. We can demonstrate on campus how it is possible to take action in ways that are fiscally responsible and enhance our collective quality of life.

We can be proud of the university's long history of dedication to environmental sustainability. I established the Campus Sustainability Council in my first year at Tufts in order to renew our commitments and establish new, specific goals for a more sustainable campus. The Council began meeting in January 2012 and has concentrated on reducing Tufts' own footprint. Our first priorities for action were the areas where we have the greatest impact on the environment: energy and water use, waste management, and greenhouse gas emissions production.

Over the past year, the Campus Sustainability Council and its working groups have developed goals and objectives related to each of these key areas of impact. This document contains their recommendations. During the deliberations, it became apparent that success would require the full engagement of the entire university community. Working together, we can make Tufts a safer, healthier, and more sustainable place to live and work. I hope that you will join me to ensure that Tufts is not only brown and blue, but green.

ANTHONY P. MONACO

President, Tufts University
Chair, Campus Sustainability Council

ACKNOWLEDGEMENTS

The Campus Sustainability Council Report would not have been possible without the efforts of many faculty, staff, and students volunteering their time above and beyond their normal course of work. The compilation of this report was managed by the Tufts Office of Sustainability and brings together all the work done throughout the past year by the Campus Sustainability Council and working groups under the guidance of Barbra Batshalom, president of the Sustainable Performance Institute.

Many thanks go out to the working group chairs Professors Ann Rappaport, Jonathan Kenny, Scott Horsley, and Gretchen Kaufman as well as staff members Betsy Isenstein, Dawn Quirk, and Bob Burns for leading the working groups, providing valuable expertise, and guiding the creation of relevant, achievable goals. I am especially grateful for the diligent work of Betsy Isenstein and Dawn Quirk in collecting and reporting all the available data on campus water and energy use and waste production.

I would like to thank all members of the working groups for devoting significant time to learning about water, waste, and energy management at Tufts and making suggestions, doing research, and providing insight into the goals and strategies outlined in this document.

The following people provided feedback and contributed to the review and editing of this report: Barbra Batshalom, Peter Kelly-Joseph, Andrew Ramsburg, Betsy Isenstein, Dawn Quirk, Grant Garven, Ann Rappaport, Colin Orians, Laurie Sabol, and the staff at the Tufts Office of Sustainability including Tina Woolston, Fannie Koa, Betsy Byrum, and Bob Lynch.

Finally, I would like to extend deepest gratitude to President Tony Monaco for convening the council and making campus sustainability one of his core strategic initiatives. Without such strong support from Tufts leadership, sustainability would not have received the level of attention it has enjoyed during the past year.

PATRICIA L. CAMPBELL

Executive Vice President, Tufts University
Co-Chair, Campus Sustainability Council

TABLE OF CONTENTS

Click on any listing below to go the corresponding page. A double arrow >> within the text will take you to the appendix indicated.

1 Executive Summary
3 Introduction
5 Cross-Cutting Issues
8 Waste Working Group
14 Water Working Group
20 Energy and Emissions Working Group

Appendices

29 A. Campus Sustainability Council
34 B. Fostering a Sustainable Culture
37 C. Tufts Reuse and Recycling Initiatives
42 D. Tufts Water Conservation and Stormwater Management Initiatives
43 E. Tufts Energy and Emissions Initiatives
58 F. Project Management Toolkit
60 G. Highlights of Sustainability at Tufts
62 H. Tufts Commitments and Environmental Policies
66 I. Greenhouse Gases Overview

Figures

10 1. Tufts Recycling Rates
16 2. Water Consumption by Campus
22 3. Tufts Greenhouse Gas Emissions and Energy Use
29 4. Sustainability Council Phases
39 5. Medford/Somerville Campus Solid Waste Data
40 6. Boston Campus Solid Waste Data
41 7. Grafton Campus Solid Waste Data
49 8. Tufts Energy Use
50 9. Energy Use Intensity by Campus
51 10. Medford/Somerville Campus Heating Fuel Use and Greenhouse Gas Emissions
52 11. Grafton Campus Heating Fuel Use and Greenhouse Gas Emissions
53 12. Tufts 2012 Greenhouse Gas Emissions by Fuel
54 13. Tufts Greenhouse Gas Emissions Per Square Foot
55 14. Tufts Electricity Use
56 15. Tufts Electricity Use Per Gross Square Foot
57 16. Tufts University-Maintained Square Footage
66 17. US Greenhouse Emissions in 2010

EXECUTIVE SUMMARY

When Tufts President Anthony P. Monaco joined the university in August of 2011, he identified sustainability as one of the strategic priorities of his administration. He formed the Campus Sustainability Council and personally serves as its chair.

The council convened for the first time in January 2012 with members from all three campuses and representation from university leadership, staff, faculty, and the undergraduate and graduate student bodies. While acknowledging that a sustainable campus encompasses much more than a reduction in energy and water use, greenhouse gas emissions, and waste production, the council focused its work on these three areas of Tufts' campus operations as they have the greatest environmental impact.

Three working groups were established: the Water Working Group, Waste Working Group, and Energy and Emissions Working Group. These groups reviewed current goals related to these topic areas, progress towards those goals, existing data, and relevant benchmarks. They then developed goals, objectives, and recommended strategies for each area. At each stage, the council provided feedback to the working groups on their recommendations.

During March 2013, feedback on the draft report was solicited from the Tufts community. Comments were addressed or cataloged for consideration during the next step in the process—the creation of implementation plans.

Summary of Working Group Goals

The *Waste Working Group* envisions the entire Tufts community playing an intentional role in fostering a cradle-to-cradle economy. The primary goal is to reduce waste by 3 percent each year, on average, through source reduction, waste management strategies, and behavior change.

The *Water Working Group* sees Tufts employing an integrated water management approach that reduces consumption, promotes reuse, and minimizes impacts on the environment. Within one year, the goals are to:

1. Develop a plan to evaluate and prioritize targets to reduce consumption.
2. Identify water reuse opportunities and implement appropriate strategies.
3. Institutionalize policies and protocols to proactively meet and exceed federal, state, and local regulations related to stormwater and wastewater.

The *Energy and Emissions Working Group* envisions Tufts as a leader in responsible climate action through energy efficiency, greenhouse gas emissions reduction, clean energy, and adaptation. The group created the following goals:

1. Reduce energy consumption 5 to 7 percent per year for three years starting in 2013.
2. Reduce greenhouse gas emissions 10 to 25 percent below 1990 levels by 2020 and 75 to 85 percent below 2001 levels by 2050.
3. Develop a renewable portfolio standard.
4. Begin the process of adaptation planning.
5. Address non-carbon greenhouse gas emissions.
6. Develop transportation initiatives to reduce the impacts of campus vehicles (fleet), commuting, and business travel.

Cross-Cutting Issues

Throughout the process, certain cross-cutting issues emerged that were common to all working groups. They are as follows:

- Responsibility, accountability, and incentive structures must be developed to support progress towards the new goals.
- Additional cross-departmental, proactive planning regarding facilities renovations and construction is needed to identify important questions or issues early on in decision-making processes.
- Data, reporting, and feedback loops are necessary to track and measure progress.
- Laboratory and hospital facilities have some of the largest environmental impacts on each campus and warrant special attention.
- There is a desire to use the campus as a learning lab to tie together sustainability work on campus with academic research and teaching.
- A culture shift towards more sustainable behaviors across the Tufts community is necessary and must be addressed in an intentional way.

Education and Behavior Change Goals

The following education and behavior change goals were also identified for Tufts faculty, staff, and students. Within five years, the entire Tufts community will:

- Know how to divert and reduce waste and actively participate in waste reduction and diversion practices.
- Understand how individual actions impact water usage and quality, why water conservation is important, and how to reduce use and mitigate negative impacts on the watershed.
- Know how to reduce energy consumption as building occupants and use that knowledge to create less energy-intensive habits.

INTRODUCTION

The Campus Sustainability Council

Since launching the Talloires Declaration in 1990, Tufts University has been a leader in promoting sustainability and good environmental stewardship in higher education.[1]

When Anthony P. Monaco became the thirteenth president of Tufts University in August 2011, he chose sustainability as one of the strategic priorities of his administration. Citing the university's "strong obligation toward the environment," President Monaco formed the Campus Sustainability Council in September 2011 and serves as its chair.

"We need to bring passion and our best ideas to bear on sustainability—and other priorities—if we are to effect change," wrote the new president in a memo announcing the council to all members of the community.

The council was created to set goals and monitor achievements regarding Tufts' activities in the areas of waste management, water and energy use, and greenhouse gas emissions. Specifically, the council's task was to:

1. Review the existing goals in these areas and assess progress to date in meeting those goals.
2. Consider relevant benchmarks for comparison with other universities.
3. Guide three working groups that address Tufts' waste management, water use, and energy use/greenhouse gas emissions.
4. Review working group proposals for revised or additional goals in each area.
5. Recommend, with input from the working groups, mechanisms for broad Tufts community input regarding the proposed revised goals.
6. Monitor progress toward achieving the established goals.

Following the finalization of this report, the vice president of operations will oversee the creation of implementation plans for all the objectives, which will provide a practical roadmap for achieving the goals outlined here.

Additional information about the council, including membership, is included in >> Appendix A.

[1] See >> Appendix G for highlights of history of sustainability at Tufts.

How This Document Is Organized

This document outlines the recommendations of the working groups in the areas of waste, water, and energy and emissions. The first section, Cross-Cutting Issues, highlights themes that were common to all three working groups.

Each of the following three sections covers one of the working groups and lays out its work from a macro to a micro level, beginning with each group's vision for Tufts and the recommended goals, objectives, and strategies for achieving the vision. Introductory information is included at the beginning of the section to provide context for the group's recommendations. Since implementation plans for each goal have not yet been created, the strategies sections included here are not comprehensive.

The appendices contain supporting documentation including details on the council membership, data on Tufts' water and energy use as well as waste and greenhouse gas emissions production, reference materials, and historical documents.

CROSS-CUTTING ISSUES

Although each working group focused on a different topic area, several recurring themes emerged from all three groups. The need to enhance sustainability-related accountability, conduct advanced planning, gather and report comprehensive data, and foster a university-wide change in culture were all identified as vital to the adoption of new sustainable practices. Additionally, research laboratories and clinical spaces were singled out as unique and highly resource-intensive spaces that warrant special attention. Connecting student scholarship, faculty research, and campus initiatives was also highlighted as an area of opportunity.

Responsibility and Accountability

Each group articulated the need for targets to be tracked within each school so that the existing chain of accountability can support new goals. Clear direction from the university president and his direct reports, down through each of the executive administrative and academic deans, is needed to directly promote and communicate sustainability priorities. Working groups recommended that select job descriptions and performance reviews include specific language related to achieving sustainability goals. New policies and protocols will be successful only if sustainability is clearly and consistently communicated as a priority and the goals are measurable and achievable.

RECOMMENDATIONS

- Provide clear direction from the university president and senior administrators.
- Include sustainability goals in job descriptions and evaluate progress during performance reviews.
- Recognize and reward best practices.

Planning

Proactive planning that incorporates sustainability-related analysis emerged as a central theme in all working groups. In this context, planning refers to making sure the right questions or issues are raised early in a decision process as well as connecting systems and stakeholder groups that do not typically interact. Proactive planning will ensure timely and effective engagement of all key stakeholders, leading to the most effective and economical decisions that incorporate life-cycle costing[2] analysis into critical path decisions.[3]

RECOMMENDATIONS

- Insert prompts into project planning documents to cue communication with key stakeholders (e.g., the recycling manager) with sufficient advance notice.
- Incorporate life-cycle costing considerations about waste, water, and energy savings early enough in the project development process so that sustainable options can be chosen at the point that allows for maximum financial savings or reduces incurred costs.

[2] Life-cycle costing is the process of analyzing and evaluating all costs associated with the use of a product or piece of equipment over its full expected life span. Life-cycle costing looks beyond the initial capital cost and takes into account factors such as purchase price, installation costs, operating and maintenance, and removal and disposal costs.

[3] Critical path decision making refers to a project planning process that identifies all major decisions that impact, contribute to, or determine the overall project performance, budget, or scheduling. Critical path items are those whose outcome influences a large number of variables and other decisions and can impact the overall project schedule and budget.

Data, Reporting, and Feedback Loops

Working groups recognized the urgent need for additional information at a more granular level about waste, water, and energy use. Good data and analysis as well as effective feedback loops that include a building's occupants are critical for tracking Tufts' progress towards its goals and allow for corrections to be made as challenges arise. While each group articulated different strategies for tracking data, all groups agreed that annual reporting back to each school (and possibly each building) will be the single most important tool for engaging stakeholder groups, keeping them on track, and providing incentive for commitment. The role of building curators came up many times as a critical mechanism for both ongoing communications and data feedback.

RECOMMENDATIONS

- Designate building curators who understand each building and act as liaisons between Facilities Services and building occupants.
- Pilot a sustainability report at the Pearson chemistry building to evaluate the effect of feedback about key data on practices related to waste, water, and energy-use.
- Create a sustainability report for each school that summarizes data related to waste management and recycling, water consumption and/or reuse, and energy-use and emissions. Include feedback on quantitative as well as qualitative aspects of performance, such as occupant behavior and commitment.

Culture Change

An organization's culture is a shared set of behaviors and characteristics—how it does business, what is considered "normal," etc. To become truly sustainable, Tufts needs to change how it makes decisions and re-examine habitual operating practices. Sustainability is not a set of projects or issues; it is a way of thinking that incorporates consideration of the future into the decision making of today. A truly sustainable university is one that thrives in the foreseeable future, without exhausting the physical resources (land, fuel, food, clean air, and water), human resources (employees and students), and financial resources necessary to keep it functioning. Members of the Tufts community must hear consistent messaging in all of their university interactions, from before they arrive on campus to after they depart. All working groups recognized the importance of being intentional about creating a culture of sustainability at Tufts.

Working groups identified two types of goals that fall into this category: education and behavior change. Although the subject of academics was beyond the scope of this council, members felt that Tufts must be committed to teaching the ethics and substance of sustainability in order to graduate global citizens who understand this burgeoning field. More work needs to be done to determine the most effective way to incorporate sustainability into the university's academic framework.

The second type of goal revolved around human behavior. A combination of outreach strategies and alterations to standard operating protocols should be used to drive the adoption of more sustainable behaviors. >> Appendix B describes one type of outreach strategy (community-based social marketing) along with the ideas generated by the working groups related to education and behavior change.

RECOMMENDATIONS

- Require one of the existing distribution requirements of the Arts and Sciences and the Engineering undergraduate programs to include sustainability concepts.
- Develop additional training tools for faculty, staff, and students to learn sustainability best practices.
- Create community-based social marketing strategies for key behaviors.
- Develop a process to address sustainability in academics.

Laboratories and Hospitals

Each working group singled out research laboratories and hospital facilities as the greatest source of opportunity for increased sustainability across all Tufts campuses due to their large production of waste and heavy use of water and energy. Specialized education and training would target specific challenges in those areas and promote actions appropriate in those environments.

RECOMMENDATIONS

- Create a working group of key stakeholders to identify unique resource-saving opportunities in laboratories and clinics.
- Work with suppliers to reduce packaging waste through take-back programs, enhanced recycling opportunities, and volume or material substitutions.
- Include sustainability-related content in existing required lab and clinic training programs and materials.

Campus as Learning Lab

Tufts' campuses can teach the entire community about sustainability. Each of the working groups articulated scenarios where student research and analysis could tie directly to site, building, or process improvements. While collaboration among students, faculty, and operational staff was uniformly supported, challenges in expectations, scheduling, and communication exist and should be addressed in order for all parties to have effective, mutually beneficial experiences.

RECOMMENDATIONS

- Develop an effective process for planning and coordinating on-campus student research and scholarship.
- Create a searchable database where student projects can be archived and referenced by current Tufts faculty, staff, and students.
- Compile a list of potential collaborative projects for students and faculty to reference.
- Organize a process, such as an annual symposium, for students to share their work with the Tufts community, especially relevant stakeholders.
- Make data about Tufts' water and energy usage and waste and greenhouse gas emissions production available to students and faculty for their classes.

WASTE WORKING GROUP

VISION: The entire Tufts community plays an intentional role in fostering a cradle-to-cradle economy.

GOAL:
Reduce waste by 3 percent each year, on average, through source reduction, waste management strategies, and behavior change.

Objectives

1. Reduce the source of waste and increase the purchase of environmentally preferable products.
2. Increase the amount of items that are reused and streamline disposal process.
3. Increase participation in recycling and diversion.

INTRODUCTION

The vision of the Waste Working Group describes a future in which each member of the Tufts community considers the impact of acquisition and disposal of an object and chooses the option that best supports a world without waste.

"Cradle-to-cradle" means taking into account the entire life cycle of a product and its components—from the extraction of raw materials, processing, manufacturing, transportation and distribution, use and purpose, repair and maintenance, reuse potential, and ultimately, recycling or disposal—thus connecting the dots between purchasing and disposal. If Tufts purchases materials that are environmentally preferable and have a high reuse value, then the lifetime use of these resources has greater overall value than materials that may fall into the environmentally preferable category but have little future value in the marketplace. A true cradle-to-cradle economy is one in which goods are not thrown away but are instead recycled into new products or turned into soil, negating the need for new extraction of raw materials.

While this vision is aspirational, the goal of 3 percent waste reduction per year was chosen – based on an analysis of trash tonnage – as a reasonable, achievable goal that is easily measured annually.

Background

Recycling began at Tufts in 1990 as a student-run initiative and has grown into a comprehensive program managed by a full-time waste-reduction program manager in the Facilities Services department. Tufts' recycling and reuse efforts are broad and include "freecycle" opportunities, a furniture surplus store, junk mail reduction programs, and composting. Tufts routinely recycles everything from cans and bottles to e-waste, printer cartridges, vehicle tires, batteries, and mattresses. For a more in-depth list of Tufts' current reuse and recycling programs, please see >> Appendix C.

Current State

Tufts' overall recycling rate has steadily increased (Figure 1), primarily driven by the increased recycling rate on the Medford/Somerville campus. The recycling rate is calculated by dividing the total material recycled by the sum of the trash plus recycling. Activities on the Boston and Grafton campuses are largely conducted in clinics and laboratories, which present unique recycling challenges. During the 2012 fiscal year, the recycling rates on each campus were as follows: Medford, 53 percent; Boston, 26 percent; and Grafton, 14 percent.

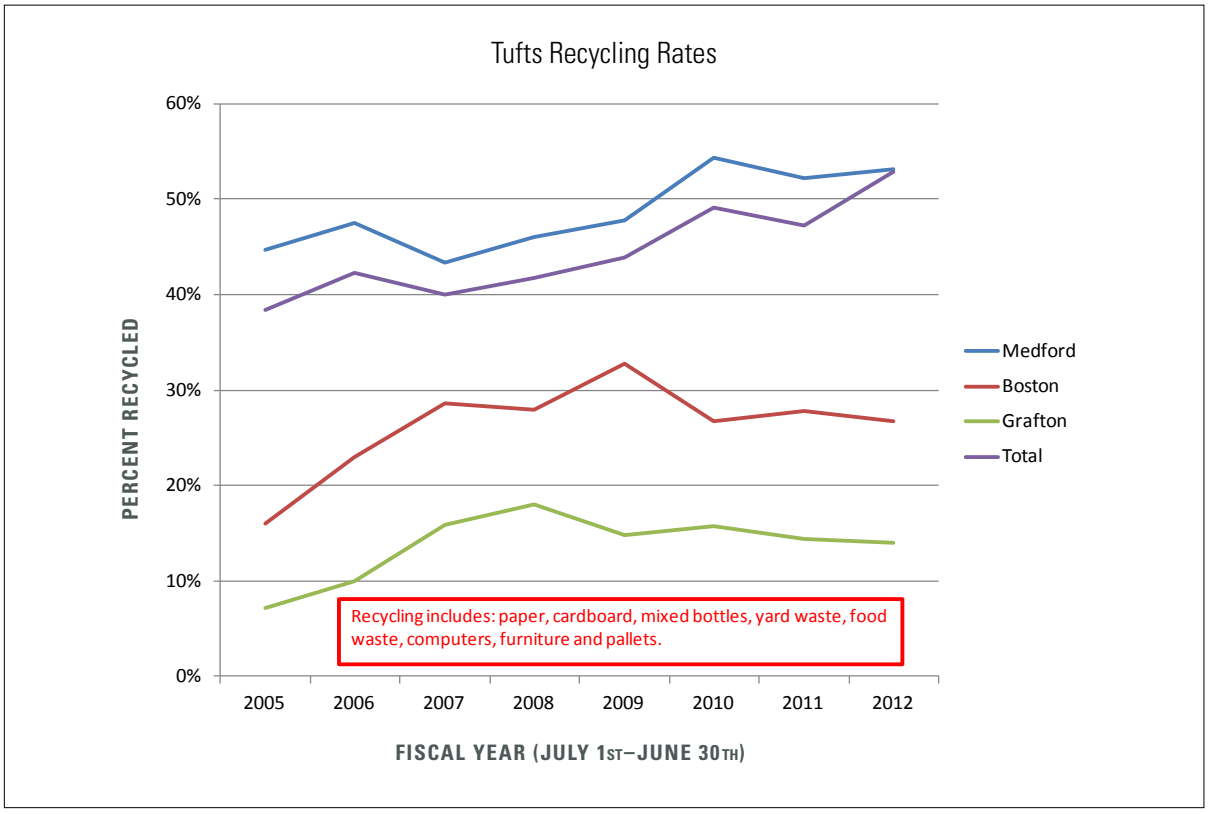

Figure 1. Tufts Recycling Rates

Additional graphs showing details from each campus are available in >> Appendix C.

SUMMARY OF RECOMMENDATIONS

GOAL: Reduce waste by 3 percent each year, on average, through source reduction, waste management strategies, and behavior change.

Objective 1: Through careful planning and consistent enforcement of purchasing policies and practices, reduce the source of Tufts' waste and increase the percentage of purchased products that are recyclable and otherwise environmentally preferable in order to support a cradle-to-cradle economy.

Recommended Strategies

A. Improve, expand, and continually update procurement guidelines to assist buyers in purchasing environmentally preferable products.

- Publish a university "statement of guidance" clarifying purchasing priorities, and reach out to people who make large purchases in each school to make sure the priorities are understood.
- Engage administration and financial decision makers to help communicate these priorities to their departments and reach procurement card (PCard) users who make purchases outside of the central purchasing system.
- Train and educate decentralized buyers in all departments.

B. Target disposables, supplies, and equipment for reduction, focusing first on products purchased in highest volume.

- Reduce the use of disposables.
- Provide readily accessible alternatives to disposable products.
- Eliminate non-recyclable materials.
- Foster behavior change (e.g., paperless meetings).

C. Establish guidelines and policies for contractors and vendors.

- Use a collaborative mechanism involving key stakeholders to establish relevant guidelines and policies for non-Tufts entities doing business on behalf of Tufts.
- Communicate changes in purchasing policies to vendors in a clear manner.
- Encourage vendors to update their offerings of environmentally preferable product choices and packaging.
- Identify key contracts to review, track, and target for compliance, and notify vendors that spot checks may be performed.

- Require vendors to provide reports that track trends and flag areas of opportunity, especially with PCard purchases.
- Create incentive programs that include internal promotion and preferred partnerships for exemplary vendors.

D. Leverage the existing centralized purchasing software tools (e.g., electronic requisitions) to guide and influence purchasers' choices by incorporating strategic prompts, drop-down menus, and other mechanisms of communication, as technology evolves and budgets permit.

E. As part of a larger annual sustainability reporting and feedback effort, provide schools with summaries of their purchasing trends and waste impacts as well as information about noncompliance with purchasing policies and protocols.

Objective 2: Improve waste management by increasing the number of items that are reused and streamlining the disposal process through improvements in planning and communication.

Recommended Strategies

A. Institutionalize planning protocols to minimize unnecessary waste.

- Incorporate deconstruction or product removal into Project Charters,[4] with Facilities Services waste management staff included in the sign-off.
- Include prompts in centralized purchasing software to cue people purchasing furniture or equipment on how to reuse or properly dispose of their old items.

B. Improve systems for tracking and communication to understand trends and identify noncompliance, advertise reuse opportunities, and promote optimal planning.

C. Enforce policies consistently across all campuses by using a school-specific sustainability report to share information about noncompliance with executive administrative deans and budget and finance officers. Balance accountability with incentives for implementing best practices.

D. Increase reuse and sharing of equipment, furniture, and other items across the university through robust planning tools and increased communication. Work specifically with labs and hospitals to identify opportunities in those areas. Establish a new surplus reutilization program.

E. Incentivize and recognize best practices by individuals or schools through an awards and recognition program based on information gathered in the sustainability report or available program information, such as RecycleMania scores. Recognition programs could be independent or integrated into existing programs, such as the Tufts Distinction Awards.

[4] A document used by Tufts Facilities Services group to outline an upcoming project's scope.

Objective 3: Increase participation in recycling and waste diversion through ongoing education and behavior change campaigns. Within five years, all members of the Tufts community will know how to divert and reduce waste, and active participation in waste diversion will increase by 50 percent.

Recommended Strategy

A. Create comprehensive communications programs for desired behaviors (see >> Appendix B), such as lab plastics recycling and equipment sharing.

- Include a range of social marketing tools, such as prompts, incentives, and enhanced infrastructure arrangements.
- Develop a broader range of training materials and methods, including videos and online trainings.

WATER WORKING GROUP

VISION: Tufts employs an integrated water management approach that reduces consumption, promotes reuse, and minimizes impacts on the environment.

GOAL 1:
Within one year, develop a plan to evaluate and prioritize targets to reduce consumption.

Objective

Identify, catalog, quantify, and manage all major points of consumption.

GOAL 2:
Within one year, identify water reuse opportunities and implement appropriate strategies.

Objective

Identify and optimize opportunities for reuse of condensate, rainwater, and greywater on campus.

GOAL 3:
Within one year, institutionalize policies and protocols to proactively meet and exceed federal, state, and local wastewater and stormwater regulations.

Objective

Reduce the environmental impact of runoff and discharge and improve water quality.

GOAL 4:
Within five years, increase understanding of water issues and water-saving practices.

Objectives

1. Increase student, faculty, and staff knowledge of water ecosystems and human impacts on water systems.
2. Encourage water-saving practices and proper disposal of chemicals and medicines.
3. Train Tufts Facilities Services personnel to reduce stormwater entering municipal systems.

INTRODUCTION

A variety of human actions significantly affect water resources, including excessive consumption and stormwater runoff. While Tufts is fortunate to be situated in a relatively water-rich region, water quality has been compromised and stream flows have declined in recent years. Climate change also threatens to severely alter weather patterns, which may exacerbate seasonal droughts and floods.

At Tufts, the combination of increasingly frequent extreme precipitation events and aging infrastructure has resulted in higher water costs and service disruptions that affect our core mission of teaching and research. Local municipalities are starting to focus on water issues through more stringent regulations aimed at reducing water use and addressing stormwater challenges.

The Water Working Group believes that Tufts can expect to be subject to stricter water quality and quantity regulations in the near future, and our community should adapt to policy changes proactively and cost-effectively. Additionally, water-related challenges will likely affect individuals in the future, no matter where they live. Therefore, Tufts has a responsibility to educate members of the campus community about how they can improve our water sustainability.

Background

Tufts has already undertaken a variety of water reduction and stormwater management initiatives. Drought-tolerant plants are used in landscaping, condensate recapture and reuse systems have been pilot tested in Medford and Boston, and irrigation wells have been installed at Alumni Field. Trayless dining was instituted in 2011, and Dewick Dining Hall features a state-of-the-art energy-efficient dishwasher. Residence halls contain low-flow showerheads, dual-flush and low-flow toilets, and front-load clothes washing machines. Dual-flush toilets are routinely installed during new construction.

Stormwater management initiatives have included using low-impact designs for stormwater management, employing integrated pest management, and installing rain barrels. For a more in-depth list of Tufts' current water reduction and stormwater management programs, please see >> Appendix D.

Current State

Water use on the Medford/Somerville campus peaked in 2008 (Figure 2). The decrease in the following year was primarily due to the identification and repair of a series of steam and condensate leaks.

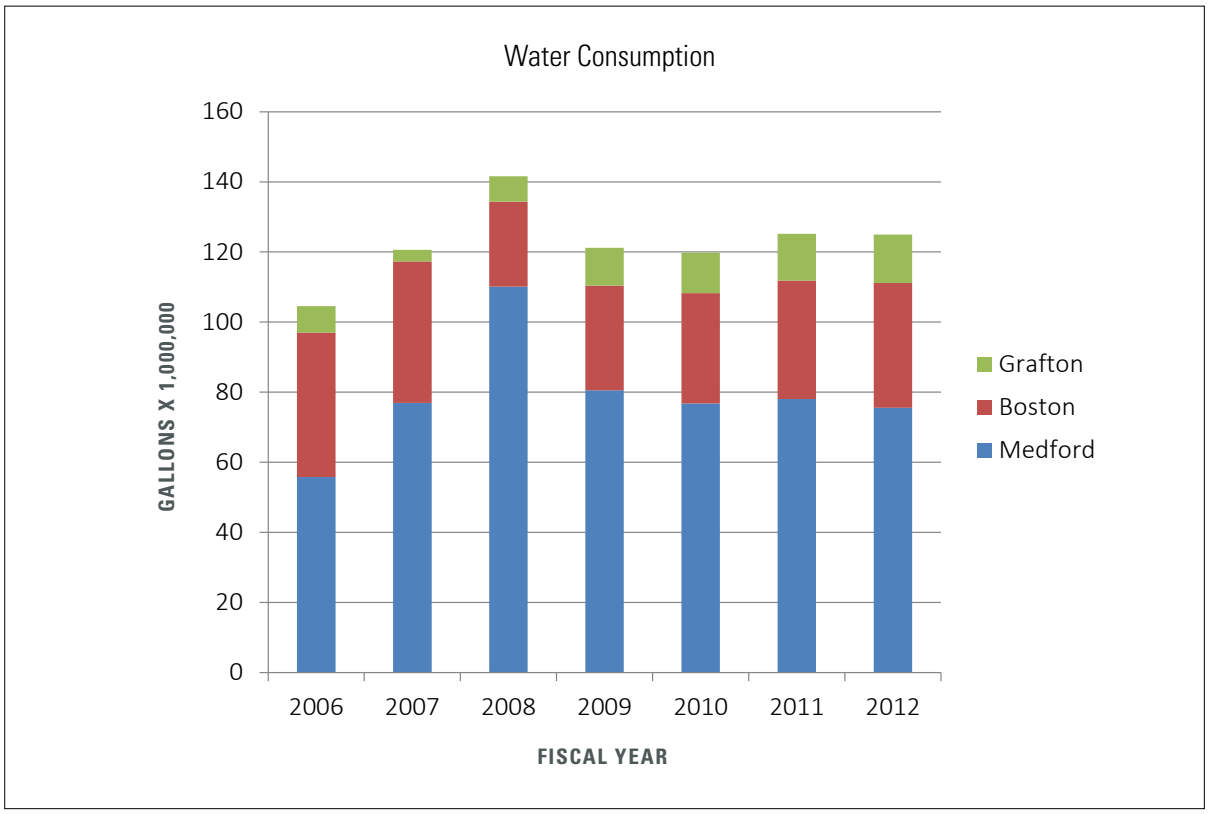

Figure 2. Water Consumption by Campus

SUMMARY OF RECOMMENDATIONS

GOAL 1: Within one year, develop a plan to evaluate and prioritize targets to reduce consumption.

Objective: Identify, catalog, quantify, and manage all major points of consumption.

Recommended Strategies

A. Identify and quantify the most significant points of consumption (irrigation, building use, and infrastructure), and create a prioritized plan to target them over the next year, including opportunities to leverage and align with existing plans for site work.

B. Institute a policy adhering to industry standards and best practices for new construction and renovation (e.g., LEED®, SITE™), and include those standards in project checklists.

C. Develop an internal standard defining Tufts-approved strategies for water use reduction and when to apply them. Integrate these standards into the main project management checklist and project goal-setting document to ensure consistent implementation.

D. Identify and maintain a list of preferred systems, products, and technologies that will reduce water consumption and costs and be referenced at every upgrade, replacement, renovation, or new project.

E. Install meters and moisture sensors to optimize irrigation systems and reduce demand. Measure water consumption for irrigation and compare to rainfall/temperature records. Benchmark all irrigation systems to ensure consumption is being metered and recorded.

GOAL 2: Within one year, identify and institute water reuse opportunities and strategies.

Objective: Optimize the potential for water reuse on campus and implement where appropriate. Explore opportunities for reuse in existing scenarios, and work with permitting authorities to potentially allow for future innovations.

Recommended Strategies

A. Identify all existing conditions where water or condensate might be captured and reused, and quantify projected savings and implementation costs. Catalog these scenarios, and institutionalize a standard approach (e.g., part of the project management checklist) for reuse on all projects.

B. Identify typical scenarios for rainwater capture for use in irrigation, and develop a plan to implement those strategies on the campuses where appropriate.

C. Identify scenarios where greywater might be reused, and initiate a proactive dialogue with the municipalities related to permitting and organizing pilot projects.

GOAL 3: Within one year, institutionalize policies and protocols to meet and exceed federal, state, and local wastewater and stormwater regulations.

Objective: Reduce the environmental impact of runoff and discharge, and improve water quality. Deploy water management strategies in an effort to improve ecosystem health and minimize negative impacts on surrounding communities (e.g., wastewater and stormwater pollution, or excessive stormwater discharge into municipal sewers).

Recommended Strategies

A. Implement careful, ongoing metering and spot testing to quantify water consumption and gauge water quality, including total suspended solids, nutrients, and pathogens. Take advantage of the numerous summer construction projects to conduct water testing before and after construction, and log and track the results.

B. Produce low-impact development (LID)[5] master plans to identify opportunities for managing site runoff and water quality. Implement plans as part of upcoming construction projects and in new initiatives, and integrate LID strategies into project goals and management checklist.

C. Plan and construct additional walkways where pedestrian traffic is causing erosion, and revegetate eroded areas to eliminate further erosion.

D. Employ integrated pest management approaches using predetermined thresholds for use of pesticides and herbicides, and limit the use of fertilizers in landscaping.

GOAL 4: Within five years, all Tufts community members will understand how their actions affect water use and quality, why water considerations are important, and how they can reduce water use and mitigate negative impacts on their watershed.

Objective 1: Increase student, faculty, and staff knowledge of water ecosystems and human impacts on water systems.

Recommended Strategies

A. Require students in Arts and Sciences, and Engineering to choose an environmental or sustainability course to fulfill one of their already existing distribution requirements.

B. Run training sessions to educate professors on how to incorporate water topics into their classes (e.g., through Tufts Institute of the Environment's annual "Tufts Environmental Literacy Institute").

C. Engage the provost's office to identify additional opportunities to integrate water issues into coursework in Tufts' graduate and professional schools.

[5] For more information on LID, visit Massachusetts Department of Environmental Protection's LID page at http://mass.gov/envir/smart_growth_toolkit/pages/mod-lid.html.

Objective 2: Encourage water-saving behavior, alternatives to water-intensive practices, and proper disposal of chemicals and medicines.

Recommended Strategies

A. Educate students and staff on how to incorporate water-saving practices into their everyday operations.

- Create comprehensive communications plans for desired behaviors (see >> Appendix B) such as taking shorter showers and turning off water when brushing teeth, washing dishes, and shaving.

B. Leverage the expertise of the Environmental Health and Safety Department to develop behavior goals for reducing inappropriate disposal of chemicals and medication in wastewater.

C. Introduce a dedicated person to focus on culture/behavior change in labs and clinics.

Objective 3: Provide training to key personnel in Tufts Facilities Services within three years, so they will know how to reduce the flow of stormwater entering municipal systems during intense rain.

Recommended Strategies

A. Integrate information about stormwater mitigation practices into the existing "Guidelines for Miscellaneous Landscape Details" document.

B. Involve staff in installing rain gardens to filter runoff and help restore the natural hydrologic system.

C. Provide additional training on low-impact development techniques as necessary.

ENERGY AND EMISSIONS WORKING GROUP

VISION: Tufts is a leader in responsible climate action through energy efficiency, emissions reduction, clean energy, and adaptation.

GOAL 1:
Reduce energy consumption five to seven percent and reduce greenhouse gas emissions[6] in line with specific local, regional, and international goals.

Objectives
1. Pursue energy efficiency, energy conservation, and renewable energy opportunities.
2. Optimize planning and design processes to create conditions conducive to long-term success.
3. Continuously improve facility performance through operations and maintenance best practices.
4. Foster sustainability as a community mindset through education, awareness, and accountability.

GOAL 2:
Develop a renewable portfolio standard (RPS) within one year.

Objective
Develop a method to integrate an RPS into Tufts' overall emission reduction strategy.

GOAL 3:
Begin the process of adaptation planning within one year.

Objective
Ensure that Tufts is positioned to adapt to the impacts of climate change on all three campuses.

GOAL 4:
Address non-carbon greenhouse gas emissions.

Objective
Institute a plan to reduce non-carbon greenhouse gas emissions on campus.

GOAL 5:
Develop transportation initiatives to reduce impacts of campus vehicles (fleet), commuting, and business travel.

Objective
Convene a stakeholder group to provide input for a long-term transportation initiative.

[6] Some of these are previously existing goals. See >> Appendix H for further information about Tufts' commitments and environmental policies.

INTRODUCTION

As the effects of climate change become more and more evident, the need to plan for future impacts of climate-related events on university business becomes increasingly urgent. Tufts, in its position as a global citizen and home to a significant amount of research on renewable energy technologies, has a duty to support the transition away from energy production based on fossil fuels.

The most immediate way Tufts can reduce its own contribution to climate change is to address its production of greenhouse gases,[7] either through on-campus burning of fossil fuels or purchasing of energy produced elsewhere. Energy efficiency is the logical first area of focus: begin by reducing the amount of energy used, and then strive to reduce the emissions potential of fuel.

The Energy and Emissions Working Group examined energy use as well as the greenhouse gases Tufts' operations produces. Although Tufts is bound by an existing goal to reduce its greenhouse gas emissions by 75 to 85 percent below 2001 levels by 2050,[8] the working group identified a need for short-term emissions goals as well as goals related to renewable energy, adaptation planning, non-carbon greenhouse and hazardous gases, and transportation. The latter two, in particular, begin to bridge the gap between the health of the climate and human health and well-being.

[7] See >> Appendix I for a list of greenhouse gases.
[8] See >> Appendix H for a description of Tufts' commitments and environmental policies.

Background

Tufts has a long history of tackling climate change; the Tufts Climate Initiative was created in 1999 to reduce the university's greenhouse gas emissions in accordance with the Kyoto protocol goals. Tufts continued to set emissions reduction goals in line with regional and national efforts when it became the first university in New England to adopt the goals of the Conference of New England Governors and Eastern Canadian Premiers Climate Change Action Plan, an international partnership of states and provinces focused on the environment, economic development, energy, and other issues.

The university has undertaken a wide range of emissions reduction and energy efficiecy initiatives, earning numerous awards and recognitions, including LEED certification of several construction projects. Tufts has pursued clean and renewable power by purchasing "greener" electricity; pilot testing solar panels in Medford; and exploring the feasibility of large solar installations, combined heat and power plants, ground source heat pumps, and wind turbines. Lighting efficiency improvements and occupancy-based lighting controls have been installed virtually everywhere at Tufts. The university has also upgraded boilers and ventilation equipment, switched to less carbon-intensive fuels, replaced windows, and retro-commissioned many buildings. For a more in-depth list of Tufts' energy-related initiatives and data on energy usage, please see >> Appendix E.

Current State

Despite growth on all three campuses, Tufts has reduced its emissions and met the Kyoto goal of a 7 percent reduction in greenhouse gas emissions from 1990 levels by 2012 (Figure 3).

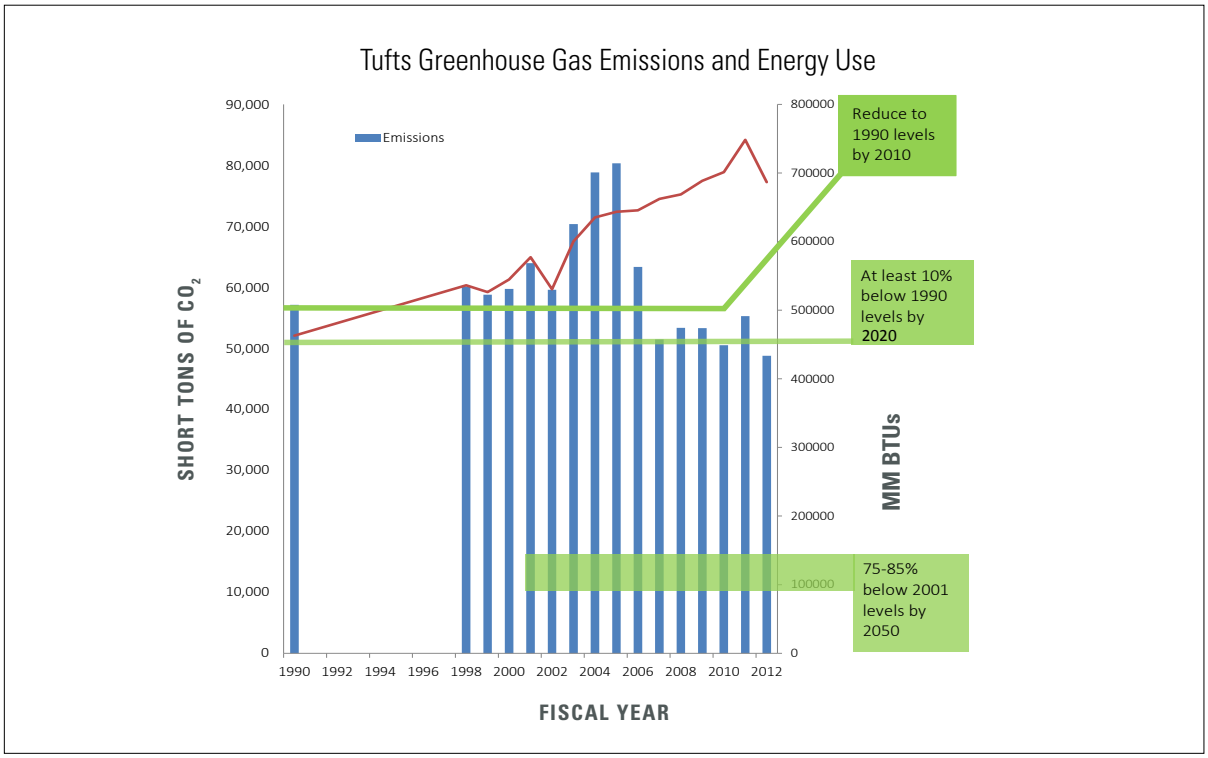

Figure 3. Tufts greenhouse gas emissions and energy use from fossil fuels. Emissions reduction commitments are shown in green.

SUMMARY OF RECOMMENDATIONS

GOAL 1: Reduce greenhouse gas emissions and energy consumption in line with specific local, regional, and international goals.

Existing emissions reduction goals:
7 percent below 1990 levels by 2012 (Kyoto Protocol)
10 percent below 2001 by 2020 (NEG-ECP CCAP[9])
75 to 85 percent below 2001 levels by 2050 (NEG-ECP CCAP)

New emissions reduction goal:
10 to 25 percent below 1990 levels by 2020, in line with Massachusetts state goals (Global Warming Solutions Act of 2008)

In addition, Tufts will reduce energy consumption 5 to 7 percent per year for three years starting in 2013 and set additional targets for consumption reduction in 2016.

Objective 1: Pursue energy efficiency, energy conservation, and renewable energy opportunities.

Recommended Strategies

A. Examine a range of energy projects across the Tufts campuses, and prioritize projects based on amount of energy and carbon saved over time versus up-front and operational costs and payback period.

B. Set consumption targets for new and existing buildings, and implement building-specific upgrades and maintenance to conserve energy.

C. Continue to actively evaluate opportunities for renewable energy production on campus.

Objective 2: Optimize planning and design processes to create conditions conducive to long-term success.

Most of these strategies require commitment, quality control, and shifts in current protocols but do not require significant resources. While the working group did not estimate the savings from these changes, discussions of typical scenarios validated that the savings in time and money would be significant.

Recommended Strategies

A. Adopt internal guidelines, standards, tools, and methodologies for managing both new projects and existing building improvements to ensure a consistent approach to project management and execution.

[9] New England Governors, Eastern Canadian Premiers Climate Change Action Plan

- Base project management on setting clear goals, fostering collaboration, and consistently applying the tools and standards.
- Institutionalize life-cycle cost analysis throughout all project phases, from initiation through design and ongoing maintenance.
- Evaluate success at every milestone using clear methodologies and key process protocols.

B. Institutionalize and refine an inclusive planning process, in which the Planning and Facilities Services departments work with other stakeholders to connect planning with long-term operation and maintenance and optimize performance throughout a project's life cycle.

- Establish minimum lead times for key decisions so necessary analysis can be performed and all critical stakeholders can provide input as appropriate.
- Allocate swing space to optimize staff time and minimize avoidable costs.

C. Require use of the processes and tools contained within a Tufts-specific project management toolkit. The toolkit will contain the following essential tools:

- Project charter and/or owners' project requirements, including a project roadmap (by schematic design; created through a collaborative process between the design team and Tufts) and a project-goal setting document.
- Adopted framework (LEED and other).
- Tufts building performance guidelines.
- Life-cycle costing template.
- Project management checklist (includes utility incentive program participation).
- Procurement guidelines.
- Building information modeling guidelines.
- Maximo® (and other systems for tracking costs).
- Building systems commissioning guidelines.

Refer to >> Appendix F for a detailed description of the project management toolkit.

D. Develop a campus energy and utility master plan that provides a comprehensive overview of systems and loads, supports intelligent decision making, and ensures that every decision is made in the context of larger system constraints.

E. Enhance accountability by ensuring that all stakeholders involved in a capital project consider the long-term impacts of campus energy consumption and emissions in their decision making.

- Create energy budget allocations at the school level that are the responsibility of the academic and executive administrative deans and budget and finance officers.
- Consider a larger-scale, systemic accountability strategy. In the absence of a national energy policy or carbon tax, Tufts could create an environment that fosters energy and carbon reductions by establishing an internal carbon tax and creating incentive programs that reward lower energy use.

Objective 3: Continuously improve facility performance by institutionalizing best practices for operations and maintenance.

Recommended Strategies

A. Establish internal standards and processes based on life-cycle costing and long-term energy intensity targets that address project closeout, long-term operation and maintenance, and equipment upgrades. Institutionalize a formal lessons-learned process to inform future decisions. These standards and tools include:

- Post-occupancy evaluation and project-closeout checklists.
- Lessons-learned checklist and meeting of Tufts team and design team within six months of occupancy.
- Internal review system and database that tracks performance of service providers (input as part of lessons-learned meeting).
- Operations and maintenance standard and retro-commissioning guidelines.
- Preventative maintenance checklist and plan for each building.
- Lighting protocols.
- Equipment replacement list, identifying products that meet the internal standards' specifications.

B. Expand data and tracking efforts and increase submetering over time, taking particular advantage of ongoing construction opportunities.

- Modernize and enhance network metering to allow for better data mining and analysis.
- Study the most effective ways to install submeters, and network existing and new meters.
- Collect data through a common platform (e.g., the campus building automation system).
- Utilize results of data analysis to inform the setting of longer-term reduction targets.

C. Engage Facilities Services staff to work with the schools to define, prioritize, schedule, and implement preventative maintenance programs and ongoing energy efficiency and equipment upgrades.

D. Enhance accountability by organizing a change-management team to work with schools, particularly the medical and dental schools, to establish requirements for lab managers to implement and enforce standard operating procedures that support best practices. Initiatives may include labeling buildings with their energy use or incorporating energy reduction responsibilities into job descriptions.

Objective 4: Foster sustainability as a community mind-set through education, awareness, and accountability.

Recommended Strategies

A. Within five years, educate the Tufts community on what they can do to reduce energy consumption.

B. Integrate protocols and training related to energy-intensive behaviors into existing lab and hospital employee education requirements.

C. Engage a task force to work with labs, hospitals, and school leadership to ascertain where appropriate equipment sharing can take place and work to institutionalize those practices where possible.

GOAL 2: Develop a renewable portfolio standard (RPS) within one year.

Objective: Develop a plan to integrate energy derived from fossil fuel alternatives into Tufts' overall emissions reduction strategy.

The working group recognized the need to move away from fossil fuels for long-term financial stability and emissions reduction potential. This goal was not developed in depth at the time of this report.

Recommended Strategy

A. Convene a stakeholder group to define boundaries and requirements, determine targets, and craft a roadmap of how to achieve the targets.

GOAL 3: Begin the process of adaptation planning within one year.

Objective: Ensure that Tufts is positioned to adapt to the impacts of climate change on all three campuses.

Recommended Strategies

A. Convene a stakeholder group within one year to identify areas of vulnerability with regards to the predicted effects of climate change (e.g., equipment vulnerable to flooding, increased need for cooling). Address both the resilience of physical infrastructure as well as the ability to manage scheduling and other operational issues during peak heating or cooling periods.

B. After risk assessment, develop an adaptation and resilience plan including a prioritized list of corrective actions. Integrate the adaptation plan into the university's planning process.

C. Incorporate assessment of the risks due to predicted climate change into the project management checklist.

GOAL 4: Address non-carbon greenhouse gas emissions.

Objective: Institute a plan to reduce non-carbon greenhouse gas emissions on Tufts' campuses related to construction finishes, lab and hospital chemical use, off-gassing from plastics, and other sources of greenhouse and noxious gases.

Recommended Strategies

A. Develop an accounting of sources of emissions, including chemicals used in labs and hospitals and products used in construction and maintenance (e.g., paint, adhesives, and refrigerants).

B. Develop a list of alternative, less harmful options and/or procedures that minimize the storage or use of these chemicals. Additional efforts to reach out to suppliers and engage them in meeting Tufts' objectives may stimulate additional opportunities.

C. Develop a prioritized reduction plan based on the potential for greenhouse gas emissions, value to research and teaching, effect on occupant health, and other factors.

GOAL 5: Develop transportation initiatives to reduce the impacts of campus vehicles (fleet), commuting, and business travel.

Vehicle traffic on campus roads, particularly on the Medford/Somerville campus, presents an opportunity to reduce greenhouse gases from the burning of gasoline and diesel, as well as improve air quality and pedestrian and cyclist safety on campus. Programs designed to discourage single-occupancy car travel can enhance the health and well-being of students and employees through increased walking or biking for those who are able, additional social interaction, reduced congestion on campus roads, and increased available space in the central core of campus for other uses such as building sites, gardens, or recreation.

Objective: Within one year, convene a stakeholder group to provide input for a long-term transportation initiative.

Recommended Strategies

A. Identify and prioritize opportunities to minimize emissions from transportation to, from, and around Tufts' campuses by students, employees, and vendors.

- Address Tufts' fleet and vendor fleets by examining logistics for campus deliveries, increasing the use of electric and alternative fuel vehicles, and enforcing existing state anti-idling laws.
- Create a policy for intra-campus travel that encourages carpooling and public transit.

B. Develop a strategic approach to shift commuters from single-occupancy cars to alternative methods of transportation using community-based social marketing techniques (see >> Appendix B).

- Tie these efforts in to Tufts' health and wellness initiative.
- Encourage, facilitate, and incentivize travel by walking, biking, carpooling, and public transportation.

C. Develop a way to quantify air and ground miles traveled, and develop protocols and policies to reduce miles traveled for university business.

D. Evaluate opportunities to create more pedestrian-friendly campuses through reducing the number of cars in campus cores.

APPENDIX A: CAMPUS SUSTAINABILITY COUNCIL

Purpose, Structure, and Process

The council's membership consists of university leadership, Tufts staff and faculty, and undergraduate and graduate student representatives from across the university's various schools, programs, and campuses.

The council oversees three working groups devoted to developing goals, strategies, and metrics for improved sustainability in these major areas of environmental impact: waste, water, and energy and emissions.

The working groups also boast a diverse array of members representing Tufts staff, faculty, and students. Each working group is co-chaired by a faculty member and a staff member who have direct influence over the area of interest.

Since forming, the council and its working groups have met regularly to develop goals for improved campus sustainability and strategies designed to best reach those goals. Figure 4 outlines the process that the council and working groups followed, from creating a vision (V) through determining the appropriate metrics for implementation planning.

Figure 4. Sustainability Council Phases

Over the course of one year (January 2012–January 2013), the council met five times to discuss the findings of the working groups.

The working groups reviewed existing environmental commitments (see >> Appendix H) and progress toward those goals. They also examined available data and relevant benchmarks related to water, waste, and energy and emissions. They developed goals, objectives, and strategies for each area and began developing implementation plans, timelines, and metrics to make sure each goal is met. At each stage the council provided feedback to the working groups about their recommendations.

The release of this document marks the conclusion of the intense, first-year phase of the council. The vice president of operations will oversee the next phase: the creation of a comprehensive work and implementation plan that will provide the practical roadmap for achieving the goals outlined in this report.

THIS WORK PLAN WILL DETAIL:

- Specific strategies, initiatives, programs, and policies that will be executed in order to meet the visions, goals, and objectives included in this report.
- Methods for choosing and prioritizing initiatives based on evaluation criteria that take into account such factors as environmental and social impact, marginal abatement cost curve analysis, educational value, public awareness value, and regulatory compliance.
- The owner/project lead of each strategy and identification of key stakeholders.
- Project timelines and interim milestones and benchmarks.
- Metrics and key performance indicators.
- Reporting methodology.
- Processes for continuing feedback and program evaluation.

The Campus Sustainability Council will reconvene a year after the work plan has been put in place to evaluate progress, provide feedback, and address challenges that may have arisen.

CAMPUS SUSTAINABILITY COUNCIL AND WORKING GROUPS

Campus Sustainability Council Membership

Anthony P. Monaco, *Chair*
Tufts University President

Patricia L. Campbell, *Co-Chair*
Executive Vice President

Peter Brodeur
Associate Professor
Pathology Department
School of Medicine

Bob Burns
Director, Facilities Services

Dan J. Doherty
Trustee
Chair, Buildings and Grounds Committee
Tufts Board of Trustees

Kelly Sims Gallagher
Associate Professor
Director, Energy, Climate, and Innovation in the Center for International Environment and Resource Policy
The Fletcher School

Timothy Griffin
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Program Director, Agriculture, Food and Environment
Friedman School of Nutrition Science and Policy

Marc Hodes
Associate Professor
Mechanical Engineering
School of Engineering

Betsy Isenstein
Director
Facilities Technical Services

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Professor, Chemistry
School of Arts and Sciences

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Co-president, Tufts Sustainability Collective
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Tina Woolston
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Dick Reynolds*
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***Member January–October 2012**

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Environmental Health and Safety

Gary Smyrlian
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Campus Center Dining Services

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Strategic Sourcing Specialist
Purchasing Department

Jamie Wells
Lab Animal Care Supervisor
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Gretchen Kaufman*
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Director, Tufts Center for Conservation Medicine

***Left Tufts August 2012**

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Medford campus
Facilities Services

SCHEDULE OF MEETINGS

Campus Sustainability Council

January 30, 2012
March 30, 2012
September 14, 2012
December 11, 2012
January 28, 2013

Energy and Emissions Working Group

March 15, 2012
March 29, 2012
April 19, 2012
May 1, 2012 (Retreat)
July 10, 2012
July 27, 2012
August 21, 2012
September 10, 2012
October 9, 2012
October 18, 2012
October 26, 2012
November 20, 2012
November 30, 2012
January 25, 2013

Waste Working Group

March 12, 2012
March 23, 2012
April 6, 2012
April 20, 2012
May 4, 2012
May 18, 2012
July 9, 2012
July 16, 2012 (Retreat)
September 25, 2012
October 11, 2012
October 23, 2012
November 8, 2012
November 20, 2012
December 6, 2012
December 20, 2012

Water Working Group

March 2, 2012
March 16, 2012
March 30, 2012
April 13, 2012
April 27, 2012
May 11, 2012
July 18, 2012 (Retreat)
October 19, 2012
November 9, 2012
December 7, 2012

APPENDIX B: FOSTERING A SUSTAINABLE CULTURE

Every day marketers use research to determine their customers' values and preferences as well as their needs and concerns. They select target audiences and study the perceived barriers and benefits of buying their product. They establish clear objectives and goals and choose the best price, place, and locations to sell their product. They identify language that is oriented towards their customer. And finally, they monitor and evaluate the effectiveness of their efforts and adjust as needed.

A Science-Driven Process

CBSM is based upon research in the social sciences that demonstrates that behavior change is often more effectively achieved through initiatives delivered at the community level that focus on removing barriers to an activity while simultaneously enhancing the activity's benefits.

(McKenzie-Mohr et al., 2011)

Social marketers draw upon these well-researched methods to "create, communicate and deliver benefits that a target audience(s) wants in exchange for audience behavior that benefits society without financial profit to the marketer" (Kotler & Lee, 2008). Social marketing is used extensively in public health and injury prevention (e.g., anti-smoking campaigns).

Community-based social marketing (CBSM) adds additional, community-based tools to the social marketing process as well as the concept of pilot testing. CBSM developed out of the recognition that widespread education campaigns, the method of choice for many environmentalists, do not usually lead to widespread behavior change. While awareness and knowledge of the issues at hand may increase, this often does not translate into an actual change in behavior in the targeted group. CBSM has proven to be a more effective way to create change that is beneficial to society at large and works particularly well for environmental changes. Many examples of successful applications of this process exist (Kotler & Lee, 2008; McKenzie-Mohr, Lee, Schultz, & Kotler, 2011; and Weinreich, 2011).

CBSM can be used for a wide variety of behavior changes, from recycling to choosing energy efficient products. At its core, CBSM is a community-focused, deliberate, strategic process that selects specific, targeted behaviors, identifies the relevant audience(s), examines barriers and potential benefits of the desired behavior, creates a comprehensive plan, and evaluates the effectiveness of the efforts.

The need for a cultural shift towards more sustainable actions came up in every Campus Sustainability Council working group, along with the recognition that just telling someone to shut off the lights or take a shorter shower isn't enough. Most people at Tufts care about the environment and do not wish to do harm but are stymied by existing systems and mindsets that support the status quo. Without addressing the underlying barriers to action, there will be little progress toward creating the systemic change necessary to meet our goals. CBSM provides a robust process through which to do this.

There are five steps to CBSM (McKenzie-Mohr, Lee, Schultz, & Kotler, 2011):

1. Select which behavior to target.
2. Identify the barriers and benefits to the selected behavior (from the audience's perspective).
3. Develop a strategy that reduces barriers to the behavior to be promoted, while simultaneously increasing the behavior's perceived benefits.
4. Pilot the strategy.
5. Evaluate broadscale implementation and conduct ongoing evaluation once the strategy has been broadly implemented.

Each step consists of many pieces. For example, in order to select the behaviors to target, you must know your goals, objectives, and target audiences. The working groups decided upon the following goals related to education and behavior change:

1. Within five years, all members of the Tufts community will know how to divert and reduce waste, and active participation in waste diversion will increase by 50 percent.
2. Within five years, all Tufts community members will understand how their actions affect water use and quality, why water considerations are important, and how they can reduce use and mitigate negative impacts on their watershed.
3. Within five years, all members of the Tufts community will know what they can do to reduce energy consumption as building occupants and will use that knowledge to modify their habits to be less energy intensive.

SOME IDENTIFIED AUDIENCE SEGMENTS ARE:

- Lab users
- Clinic staff, faculty, and students
- Principal investigators (PIs)
- General building occupants
- Students
- Faculty
- Staff
- Residential students
- Gym users
- Dining staff
- Graduate students
- Off-campus students
- Animal care workers
- Service contractors (e.g., construction, HVAC, landscaping)
- Custodians

Specific behaviors have to be non-divisible and end-state, so the desired behavior change is clearly linked to the desired outcome. Therefore it is important to avoid focusing on a particular strategy, such as "getting an energy audit" (not end-state, since it is often just one step in the process of reducing energy use) when the desired behavior is actually "insulate the attic." Clearly defining the goal (e.g., reduce energy use by homeowners) allows one to determine the most effective strategies. Below are examples of some of the behaviors identified by the working groups:

WASTE

- Place all recyclable office items in the correct recycling bin.
- Notify the Waste Reduction Program Manager when disposing of potentially recyclable or reusable materials.
- Purchase recycled-content products.
- Place compostables in residence hall/public/dining compost bin.
- Break down and recycle cardboard during residence hall move-in.
- Purchase EPEAT-certified computers.
- Use surplus furniture.

WATER

- Reduce water use (e.g., by taking shorter showers, turning off faucet when brushing teeth, washing only full loads of laundry).
- Dispose of excess medications properly (e.g., by mixing them with coffee grounds and putting in the trash instead of flushing them down the toilet).

ENERGY

- Shut fume hood sash (on non-automated fume hoods).
- Share equipment—especially equipment that runs continuously.
- Turn off equipment when not in use.
- Close windows when air is conditioned (i.e., the heat or A/C is on).
- Use power strips.
- Turn off lights in unoccupied areas.
- Report inefficiencies.
- Use video conferencing.

Some or all the behaviors identified by the working groups may be addressed depending on which have the highest impact, lowest current participation rate, and highest probability of adoption. These are still under evaluation.

Works Cited

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McKenzie-Mohr, Doug, Nancy R. Lee, P. Wesley Schultz, and Philip Kotler. 2011. *Social marketing to protect the environment: What works.* Thousand Oaks: Sage Publications.

Weinreich, Nedra K. 2011. *Hands-on social marketing: A step-by-step guide to designing change for good.* Thousand Oaks: Sage Publications.

APPENDIX C:
TUFTS REUSE AND RECYCLING INITIATIVES

Reuse Efforts

- r2ePACK (Reuse. Recycle Everything. Pack and Clean…'K?) is a large-scale recycling and reuse initiative that takes place during move-out at the end of the academic year. It encourages students to decrease their consumption of new goods and provides "freecycle" opportunities.
- South Hall's recent renovation introduced Tufts' first dormitory "freecycle" swap area.
- Tufts Recycles! hosts weekly hours to furniture shop at the 550 Boston Avenue warehouse and works to reuse as much surplus furniture as possible either at Tufts or by donating to outside groups such as local school systems and nonprofits.
- Outdated mattresses are donated locally.

Recycling Efforts

Tufts routinely recycles from both daily Facilities Services' operations and university activities. The following are recyclable at Tufts:

- Bottles and cans
- Cell phones
- Computers and printers
- Construction and demolition waste
- Electronic media
- Fluorescent lamps (lightbulbs) and ballasts
- General-use batteries
- Glass
- Mattresses that cannot be reused (80% are reused)
- Metal
- Mixed paper and cardboard
- Plastic (rigid only, not films or Styrofoam)
- Printer cartridges
- Vehicle batteries
- Vehicle tires

Other recycling initiatives include the following:

- Special cardboard recycling services are provided during September student move-in.
- Carpet from Medford campus renovations and area rugs left behind in residence halls at move-out are often recycled.
- Recycling services are available for all special events.
- The Greenbean reverse vending machine in Medford's Meyer Campus Center will allow students to receive 5 cents for each eligible can deposited.
- Recycling services are made available to fraternities.
- Tufts participates in the nationally recognized RecycleMania competition and organizes an on-campus residence hall competition.
- Custodial staff members are trained annually in proper recycling techniques.
- Glass/metal/plastic and mixed-paper recycling bins are provided to every building, department, and kitchen, as well as outside.
- Thirty-four new outdoor trash and recycling receptacles were installed on the Medford campus between FY10–FY12.
- Mixed-paper deskside bins are made available to all residential students, students with offices, and employees.
- Single-stream (zero-sort) recycling was adopted at the Dental School to meet the unique needs of a public clinic.
- Eco-Reps (students in residence halls) and Eco-Ambassadors (employees in offices) are trained in recycling and subsequently teach their colleagues, act as a resource in their office or residence hall, and monitor recycling in their area.

Composting

- Three public compost bins are available to Medford campus staff, faculty, and students.
- Eco-Reps maintain compost bins in the staffed residence halls.
- Food is composted at special events (e.g., Community Day, matriculation, the President's Picnic in Medford and in Grafton).
- Yard waste is routinely composted.

Mail Services

- The address hygiene program is a partnership with the intramail network to scrub lab catalog mailing lists before delivery. This reduces deliveries to researchers no longer at Tufts, provides a small stipend, and keeps extra catalogs out of the waste stream.
- The recycled supplies program periodically makes interdepartmental envelopes, paperclips, and binder clips available to departments from mail services' existing recycled supplies.
- Junk mail addressed to students, faculty, or staff who are no longer at Tufts is picked up and recycled weekly.

Metrics

Tufts' overall recycling rate has steadily increased, primarily driven by the increased recycling rate on the Medford/Somerville campus (Figure 5). Activities on the Boston and Grafton campuses (Figures 6 and 7) are largely conducted in clinics and laboratories, which present unique recycling challenges. Beginning later in 2013, Tufts Recycles! will create waste profiles of each school that will help focus our efforts specifically on each campus' needs to meet reduction goals.

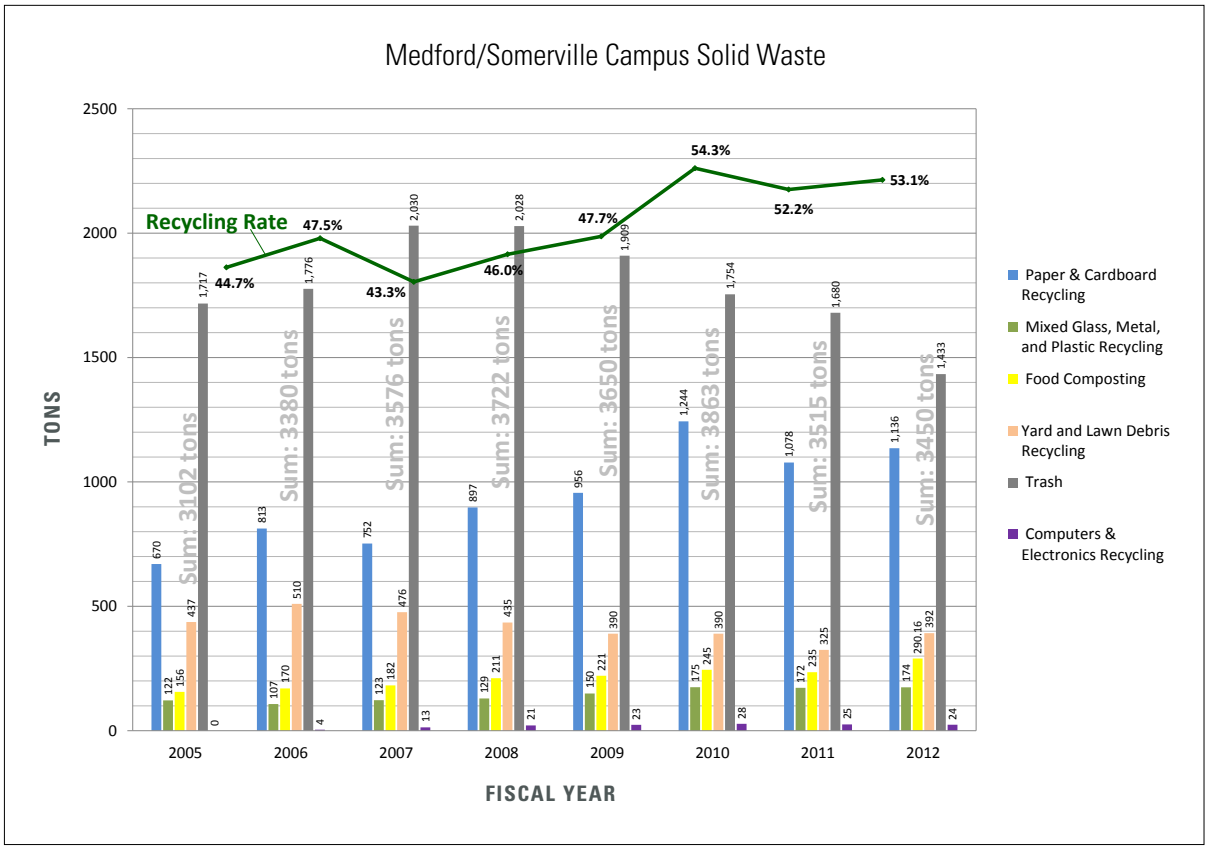

Figure 5. Medford/Somerville campus solid waste data, including tons of recycling and trash collected, and the recycling rate over time.

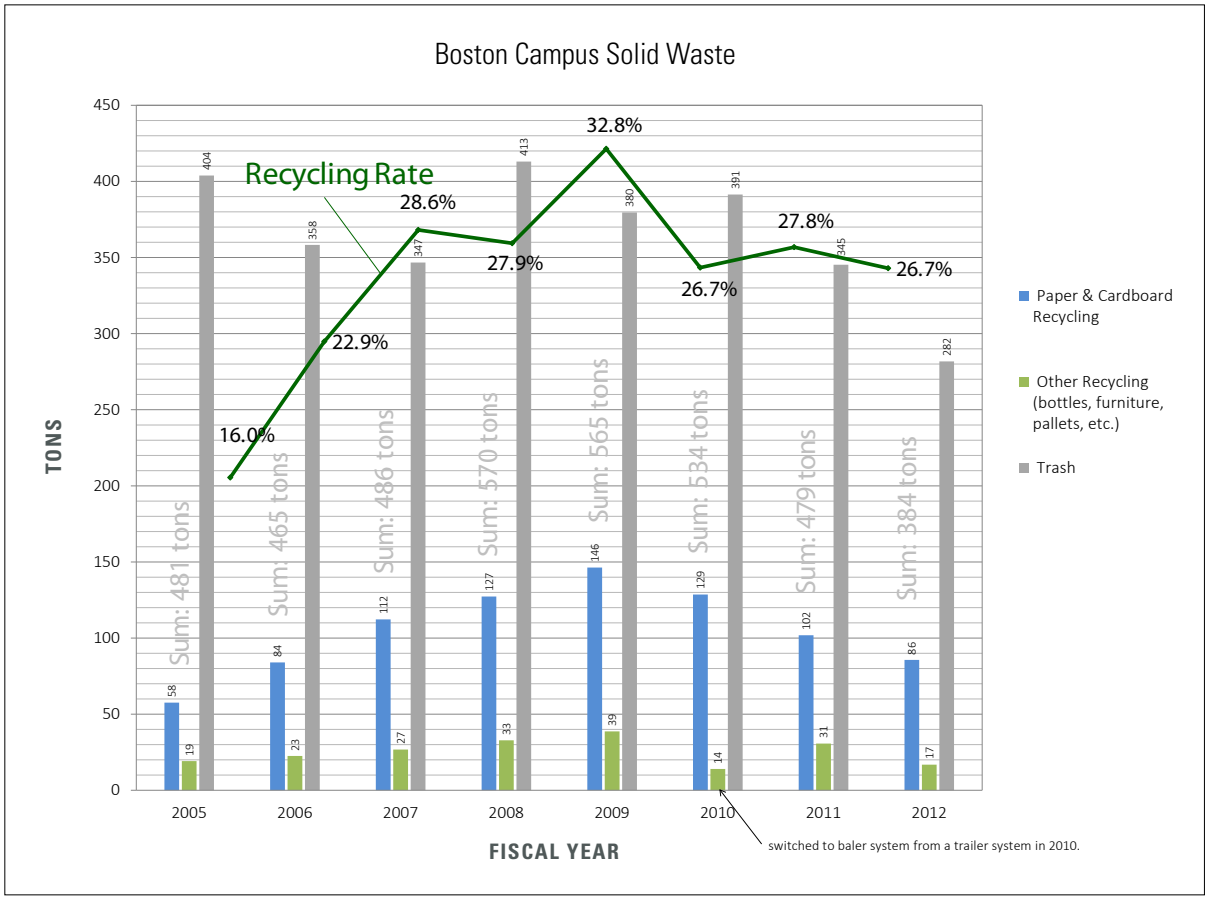

Figure 6. Boston campus solid waste data, including tons of recycling and trash collected, and the recycling rate over time.

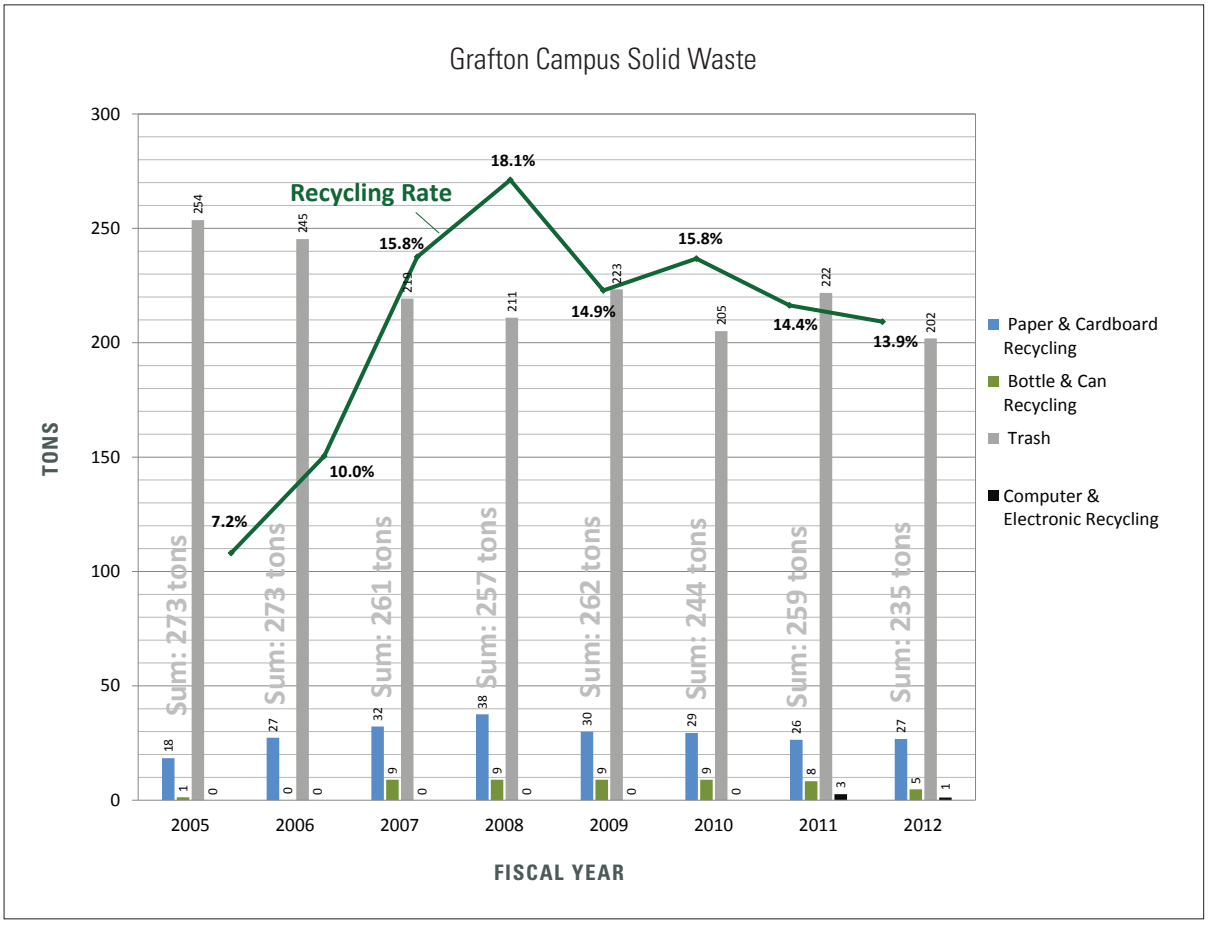

Figure 7. Grafton campus solid waste data, including tons of recycling and trash collected, and the recycling rate over time.

APPENDIX D: TUFTS WATER CONSERVATION AND STORMWATER MANAGEMENT INITIATIVES

Water Conservation

- Two irrigation wells installed at Alumni Field were activated in spring 2012. Efforts to identify appropriate areas for additional groundwater for irrigation continue with good prospects in the area of Ellis Oval.
- Drought-tolerant plants are used in landscaping.
- Weather-informed irrigation technologies are being investigated.
- Condensate recapture and reuse implemented in pilot tests in Medford and Boston (2012).
- Dishwasher in Dewick Dining replaced with a state-of-the-art energy-efficient dishwasher (2012).
- Trayless dining instituted (2011).
- Low-flow showerheads installed in all Medford/Somerville and Boston residence halls (2008).
- Medford residence hall bathroom upgrades include dual-flush or low-flush toilets and low-flow showerheads.
- Dual-flush toilets used routinely in new construction.
- Front-load clothes washing machines requiring less water, energy, and detergent are installed in most residence hall laundry rooms.

Stormwater Management

- Students from Urban and Environmental Planning and Policy have completed preliminary low-impact designs for use by Facilities Services to address stormwater retention and quality on the Medford/Somerville campus.
- Fifty percent of the buildings on the Medford/Somerville campus have downspouts that drain into dry wells.
- Integrated pest management is used on the approximately 20 acres of grounds on the Medford/Somerville campus.
- Tufts' first rain garden has been installed on the Medford/Somerville campus near Hodgdon and Lewis Halls. The garden features permeable stone that will filter rain from the surrounding area to reduce downstream flooding and improve water quality (2012).
- Rain barrels installed at 520 Boston Avenue to capture roof runoff for landscape irrigation.

APPENDIX E: TUFTS ENERGY AND EMISSIONS INITIATIVES

Energy Sourcing

- Tufts holds a long-term power supply contract with TransCanada, an electric supplier with a clean portfolio of power generation, consisting of generation from hydropower, natural gas, and wind.
- In 2011, 30 percent of the Boston campus' purchased steam was cogenerated, with zero emissions attributable to Tufts.
- Oil-to-natural gas conversions:
    - Central heating plant, Medford (No. 6 fuel-to-gas conversion complete with No. 2 fuel backup planned).
    - Tilton Plant, Somerville (operational change from No. 6 fuel-to-gas conversion to No. 2 fuel as backup planned).
    - Hospital for Large Animals and Foster Hospital for Small Animals, Grafton (No. 2 fuel-to-gas conversion).
    - 179 College Avenue, Medford (No. 2 fuel-to-gas conversion).
    - 17 Chetwynd, Somerville (No. 2 fuel-to-gas conversion).
    - Wood-frame houses routinely converted to natural gas, if available, as boilers need replacing.

Energy Conservation

- Medford campus generator readiness testing reduced to one hour per month.
- ENERGY STAR refrigerators purchased for residence halls.
- Boiler upgrades:
    - Routinely using highly efficient condensing boiler technology when steam is not required.
        - Replace existing conventional efficiency boilers at:
            - Jean Mayer Administration Building, Grafton
            - Hospital for Large Animals and Foster Hospital for Small Animals summer boiler, Grafton
            - Science and Technology Center at 4 Colby Street, Medford
            - Mayer Campus Center, Medford
            - Gifford House, Medford

- Installed highly efficient condenser boiler technology in new construction at:
  - Sophia Gordon Hall (supplies Granoff Music Center as well), Somerville
  - 80 George Street, Medford
  - 58 Winthrop Street, Medford
  - Varis Campus Center, Grafton
  - Isolation Building, Grafton
  - Tisch Fitness Center, Medford (under construction)

- Upgraded boiler controls for improved boiler control and more efficient operation at:
  - Grafton—Building 20, Hospital for Large Animals and Foster Hospital for Small Animals
  - Medford—Central Heating Plant
  - Planned for Medford—Tilton, Cousens and Jackson boiler plants

- Retrocommissioning:
  - Tisch Library variable air volume box retrocommissioning as preparation for Tisch air-handler replacements. Various low-/no-cost repairs and adjustments made to dampers, valves, controllers, coils, sensors, and thermostats.
  - Large Animal Hospital and Small Animal Hospital retrocommissioning:
    - 4 Colby St. retrocommissioning led to several energy improvements:
    - Returned previously unused heat-recovery equipment to operation.
    - Installation of condensing boilers.
    - HVAC (Heating, Ventilation and Air Conditioning) chiller retrofit project reused an existing 17-year-old chiller by retrofitting it with a newer, more environmentally friendly refrigerant and three highly efficient, frictionless, oil-free, magnetic-bearing compressors.
    - The eighth annual residence hall winter break shutdown is a team effort among Facilities Services, Residential Life, Public Safety, and the Office of Sustainability. All unsupervised residence hall rooms are checked to be sure that lights are off, heat is turned down, appliances are off, and windows are closed for the month-long winter break.
    - Variable frequency drives are installed at every feasible opportunity.
    - Demand control ventilation (CO_2 control), outdoor air reset, and other energy-savings controls are applied wherever possible using the building automation system.
    - Aircuity system (demand control ventilation) was installed in Arnold Laboratory renovations, floors five and six. The system allows for reduction of general exhaust air changes during normal operations but continually samples air quality and ramps up air changes in the event of a chemical spill.

- Capital (new) projects:
  - 520 Boston Avenue renovation included insulated walls, occupancy-based lighting, heating and cooling controls, replacement of inefficient air-handling equipment with one high-performance rooftop air-handling unit, new low-e[1] windows, daylight harvesting, and careful attention to sustainable material choices. Rain barrels installed to landscape irrigation. Plantings selected for ease of maintenance and drought tolerance. Bicycle rack installed.
  - Steve Tisch Sports and Fitness Center includes a high-efficiency oil-free variable speed chiller, high-efficiency energy-recovery enthalpy wheel for areas requiring 100 percent outside air, an efficient fan wall system with variable frequency drives, a high-efficiency summer boiler, and a Kone EcoSpace machine room-less elevator (no oil used and one-third the energy of a hydraulic elevator). Electrical efficiency includes daylight harvesting at south-facing windows, efficient lighting with dark-sky compliant LED[2] site lighting, and ENERGY STAR-rated LEDs where appropriate. Occupancy sensors throughout. Dual-flush toilets, drought-resistant landscaping, on-site stormwater mitigation, and hydration stations to refill water bottles. Recycled rubber flooring used in first-floor corridors, and construction waste recycled to date is 83 percent.
  - Biology labs at 200 Boston Avenue include cutting-edge laboratory energy-efficiency approaches, with chilled beams, radiant heating, demand control ventilation (Aircuity), energy recovery, and high-efficiency chillers.

- Deferred maintenance:
  - Dewick Dining—HVAC equipment replacement designed with highest-efficiency equipment.
  - Cohen Auditorium—HVAC and lighting replacements designed with highest-efficiency equipment.
  - Considerable focus on building-envelope improvements, including new or refurbished windows and roof replacements. Infrared photography before and after has become standard.
    - Windows replaced at:
      - Biomedical Research and Public Health (BPRH) building, Boston work is ongoing
      - Dental Building, Boston
      - Tufts Administration Building, Somerville
      - 80 George Street, Medford
      - Miller Hall, Medford
    - Windows refurbished on the Medford campus at:
      - Paige and Minor Halls

[1] Low-e (low thermal emissivity) windows reduce the amount of heat from the sun entering the building

[2] LED (Light-emitting diode)

        - Braker Hall
        - East Hall
        - West Hall
        - Goddard Chapel
        - Eaton Hall
        - Barnum Hall

    - Medford summer 2010 wood-frame renovations included insulation and low-e windows.
    - Cousens Gym roof replacement included insulation and is well positioned for a future solar project.

- Lighting:
    - Lighting efficiency improvements and occupancy-based lighting controls are virtually everywhere.
    - Projects recently completed:
        - LED site lighting being tested on the Medford/Somerville campus.
        - A19 LED lamps, which replace traditional lightbulbs, were provided to all incoming students in the fall of 2013. Lamps provided by NStar and National Grid at a deep discount.
        - Installation of more than 1,500 LED lamps on all campuses. LED lamps funded by Mass Save at no cost to Tufts.
        - Public Safety, Medford—old technology T8s converted to new technology T8s.
        - Jackson Gym and Dance Studio, Medford—HID[3]-to-fluorescent conversion.
        - Aidekman Art Gallery, Medford—incandescent to LED upgrade, controls upgrade.
        - Grafton—Administration Building, Loew Center, Faculty Office Building, Buildings 20 and 21, Peabody Pavilion, McGrath Teaching Lab, and the Hospital for Large Animals and Foster Hospital for Small Animals.
        - Medford:
            - Classrooms in Eaton Hall.
            - TAB lighting controls.
            - Brown and Brew LEDs, Tufts Institute for the Environment, 527 and 550 Boston Avenue, Anderson Hall, Robinson Hall, Central Heating Plant, Cousens boiler plant, 175 College Avenue and Blakeley Hall common areas.
            - Dowling parking garage LED retrofit, first of its kind in Massachusetts.

[3] HID (high-intensity discharge)

- Projects currently under study:
  - Medford
    - Dowling Hall, Michael Pearson, stairwell and corridor lighting, Remis Sculpture Court, Carmichael Dining—incandescent to LED upgrade, LEDs in site lighting.
  - Boston
    - Jaharis—additional lighting controls.
    - Biomedical Research and Public Health building—various locations.

Vehicles

- Facilities Services on Medford campus uses a first-generation Toyota Prius and B5 ultralow sulfur diesel (5 percent biodiesel) in diesel vehicles.
- Grafton Facilities Services uses an electric vehicle when weather permits.
- Boston Facilities Services uses biodiesel for the Green Machine Sweeper.

Renewables

- Sophia Gordon Hall has a roof-mounted 23.8-kW photovoltaic system and a roof-mounted solar thermal system to supplement the gas-fired domestic hot water system.
- Fairmount House has two 250-watt photovoltaic panels on the roof generating about 700 kWh of electricity annually (since 1999).
- Schmalz House has two solar thermal panels for supplemental domestic hot water and a small photovoltaic panel to run the system pump (since 1999).
- Lane Hall ground-source heat pump installed as a pilot project and provides conditioned air to a basement classroom.
- Studies:
  - Data Center Efficiency Study considered hot aisle containment, evaporative fluid cooler for heat rejection, high-efficiency lighting and controls, electronically commutated motor (ECM) motors, and heat rejection to the building heat pump system.
  - University-wide photovoltaic review in process with competitively selected solar developer. Under consideration:
    - Grafton—engineering in process for two ground-mounted photovoltaic systems. Total generation expected to be 3 megawatts in two locations.
    - Medford—selected roofs will be considered based on size, orientation, exposure, roof age, and condition.
    - Boston—high-rise roofs less feasible because of higher installation costs and complexities of the downtown electric system.

- Building 20 Combined Heat and Power Feasibility Study, with preliminary calculations showing a six-year payback with utility incentive (2011).
- Cummings School of Veterinary Medicine Wind Turbine Feasibility Study funded through a grant from the Massachusetts Renewable Energy Trust (2010).
- Cousens South-Facing Roof Solar Feasibility Study (2010).
- Grafton Campus Renewable Energy Feasibility Study (2006).

Demand Response

- Jaharis and the Biomedical Research and Public Health building (BRPH) generators are enrolled in the New England Independent System Operator's (ISO-NE) demand response program. Demand response allows the ISO to use our generators and others to stabilize the electric grid during times of grid stress and helps reduce the need to bring older, dirtier plants on-line or build additional power plants.

Recognition

- Medford Green Business Award 2012.
- Northeast Energy Efficiency Partnerships 2010 Business Leader for Energy Efficiency for continued efforts to advance energy efficiency resulting in savings of over six million kWh per year.
- The Grafton Building 20 Energy Conservation Project received the "Best Energy Project in Higher Education" award from the New England Association of Energy Engineers (2009).
- National Grid recognized Tufts with its "Excellence in Energy Efficiency" award as it celebrated 20 years of energy efficiency programs (2008).
- LEED Certifications:
  - Sophia Gordon Hall—gold
  - School of Dental Medicine, vertical expansion—silver
  - School of Dental Medicine, level 2 renovation—gold
  - School of Medicine, Sackler Building—silver anticipated
  - Biology Labs at 200 Boston Avenue—gold anticipated

Metrics

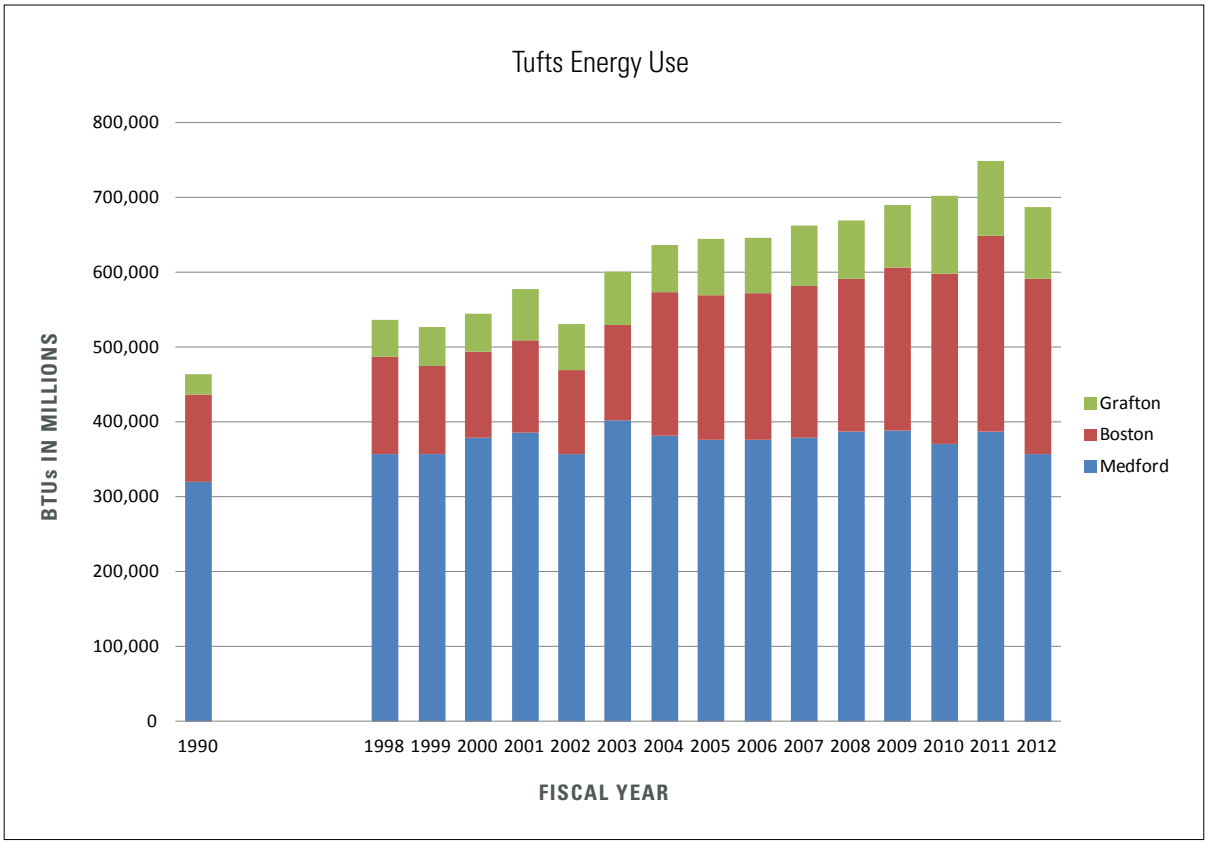

Figure 8. Fossil fuel-generated energy consumption, including heating and transportation fuels and electricity.

Figure 9 shows the difference in energy intensity (BTU per gross square foot) of buildings on the different campuses. As complex and energy-intensive facilities have been added on the Boston and Grafton campuses, energy consumption has climbed. New facilities in Medford have been less technically complex, and more resources have been devoted to energy efficiency projects. It is this trend that has led to the decline in energy intensity over time.

New building designs incorporated energy efficiency to varying degrees, so resulting consumption would have been higher without deploying these strategies. Energy performance in Tufts' facilities is extremely weather dependent (note the impact of the very warm winter of 2012).

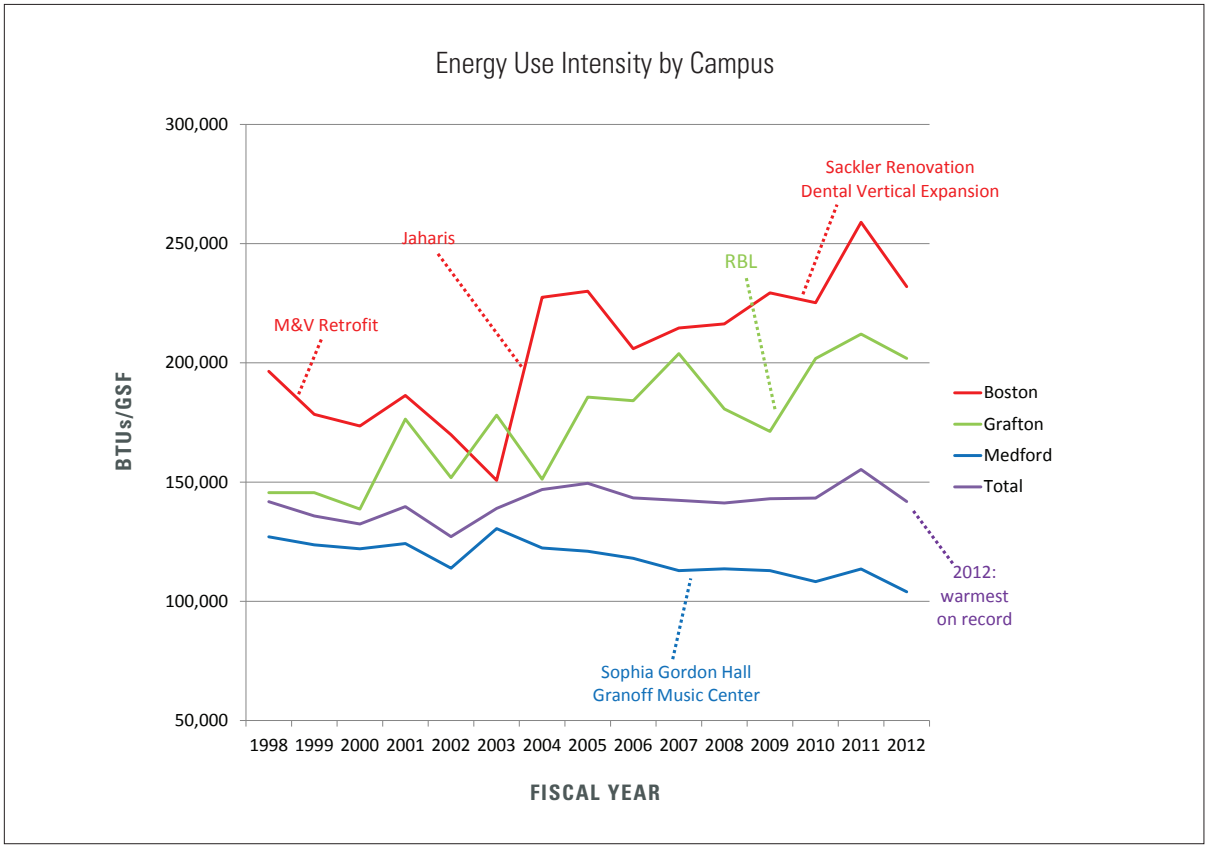

Figure 9. Energy used per 1,000 gross square feet (GSF) by campus, excluding transportation fuel use.

The following charts show the amount of heating fuels burned to heat buildings on the Medford/Somerville (Figure 10) and Grafton (Figure 11) campuses from 1998 on, with 1990 included as a reference point. Since all the fuels have different units of measurement (gallons, therms, etc.), they were all converted to British Thermal Units (BTUs), a standard measure of the energy content of the fuel.[4]

In February 2011, Tufts stopped burning No. 6 fuel, a heavy "leftover" product of crude oil after the more valuable hydrocarbons have been removed. No. 6 fuel contains many impurities. The Tilton Heating Plant was switched to natural gas and remains on gas to this day. The Central Heating Plant was converted to No. 2 fuel while preparations were made to convert to natural gas. Also known as home heating oil, No. 2 fuel is similar to diesel fuel and is a cleaner burning fuel than No. 6 fuel.

The Central Plant boilers first fired on natural gas on November 30, 2011. Both the Central and Tilton plants will use No. 2 fuel as the backup fuel. Because both No. 2 fuel and natural gas have lower emissions coefficients than No. 6 fuel, the conversion will reduce Tufts' emissions profile due to heating fuel.

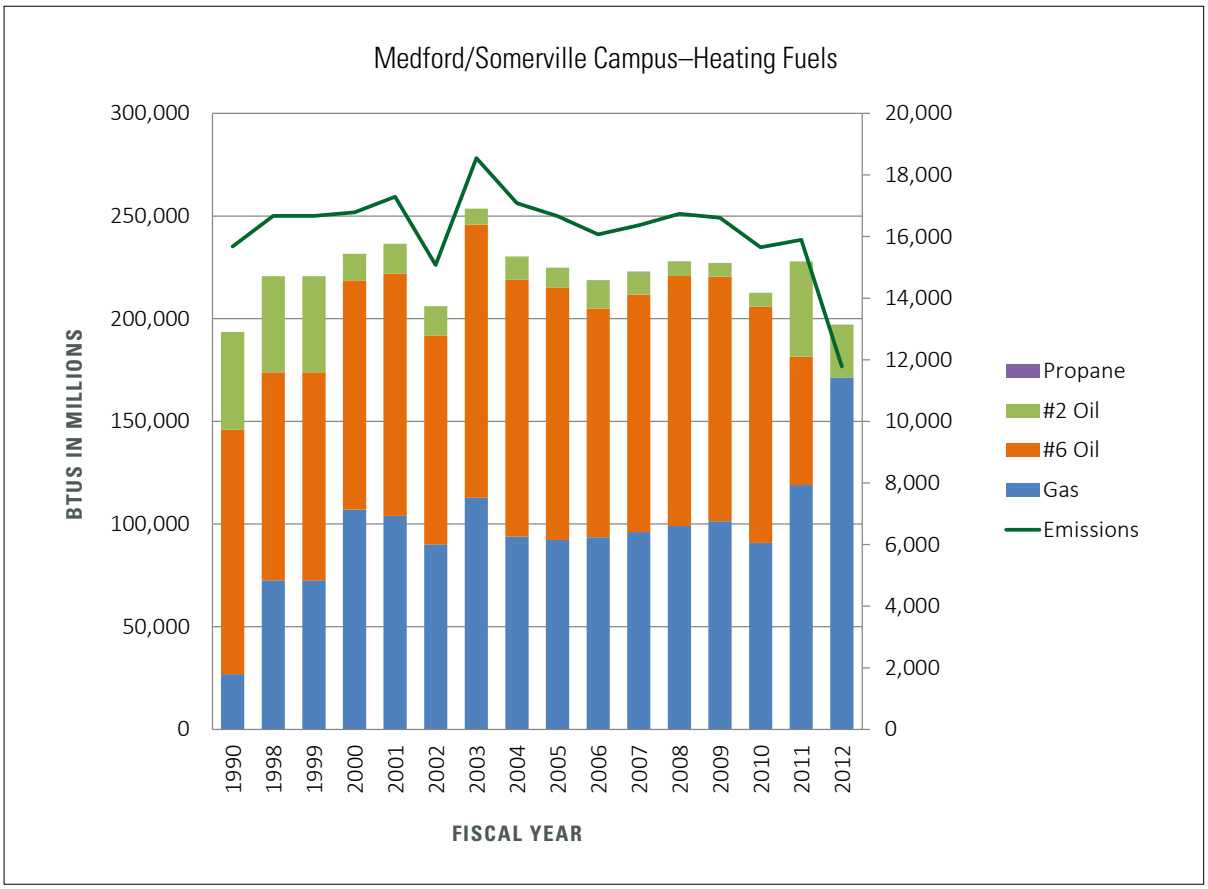

Figure 10. Medford/Somerville Campus Heating Fuel Use and Greenhouse Gas Emissions

[4] A British Thermal Unit (BTU) is the amount of heat energy needed to raise the temperature of one pound of water by one degree F. This is the standard measurement used to state the amount of energy that a fuel has as well as the amount of output of any heat-generating device.

No. 2 fuel use on the Grafton campus has been reduced over time as gas infrastructure was built out and boilers were converted or replaced (Figure 11). The most significant conversion took place in the spring of 2008 when the boiler plant serving the Hospital for Large Animals and the Foster Hospital for Small Animals was converted to natural gas with No. 2 fuel as a backup.

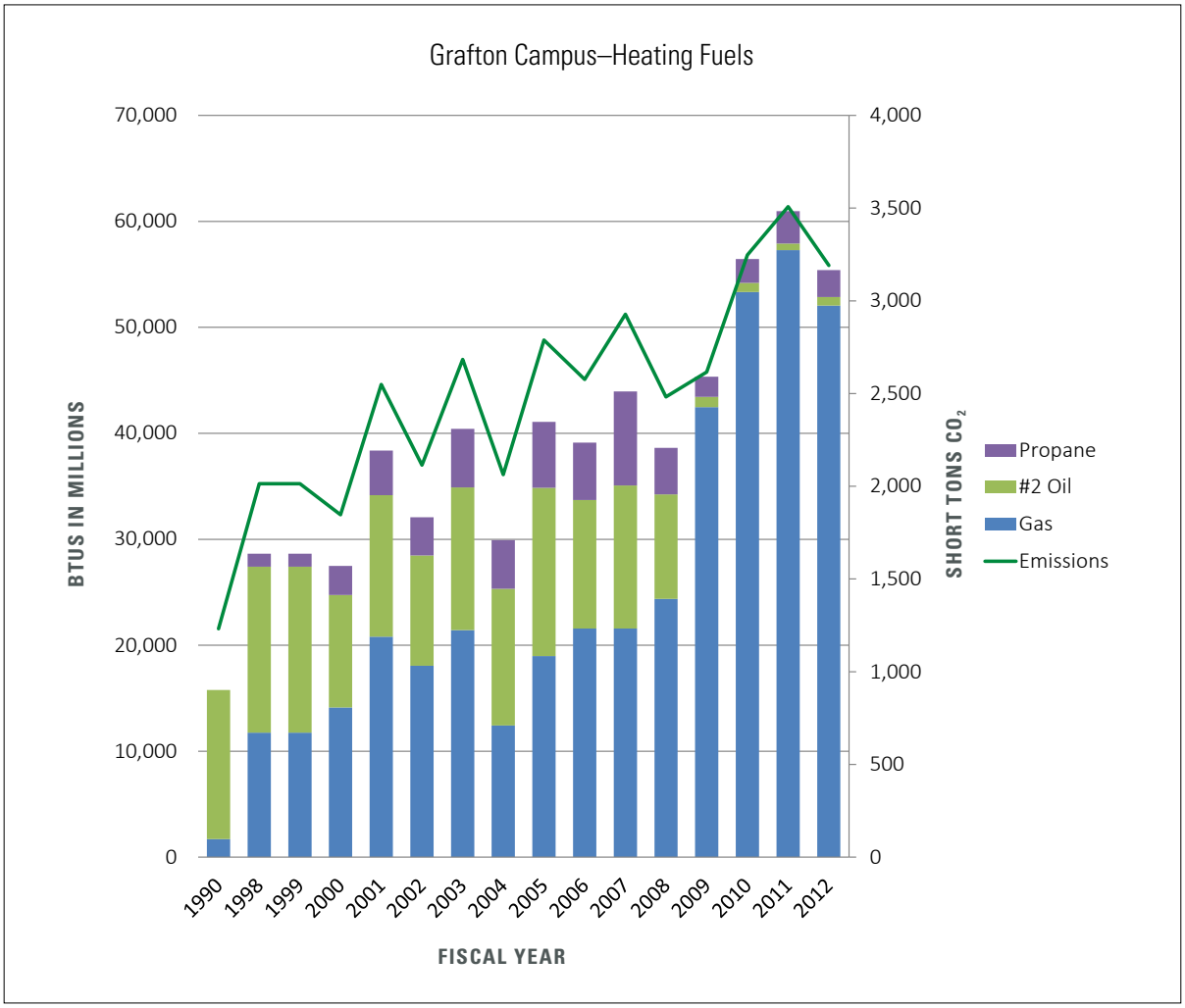

Figure 11. Grafton Campus Heating Fuel Use and Greenhouse Gas Emissions

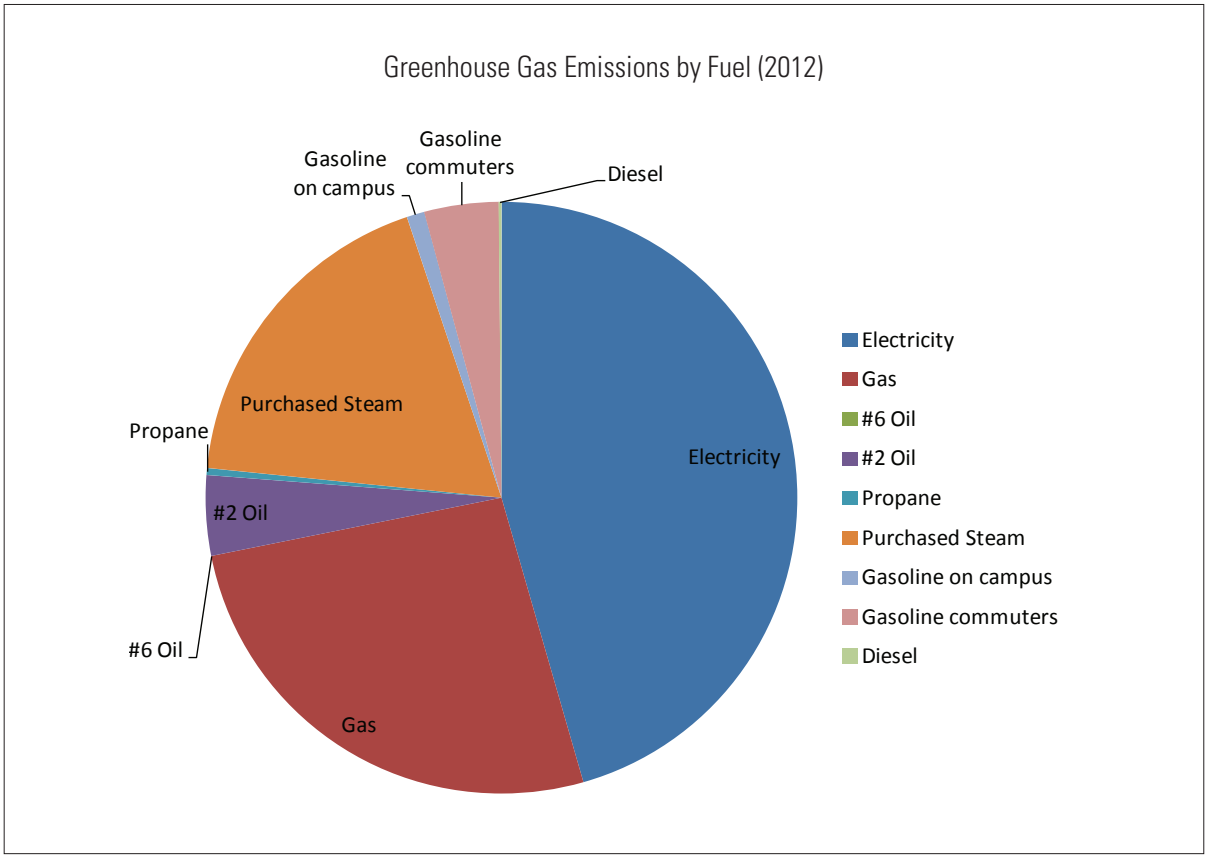

Figure 12. Tufts 2012 Greenhouse gas emissions by fuel in short tons of CO_2 equivalent.

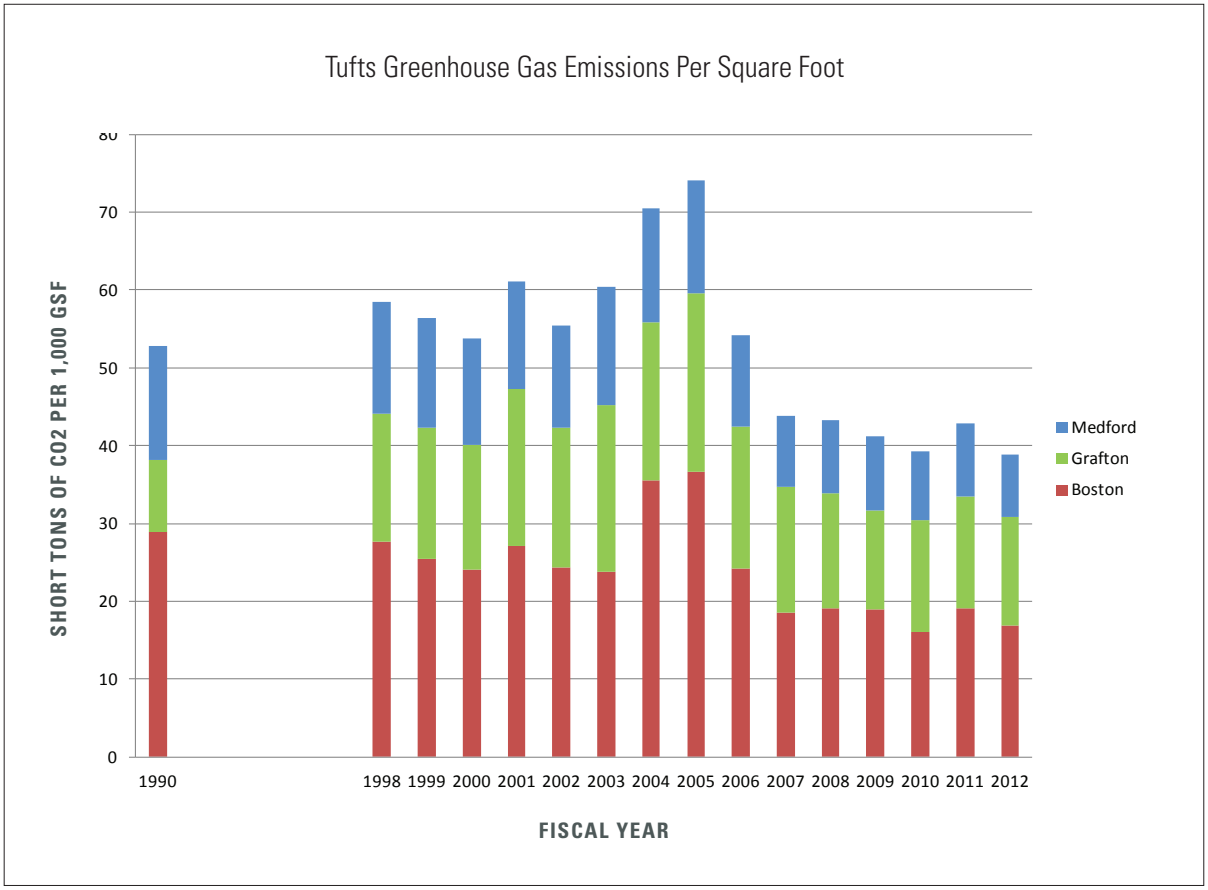

Figure 13. Tufts greenhouse gas emissions (short tons of CO_2) per 1,000 gross square feet (GSF).

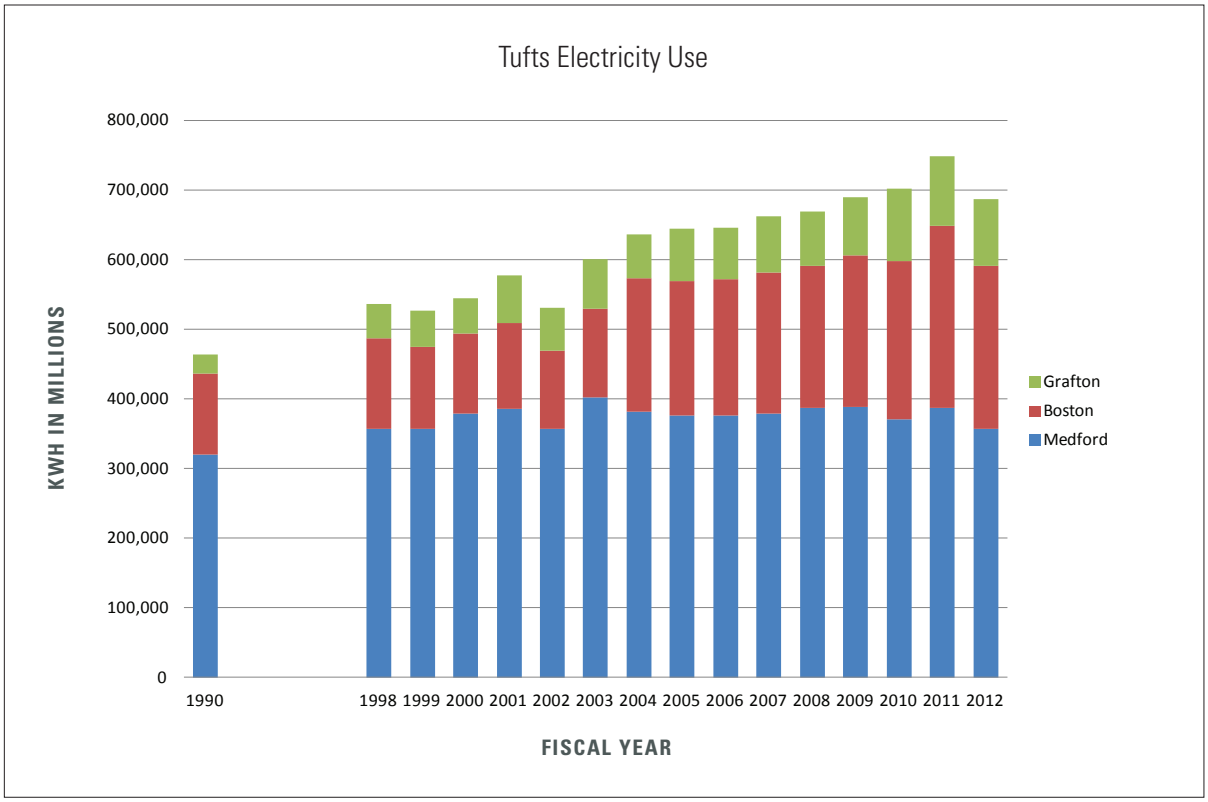

Figure 14. Tufts electricity use in million kilowatt hours (kWh).

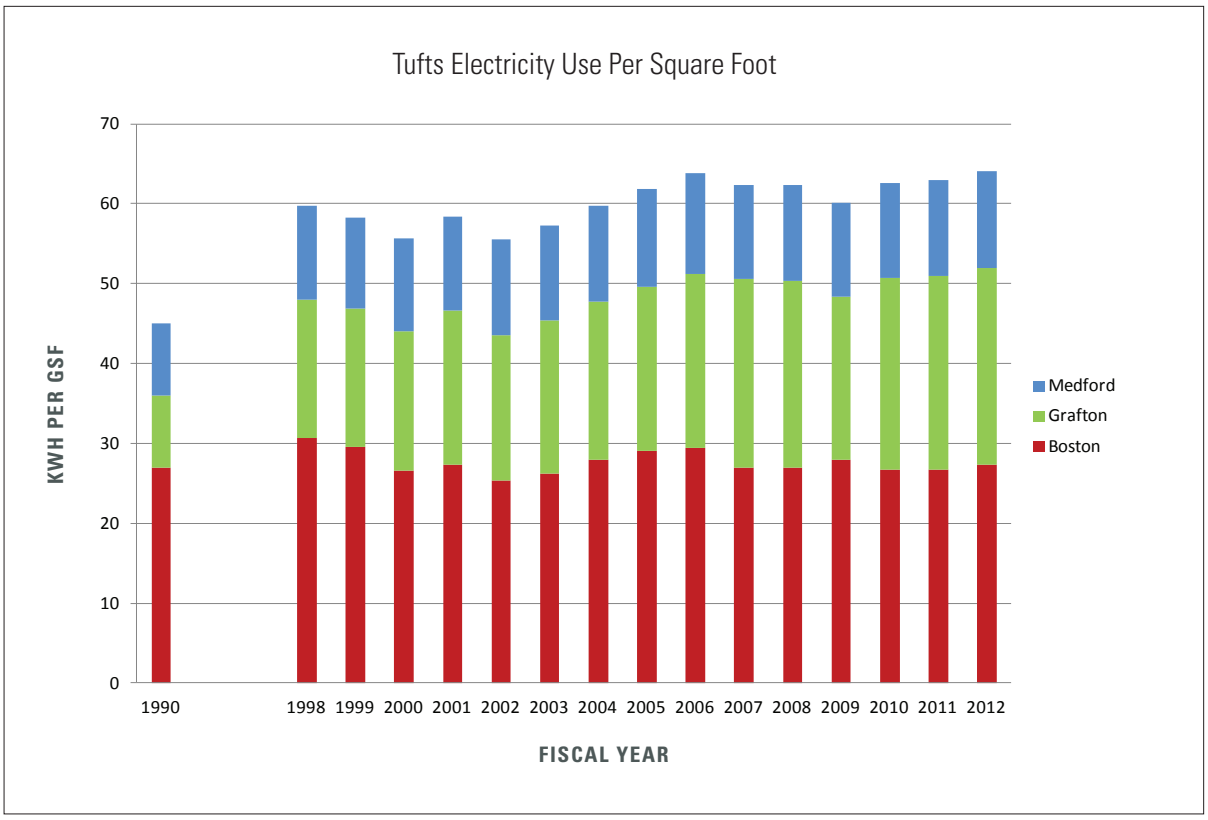

Figure 15. Tufts electricity use (kWh) per gross square foot (GSF).

As Tufts grows, so does the amount of space it uses (Figure 16). Tufts' building footprint has expanded and changed over time and is expected to expand into the future, making waste, water, and energy reductions especially challenging.

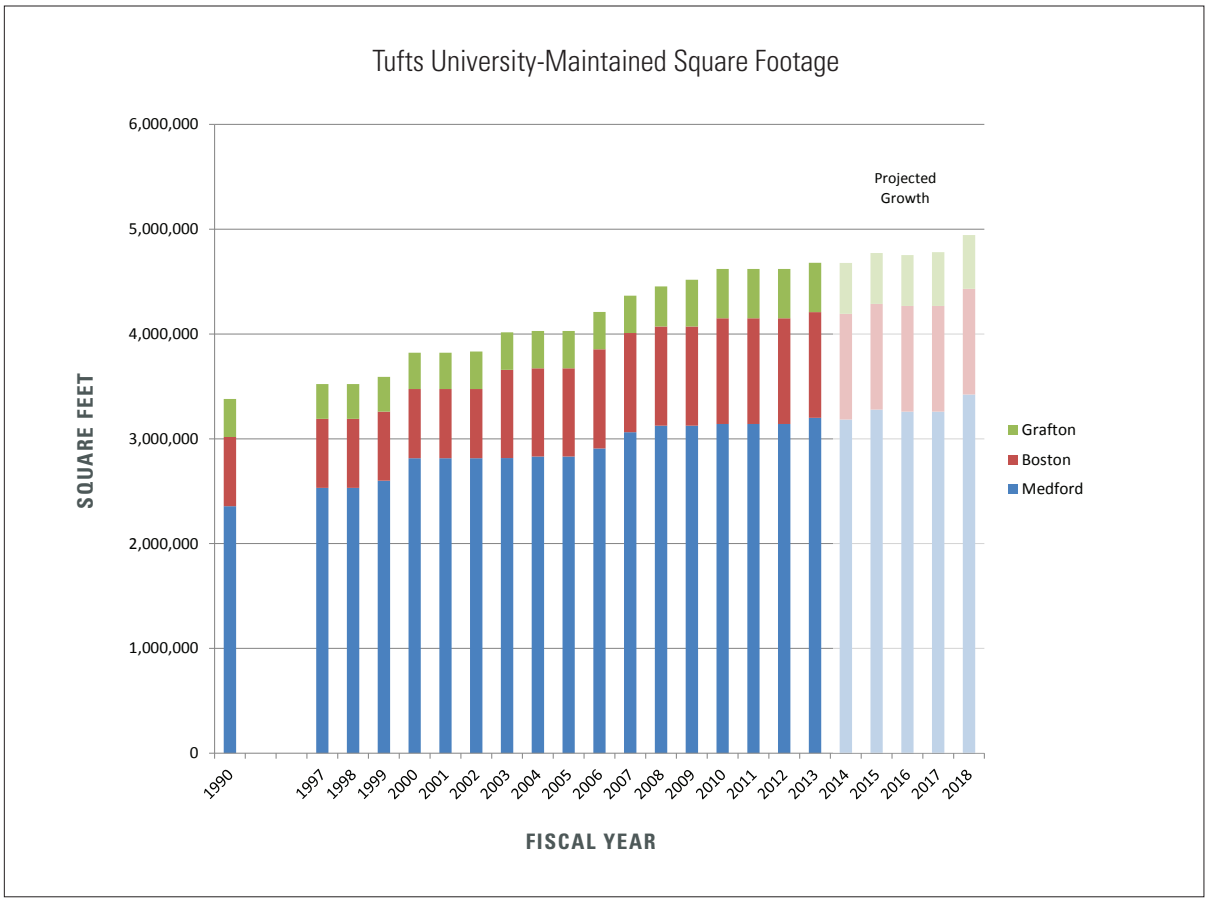

Figure 16. Tufts University-maintained square footage.

APPENDIX F: PROJECT MANAGEMENT TOOLKIT

The Energy and Emissions Working Group discussed many aspects of the design, construction, and operations process that could be improved by institutionalizing new protocols and tools. These tools and processes are captured in the Project Management Toolkit, outlined here. The aim of the Toolkit is to embed life-cycle costing and clear goal setting in the process and link design and construction more intentionally to operations and maintenance. The group felt strongly that the consistent implementation of these items across all projects would save money, improve the performance of the facilities, and safeguard occupant health and satisfaction. Additionally, the creation of a Lessons Learned process will ensure that design teams, staff, faculty, and building occupants have a chance to reflect and gather data to inform future projects.

1. Project Charter: The Project Charter is an existing tool used by Tufts that can be enhanced by including items relating to operations and maintenance (O&M) in order to better inform budgetary and planning considerations. Facilities staff should be engaged in this process to give feedback and ensure that planning and coordination is being optimized, including the use of swing space. The Project Charter is created at the inception of the project and is used internally by Tufts to get all parties on the same page about project needs.

2. OPR (Owners Project Requirements): The OPR is a new tool for Tufts. It is used to set project performance targets, understand occupancy patterns, and refer to specific third-party standards and other aspects of the project that should influence design decisions. The OPR may be integrated into the Project Charter or be a stand-alone document. The OPR is created prior to the issuance of a Request for Qualifications (RFQ) or Request for Proposals (RFP).

3. RFQ and RFP (Request for Qualifications and Request for Proposals): Tufts needs to create a standard set of documents that articulates its priorities and expectations related to project process and outcomes. Different documents need to be created for different types of services (e.g., architectural, commissioning, etc.). Tufts can build upon the best existing example and ensure that the same model is used consistently.

4. Design Team Selection Process: There are alternative design team selection processes that provide both the owner and teams with more valuable interactions and highlight the fit of the working relationship in addition to the skills and capabilities of the team. These processes are similar to "micro-charrettes," where the team spends an hour or so with the owner in a working session. For larger, more complex projects, Tufts may choose to implement this process.

5. Project Goal Setting and Project Management (PM) Checklist: The Project Goal Setting document contains detailed, specific parameters to be considered on every project and would help ensure quality control across all projects. The PM checklist provides guidance to ensure each project manager is asking the right questions at the right time and adhering to best practice protocols. This includes utility rebate program participation and commitment to third-party performance guidelines, such as LEED.

6. Integrative Design Process (IDP) and Project Management (PM): The standard design and construction process does not support highly integrated building systems, collaboration, or success in high-performance projects. Tufts will adopt standard protocols and a methodology for project management that is based on IDP (defined and outlined in the ANSI standard for IDP) and optimizes critical-path decision making to achieve optimum performance. This process methodology utilizes new tools to help manage quality control across projects, such as life-cycle costing templates and the Project Roadmap.

7. Project Roadmap: Early in the design process of a project, the team will work together to create a Project Roadmap that articulates specific performance metrics and outlines major points of analysis and critical-path decision making. This serves to clarify who is responsible for what action and how he or she will collaborate to achieve success. This ensures that life-cycle cost assessments and analysis verification happen in a timely manner with appropriate input. The roadmap also includes targets and deliverables related to simulations and analysis as well as LEED requirements, where applicable. This roadmap can be embedded in the master project schedule or be a stand-alone document. The roadmap aligns with the Owners Project Requirements. Decisions such as whether or not to use Building Information Modeling (BIM) or Integrated Project Delivery (IPD, a multi-prime contract for design and construction services) are made by this stage.

8. Building Systems Commissioning (Cx): The Building Systems Commissioning checklist ensures consistent quality and implementation of protocols by all Tufts facilities staff and outside vendors.

9. Post-Occupancy Evaluation (POE): Tufts will develop a checklist of items to evaluate in the post-occupancy phase and directions for engaging all appropriate stakeholders in the process. The POE should occur one year post-occupancy and take place in conjunction with the Lessons Learned debrief.

10. Lessons Learned: Lessons Learned includes both a checklist of items to review as well as data from the POE. The review includes cost, systems performance, occupant satisfaction, and other factors. Tracking of products used and system performance can be captured in a database that is maintained to inform future decisions. An internal "Angie's List" is proposed to track satisfaction of outside contractors and vendors and be referenced by project managers on future projects.

11. Building Curator and Annual Reporting: The building curator is proposed to be the point of connection to gather and disseminate comprehensive consumption patterns and occupancy behavior. This includes data related to energy use, emissions, water use and management, waste (including purchasing) and building occupant behavior regarding lighting and equipment uses. Existing tools, including Maximo, will provide data tracking. The building curator is the keeper of the building profile, knowing the history and eccentricities of a particular building so that when a change is proposed, he or she can provide any information that might influence planning decisions. After the Lessons Learned milestone, ongoing reporting and evaluation happens through the Sustainability Report and with the assistance of the building curator.

12. Preventative Maintenance Plan: Facilities staff will work with each school to develop a preventative maintenance plan and institute standard protocols for basic equipment upgrades.

APPENDIX G: HIGHLIGHTS OF SUSTAINABILITY AT TUFTS

Tufts University has a long and rich environmental history. Here are some highlights of environmental and sustainability milestones in the past half century.

1973 The M.A. degree is first offered through the new Department of Urban, Social, and Environmental Policy, founded by Professor Hermann Field.

1984 The Center for Environmental Management (CEM) is established with EPA funding. The Lincoln Filene Center begins the New England Environmental Network and launches the first of 18 annual New England Environmental Conferences.

1984 The undergraduate Environmental Studies Program begins as an optional second major, open to students majoring in any field in Arts & Sciences or Engineering.

1986 CEM receives a five-year grant from the EPA and supports more than 65 faculty members to conduct research projects, in addition to training, outreach, corporate involvement, and campus greening.

1990 Tufts receives EPA funding to initiate Tufts CLEAN! (Cooperation, Learning and Environmental Awareness Now!) to reduce or eliminate harmful environmental impacts of the university's own operations.

Tufts CLEAN! becomes a model for many other universities, with its achievements and challenges documented in Greening the Ivory Tower (1998, MIT Press) by Sarah Hammond Creighton, former director of the Tufts Office of Sustainability.

1990 Jean Mayer, Tufts president, convenes 22 university presidents and chancellors in Talloires, France, to discuss environmental sustainability. They sign the Talloires Declaration, a ten-point action plan for incorporating sustainability and environmental literacy into campus teaching, research, operations, and outreach. The declaration has since been signed by more than 433 university presidents and chancellors.

1990 The Center for International Environment and Resource Policy (CIERP) at The Fletcher School is established.

1991 Tufts Environmental Literacy Institute (TELI), a training course for faculty to learn how to incorporate environmental topics into courses in any discipline, receives the Presidential Environment and Conservation Challenge Award from the Council on Environmental Quality.

1993 The Global Development and Environment Institute (GDAE) is founded under the direction of Neva Goodwin and Professor William Moomaw to promote a better understanding of how societies can pursue their economic and community goals in an environmentally and socially sustainable manner.

1997 The Tufts Center for Conservation Medicine (TuftsCCM) pioneers the concept of conservation medicine as a new approach focusing on the health relationships at the interface of humans, animals, and the environment.

1998 Tufts Institute of the Environment (TIE) is established under the direction of Professor William Moomaw to coordinate and catalyze environmental research, learning, outreach, and service across all schools of Tufts University.

1999 Tufts pledges to meet or beat the Kyoto Protocol to the United Nations Framework Convention on Climate Change, setting the goal of reductions in greenhouse gas emissions from Tufts campuses to 7 percent below 1990 levels by the year 2012. The Tufts Climate Initiative, a grant-funded unit housed by TIE, is created to help the university meet these goals.

2000 Tufts President John DiBiaggio and Grace Perez, executive director of the Mystic River Watershed Association, join organizational forces to create the Mystic Watershed Collaborative to improve water quality, habitat, public access, and watershed awareness in the watershed where the main Tufts campus is situated.

2001 The first Eco-Reps program for residential students begins.

2003 Tufts joins the Chicago Climate Exchange. President Lawrence Bacow adopts the goals of the New England Governors and Eastern Canadian Premiers Climate Change Action Plan (10 percent reduction from 1990 levels of greenhouse gases produced by the university by 2020 with a 75 to 85 percent reduction from 2001 levels by 2050).

2004 The interdisciplinary Water: Systems, Science and Society (WSSS) graduate program begins.

2005 The US Environmental Protection Agency awards the prestigious Climate Protection Award to Tufts.

2006 Sophia Gordon Hall, Tufts' first LEED-certified building, opens and receives LEED Gold certification.

2006 The Tufts Climate Initiative becomes a department under Tufts Central Administration and is renamed the Tufts Office of Sustainability.

2008 The Eco-Ambassador program, which teaches staff and faculty how to enact changes in their office or departments to make them more sustainable, begins. Tufts Environmental Literacy Institute (TELI) restarts.

2008 Engineering for Sustainability is identified as one of the three strategic focus areas for the engineering school.

2009 Tufts is ranked ninth on *Sierra* magazine's list of Top Ten Greenest Schools.

2009 Tufts Dental School vertical expansion is LEED Silver-certified.

2010 Tufts is recognized by the Northeast Energy Efficiency Partnerships as a Business Leader for a five-year body of energy-conservation projects.

2010 Tufts dining goes "trayless" as a result of advocacy by students in the Ex-College's Environmental Action Class. Weekly on-campus farmer's market opens on Medford campus.

2010 Tufts' Engineering Professor Maria Flytzani-Stephanopoulos is named first Haber Professor of Sustainable Energy.

2011 Tufts Bikes, a student-run free bike-sharing program, is launched. "Hodgdon Goes Green" eliminates the sale of single-use beverages bottles and disposable bags at the Hodgdon-Good-To-Go eatery.

2011 Tufts earns a silver rating in the Sustainability Tracking, Assessment & Rating System™ (STARS), developed by the Association for the Advancement of Sustainability in Higher Education (AASHE).

2012 President Tony Monaco establishes the Campus Sustainability Council to look at the areas of water, waste, and energy and emissions.

2012 Tufts is named a Pinnacle Employer for Excellence in Commuter Options at the Massachusetts ECO Awards. Tufts Dental School Level 2 Renovation Project is LEED Gold certified.

2012 Tufts receives a Green Award from the City of Medford in recognition of its work in energy efficiency, water conservation, and resource conservation.

2012 Tufts is presented with the Silver Institution Recycling Award at MassRecycles' 17th Annual Recycling Awards Ceremony.

For more information about the environmental history of Tufts, see the Tufts Office of Sustainability website (http://sustainability.tufts.edu).

APPENDIX H:
TUFTS COMMITMENTS AND ENVIRONMENTAL POLICIES

Greenhouse Gas Emissions Goals

1. In 1999, Tufts University president John DiBiaggio committed Tufts to reducing its greenhouse gas emissions consistent with the goals of the Kyoto Protocol (7 percent below 1990 levels by 2012).

2. In 2003, Tufts President Lawrence Bacow renewed the university's dedication to climate protection by adopting the goals of the New England Governors and Eastern Canadian Premiers Climate Change Action Plan (NEG-ECP CCAP). The NEG-ECP CCAP calls for a return to 1990 greenhouse gas levels by 2010, and a further reduction of 10 percent versus 1990 levels by 2020. The region has also set a reduction target of 75 to 85 percent below 2001 levels by 2050. These goals represent a more significant decrease in emissions than called for in the Kyoto Protocol.

Environmental Policies

In 1990, Tufts President Jean Mayer presided over the creation of the Tufts Environmental Policy and the Talloires Declaration.

President Mayer convened a group of university presidents from around the world at Tufts' campus in Talloires, France, where they created and signed the Talloires Declaration, a ten-point action plan for incorporating sustainability and environmental literacy in teaching, research, operations, and outreach at colleges and universities. The declaration has since been signed by 433 institutions in more than 40 countries.

THE TALLOIRES DECLARATION

We, the presidents, rectors, and vice chancellors of universities from all regions of the world are deeply concerned about the unprecedented scale and speed of environmental pollution and degradation, and the depletion of natural resources.

Local, regional, and global air and water pollution; accumulation and distribution of toxic wastes; destruction and depletion of forests, soil, and water; depletion of the ozone layer; and emission of "greenhouse" gases threaten the survival of humans and thousands of other living species, the integrity of the earth and its biodiversity, the security of nations, and the heritage of future generations. These environmental changes are caused by inequitable and unsustainable production and consumption patterns that aggravate poverty in many regions of the world.

We believe that urgent actions are needed to address these fundamental problems and reverse the trends. Stabilization of human population, adoption of environmentally sound industrial and agricultural technologies, reforestation, and ecological restoration are crucial elements in creating an equitable and sustainable future for all humankind in harmony with nature.

Universities have a major role in the education, research, policy formation, and information exchange necessary to make these goals possible. Thus, university leaders must initiate and support mobilization of internal and external resources so that their institutions respond to this urgent challenge.

WE, THEREFORE, AGREE TO TAKE THE FOLLOWING ACTIONS:

1. Increase Awareness of Environmentally Sustainable Development
Use every opportunity to raise public, government, industry, foundation, and university awareness by openly addressing the urgent need to move toward an environmentally sustainable future.

2. Create an Institutional Culture of Sustainability
Encourage all universities to engage in education, research, policy formation, and information exchange on population, environment, and development to move toward global sustainability.

3. Educate for Environmentally Responsible Citizenship
Establish programs to produce expertise in environmental management, sustainable economic development, population, and related fields to ensure that all university graduates are environmentally literate and have the awareness and understanding to be ecologically responsible citizens.

4. Foster Environmental Literacy for All
Create programs to develop the capability of university faculty to teach environmental literacy to all undergraduate, graduate, and professional students.

5. Practice Institutional Ecology
Set an example of environmental responsibility by establishing institutional ecology policies and practices of resource conservation, recycling, waste reduction, and environmentally sound operations.

6. Involve All Stakeholders
Encourage involvement of government, foundations, and industry in supporting interdisciplinary research, education, policy formation, and information exchange in environmentally sustainable development. Expand work with community and nongovernmental organizations to assist in finding solutions to environmental problems.

7. Collaborate for Interdisciplinary Approaches
Convene university faculty and administrators with environmental practitioners to develop interdisciplinary approaches to curricula, research initiatives, operations, and outreach activities that support an environmentally sustainable future.

8. Enhance Capacity of Primary and Secondary Schools
Establish partnerships with primary and secondary schools to help develop the capacity for interdisciplinary teaching about population, environment, and sustainable development.

9. Broaden Service and Outreach Nationally and Internationally
Work with national and international organizations to promote a worldwide university effort toward a sustainable future.

10. Maintain the Movement
Establish a Secretariat and a steering committee to continue this momentum, and to inform and support each other's efforts in carrying out this declaration.

Creators and Original Signatories

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TUFTS ENVIRONMENTAL POLICY

We, the Tufts University community, affirm our belief that university faculty, staff, and students have a responsibility to take a leadership role in conducting activities as responsible stewards of the physical environment and using educational activities to promote environmental awareness, local action, and global thinking.

In our university functions, Tufts University will strive to:

- Conserve natural resources and support their sustainable use.
- Conduct affairs in a manner that safeguards the environmental health and safety of students, faculty, staff, and communities.
- Reduce the use of toxic substances and the generation of wastes, and promote strategies to reuse and recycle those wastes that cannot be avoided.
- Purchase renewable, reusable, recyclable, and recycled materials.
- Conduct our business practices in accordance with this policy.

In our education and research missions, Tufts University will strive to:

- Foster an understanding of and a responsibility for the physical environment.
- Ensure that individuals are knowledgeable about the environmental and health issues that affect their discipline.
- Encourage environmental research.
- Conduct research and teaching in an environmentally responsible way.
- Provide a forum for the open flow of information among governments, international organizations, industry, and academia to discuss and study environmental issues and their relationship to other social issues.

In our student and employee relations, Tufts University will strive to:

- Delineate individual responsibility.
- Guide action for ensuring safety and minimizing adverse environmental impacts in the implementation of this policy.

Tufts will consider full compliance with the law to be the minimally acceptable standard and will exercise whatever control is reasonable and necessary to avoid harm to public health and the environment, whether or not such control is required by regulations.

Tufts will initiate, promote, and conduct programs that fully implement this policy throughout the university and the global community.

APPENDIX I: GREENHOUSE GASES OVERVIEW

Gases that trap heat in the atmosphere are called greenhouse gases (GHG). For more information on the science of climate change and other climate forcers, such as black carbon, please visit the EPA Climate Change Science website at:

http://epa.gov/climatechange/science/index.html

The main types of GHG are:

Carbon dioxide (CO_2): Carbon dioxide enters the atmosphere through burning fossil fuels (coal, natural gas, and oil), solid waste, trees and wood products, and also as a result of certain chemical reactions (e.g., manufacture of cement). Carbon dioxide is removed from the atmosphere (or sequestered) when it is absorbed by plants as part of the biological carbon cycle.

Methane (CH_4): Methane is emitted during the production and transport of coal, natural gas, and oil. Methane emissions also result from livestock and other agricultural practices and by the decay of organic waste in municipal solid waste landfills.

Nitrous oxide (N_2O): Nitrous oxide is emitted during agricultural and industrial activities, as well as during combustion of fossil fuels and solid waste.

Fluorinated gases: Hydrofluorocarbons, perfluorocarbons, and sulfur hexafluoride are synthetic, powerful greenhouse gases that are emitted from a variety of industrial processes. Fluorinated gases are sometimes used as substitutes for stratospheric ozone-depleting substances (e.g., chlorofluorocarbons, hydrochlorofluorocarbons, and halons). These gases are typically emitted in smaller quantities, but because they are potent greenhouse gases, they are sometimes referred to as High Global Warming Potential gases (High GWP gases).

Note: All emissions estimates are from the Inventory of US Greenhouse Gas Emissions and Sinks: 1990–2010 (http://epa.gov/climatechange/ghgemissions/usinventoryreport.html).

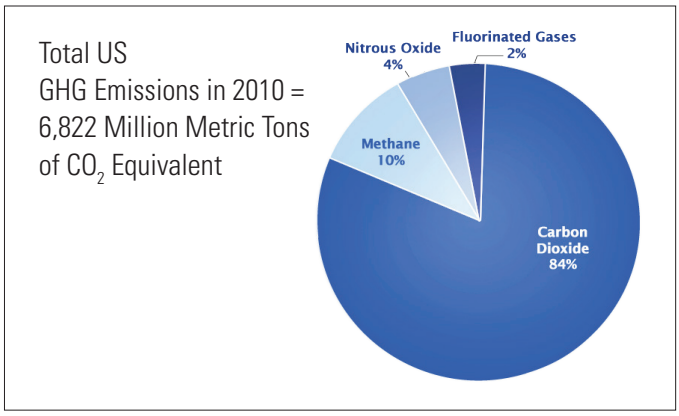

Figure 17. US Greenhouse Emissions in 2010

Source: EPA Greenhouse Gas Emissions (http://epa.gov/climatechange/ghgemissions/gases.html).

Tufts gets green

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