
Tufts Climate Initiative

5 Year Report

Reflecting on the Past, Looking to the Future

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Tufts Climate Initiative

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Executive Summary

Tufts University has made presidential-level commitments to reduce greenhouse gas emissions from the university's activities. Tufts Climate Initiative (TCI) is bridging the gap between theory and practice to reduce Tufts' emissions while educating university affiliates and community members on the importance of the climate change problem and the reality of the solutions.

Tufts and TCI have worked together for five years to take directed action to **protect the climate**. These actions include energy efficiency in new and existing buildings, renewable energy, fuel-switching, adoption of transportation technologies, and personal action initiatives. These efforts have helped to slow the growth of emissions on campus during a time period that has seen a large increase in the energy demand of the university. This progress is heartening but TCI remains cognizant of the work ahead. TCI is working closely with its partners to take practical steps that will deliver cost-efficient emissions reductions. At this point in TCI's history, TCI has developed a solid foundation of experience that is the basis for its work, today and into the future.

TCI works to **foster stewardship** and is known as an objective and common sense resource for all Tufts affiliates as well as other universities. TCI's partnerships with those who deal with the day-to-day operations of the university enables it to learn much from them while conveying its message of emissions reductions.

Alongside TCI's work to reduce the emissions of the university, it is engaged in outreach to the university community and beyond in an effort to **facilitate long-term change**. While it is important to reduce Tufts' own emissions, Tufts and TCI must also educate the future leaders of society on the importance of the climate change problem and its solutions. To do so, TCI works within the university community to engage students and help educate them on the climate change issue; it also work closely with numerous interns in an effort to strengthen its research capacity. TCI's work with the university staff is not limited to those who have a direct impact on operations; TCI also reaches out to other staff members in an effort to educate them about what they can do at work as well as at home.

TCI's position as a national leader on this issue, coupled with Tufts' leadership in environmental education and research, gives it a platform from which to bring its experience to others. In addition to its regional partnerships with non-governmental organizations and other universities, TCI staff members have published numerous reports and articles as well as given speeches to organizations throughout the country. TCI's national standing gives it credibility while at the same time raising the profile of the university.

Tufts Climate Initiative is dedicated to reversing Tufts' emissions and bringing them down to levels commensurate with the university's reduction goals. TCI's first five years have taught it much about the best ways to reach these goals, and TCI looks forward to the challenge of executing these reductions over the next five years. With an eye to past lessons learned, TCI and Tufts will continue to progress ever towards a truly sustainable university.

This report is divided into nine sections: Tufts' Commitments, TCI's Role, Partnerships, Buildings and Building Systems, Transportation, Research and Monitoring, On-Campus Actions, Off-Campus Actions, and Lessons Learned. You are invited to explore this report for a comprehensive review of TCI's work over the past five years.

Commitment

A History of Stewardship

Tufts has a long history of environmental stewardship spanning more than forty years and the Tufts Climate Initiative (TCI) is proud to carry on that legacy through its work to reduce Tufts' contribution to climate change.

Tufts was among the first to establish an environmental studies program, and subsequently received support from the Environmental Protection Agency (EPA) to launch a variety of programs, including a campus stewardship effort. In 1990, that effort served as a resource to emerging campus stewardship efforts nationwide. In addition, Tufts was the initiator of the Talloires Declaration, a statement by university presidents in support of environmental sustainability at the university level. This accord has been signed by more than 300 university presidents around the globe and commits the university to sustainability.

Commitment to the Kyoto Protocol

The focus of campus stewardship efforts at Tufts shifted when, in 1999, the university made a commitment to reduce greenhouse gases consistent with the Kyoto Protocol. What has emerged is a more strategic activity that has facilitated planning, accountability, and evaluating progress toward clear goals defined by total emissions reductions.

Tufts, through its agreement to meet the standards of the Kyoto Protocol, has committed to reduce emissions by at least 7% by 2012; at its current rate of growth, this translates into a 30% reduction in projected emissions. The university has great flexibility in how it reduces its emissions and therefore is working on various fronts to reduce emissions in the most feasible manner.

Tufts is Committed to New England

As part of its commitment to New England, Tufts is participating in a plan the New England Governors/Eastern Canadian Premiers instituted in August 2001 to reduce greenhouse gas emissions in this region. This commitment means that diverse organizations throughout the New England states and Eastern Canadian provinces will work together to jointly realize the reduction goals. When President Bacow reiterated his support for Tufts emission reductions, he specifically agreed to meet the goals of the NEG/ECP organization.

Chicago Climate Exchange

In addition to these commitments, Tufts is a founding member of the Chicago Climate Exchange. The Exchange is the first market-based effort to initiate multi-sector trading of carbon emissions. Tufts has joined the exchange, as its first university member, along with other organizations, both private and public, from 25 different industries. This commitment requires Tufts to reduce emissions by at least 1% per year from 2003 to 2006. Participation in this exchange gives Tufts and TCI the opportunity to explore market-based solutions to reducing greenhouse gas emissions.

TCI's Role at Tufts

Bridge: Ideas to Action

TCI plays the roles of initiator, researcher, advocate, and realist, among many others. TCI serves as the bridge between the academic side of the university, which represents the ideals and activism of students and faculty, and the operational side of the university which means dealing in the practical realities of operating a major research university day in and day out. TCI firmly believes in working closely with the people whose decisions can have the biggest impacts on greenhouse gas emissions; in most cases, this is the managers and staff of the Division of Operations. While students may desire immediate changes, the reality is that change within the university is often a slow-moving process.

TCI must constantly weigh taking actions that increase its visibility against taking actions that will have significant impact. While it may be admirable to put solar panels on dorms and houses, the reality is that steam traps and variable speed drives help reduce Tufts' energy usage by a much greater amount at a lower cost than what is produced by those solar panels. But the solar panels are visible, and show the "progress" the university is making, and TCI must continually balance the high profile actions against those with the largest gains.

TCI Strategy

The TCI experience has shown that successful applied action to reduce climate change impacts is distinct from other efforts within the university in that it requires significant investment, it cuts across academic and operational boundaries, and it requires personal and institutional change. TCI's mission is to create long-lasting change rather than superficial efforts that do little to reduce impacts on the planet. TCI has been successful by undertaking action in the following ways:

TCI's mission is to **create lasting change** rather than superficial action.

- Targeting projects that have resources already assigned (new buildings, renovations, etc.)
- Working within university processes to add value through funding, personnel, and expertise
- Conducting sound and credible research
- Building alliances at multiple levels in the organization
- Sharing lessons with wide audiences.

Information Source

TCI serves as an information clearinghouse for the university. TCI has the resources to answer questions and consult with other departments within the university. The TCI website (www.tufts.edu/tci) offers resources to the Tufts community as well as to those outside the university. If community members have more specific requests, TCI is able to handle those as well. In addition, the staff is able to find the correct person to answer questions if they are not able to answer the question themselves. TCI also provides information to students, faculty, and staff as well as many other universities. This is an area where TCI continues to build capacity.

Advocate

TCI plays the important role of advocating for climate change issues within the university. This advocacy takes many shapes and is continually evolving. The every day focus is advocating for increased efficiency in existing and new buildings. This means working closely with the Facilities and Construction departments as their work has a real impact on Tufts' emissions. However, TCI works with all divisions of the university to reduce emissions. For example, TCI staff may work with Purchasing to "green" the university's supplies or help Facilities find the most fuel efficient vehicles or offer workshops to undergraduates to enable them to reduce their impact. In addition to encouraging more funding for climate change work and research at Tufts, TCI also promotes increased awareness of these issues among members of the university community.

Staff and faculty associated with TCI act as advocates in university decisions that affect greenhouse gas emissions, and these decisions take place at many levels in the organization. This is part of TCI's commitment to create a sustainable mechanism within the university to continually consider these issues. For example, TCI worked with university facilities personnel, financial representatives, and the Vice President of Operations to free up funds to create an Energy Reserve Fund to pay for efficiency projects on campus and create a mechanism to repay the fund from operating budgets. This sort of advocacy will help create ongoing emissions reduction within the university.



Creating Change through Partnerships

TCI's five years of work at Tufts has demonstrated the importance of creating strong partnerships between TCI and its on- and off-campus partners in order to reduce emissions. These partnerships are at the core of TCI's work.

Funders

Tufts University and TCI are grateful for the important support and commitment of their funders. Most importantly, shortly after Tufts made the commitment to reduce greenhouse gases, TCI received support from the Henry P. Kendall Foundation to assist in implementing the commitment. Annual funds support a part time program manager and a part time assistant, graduate student researchers, and some faculty time during the summer. These funds also are used as a catalyst, for example, paying the incremental cost associated with more efficient equipment, subsidizing the purchase of some equipment, investing in additional monitoring equipment so that building-specific energy demands are better understood, and providing the resources and advocacy described in this report. TCI is also grateful for the support of the Rockefeller Brothers Fund. The Massachusetts Renewable Energy Trust has also pledged major financial support to the TCI-initiated green power elements of the Sophia Gordon Hall. Without this support, the green features of the building would go unfunded. The total amount promised to and/or received by TCI from these three external funders equals **\$986,000**.

Tufts Division of Operations: Making Efficiency Happen Every Day

TCI is demonstrating that climate protection can be implemented here and now, using off-the-shelf technologies, creative planning, and proven engineering strategies. To do this TCI links Tufts research and student education with the strong leadership and the actions of the Division of Operations. As a result of TCI's advocacy, Operations has established an Energy Reserve Fund that is used to finance efficiency projects on each of Tufts' three campuses. TCI works to support the ongoing funding of this Fund and strongly supports the Energy Manager and other members of the Division of Operations to implement a range of efficiency projects. In addition, TCI works to provide seed funding and access to relevant experts to make projects more far-reaching and comprehensive.

Tufts' Energy Manager is a crucial partner, able to respond quickly and with appropriate expertise. The Energy Manager provides important data, project support, guidance to students, and a liaison with Facilities staff. TCI works with the Energy Manager by funding specific projects such as outside consultants that can advise the university, specific energy-saving measures, or pilot tests of new equipment and techniques. This partnership is critical for meeting needs in a timely manner and with more creative solutions than might otherwise be undertaken.

Tufts Institute of the Environment

TCI is physically and administratively located at the Tufts Institute of the Environment (TIE). TCI receives important support from TIE. In the recent year, TIE core funding (from "hard" university dollars) has supported one day per week of TCI staff time, provided support for some travel, education initiatives, and events coordination. TCI staff serve as non-voting members of the TIE steering committee. This relationship also helps increase our visibility within the Tufts community.

Other On-Campus Partners

The cooperation of faculty, administrators, and staff throughout the university are important to underscore. TCI has worked with too many Tufts personnel to name individually, but it is critical to

recognize the depth of involvement of many people throughout the university. TCI has received support in the form of research from faculty members throughout the university. TCI has worked with the Purchasing department to “green” our campus procurement policies. The Grounds department has implemented work policies that reduce the university’s impact in this area. The Mail Service has been a close partner and currently uses a TCI-sponsored electric vehicle for mail delivery. The Public Safety department also utilizes an electric vehicle and has worked with TCI to complete vehicle research in the past. The university’s emissions reductions can be partly credited to the continual work of these diverse campus organizations.

Massachusetts Climate Action Network

TCI has been a partner of the Massachusetts Climate Action Network (MCAN) for the past four years. This partnership has included hosting their annual conference as well as a training workshop for climate change speakers. TCI also hosts the Cambridge Climate Action Calendar on its website. TCI’s partnership with MCAN provides high visibility for Tufts efforts with local climate change activists and provides the Network with examples of real action.

Support for Regional Efforts: Northeast Sustainable Energy Association

For two years, TCI worked with the Northeast Sustainable Energy Association to host their annual conference here at Tufts. This partnership involved considerable work and brought over 800 building professionals to the Tufts campus each year. Tufts was able to benefit by using university buildings as case studies for workshops and provide university staff, faculty, and students with easy access to the rich conference content. In addition, TCI’s prominence provided high visibility to Tufts’ work through welcoming speeches, campus tours, and participation in the conference sessions.

Zipcar Expands Tufts’ Transportation Options

Tufts has become a university partner with Zipcar to provide an alternative form of transportation for the Tufts community. As part of this program, Tufts is hosting a 2004 Toyota Prius and two 2002 Toyota RAV4 EVs. As part of the partnership with Zipcar, the application fee has been reduced to \$20 for Tufts affiliates. Zipcar estimates that each of its cars takes the equivalent of 7 to 10 other cars off the road, thereby reducing congestion and pollution. TCI has supported this program as a way to reduce the vehicle emissions that are caused by Tufts affiliates.



Toyota Electric Vehicles at Tufts

TCI has partnered with Toyota Motor Sales USA to bring RAV4 electric vehicles to Tufts. Tufts Public Safety is using one of the vehicles around campus for various public safety outreach functions. The university mail service also uses one of the vehicles to deliver mail on the Medford campus as well as driving back and forth to the Boston campus twice daily. The vehicles can go between 50 and 75 miles on one charge and are recharged overnight after being used during the day. As noted above, two of the RAV4 EVs are also being used as part of the Zipcar service on campus and are available to any Zipcar member. These vehicles significantly reduce CO₂ emissions thereby helping the university towards its reduction goals. Additionally, the novelty of the vehicles has created significance interest in them which has given TCI the opportunity to explain why CO₂ reductions are important and what other projects have been undertaken around campus to reduce emissions.

TCI and the New England Science Center Collaborative

One important new partnership is with the New England Science Center Collaborative. In this role TCI is participating as the coordinator and “expert” in their *Greening the Science Center* program¹. This program is designed to help four science centers throughout New England to make direct reductions of greenhouse gas emissions and to link climate change education with their exhibits. TCI staff conduct site visits and oversee the development of recommendations. Along with NESCC, TCI co-sponsored an event in January 2003 to educate the media on the issues surrounding climate change.

Community Partners

TCI has worked with numerous local and regional partners to sponsor events that have educated hundreds of Tufts affiliates, professionals, and community members on the issues surrounding climate change and what they can do about it.

Through Mass Energy, TCI works with the Green Power Aggregation study group to determine the needs of commercial energy users. TCI is also part of the Solar Boston Initiative, another initiative of Mass Energy; Solar Boston and TCI worked together to produce a feasibility study of solar hot water on the Grafton campus. TCI partnered with ICLEI – Local Governments for Sustainability to host their intern coordinator in TCI’s offices. TCI has also partnered with Clean Air Cool Planet (CACP). CACP is an organization that grew out of an event at Tufts in 1999. Tufts was Clean Air Cool Planet’s first university partner and TCI staff provide ongoing consultation to their staff. This program helps raise TCI and Tufts’ visibility.

TCI works closely with the two communities that host Tufts’ main campus. The cities of Somerville and Medford are active participants in the “Cities for Climate Protection” program. TCI works with each city to co-sponsor events, share ideas, test technology, and provide interns for their programs.

TCI has also partnered with the Green Roundtable. The Green Roundtable is a non-profit organization that is working to promote and support green building in Boston and TCI has assisted them as they work to introduce green building in this region. This partnership has provided Tufts with valuable information about green building and its applicability for the university.



¹ TCI’s participation is supported with a small grant.

Buildings and Building Systems

Reducing Greenhouse Gas Emissions: The Cornerstone of TCI Activities

Reducing carbon emissions from university operations continues to be the cornerstone of TCI's activities. TCI's approach to reducing carbon emissions is perhaps the most comprehensive approach at any university in the country because it is multifaceted and includes efforts to make new buildings highly efficient, undertake renovations that use efficient technologies in existing buildings, incorporate alternative fuels, and change personal behavior.

With diverse sources of greenhouse gas emissions, multiple solutions are necessary. This is where the combination of a clear commitment and a willingness to use the university as a learning laboratory are particularly compatible. Knowledge of the campus and data from the greenhouse gas inventory suggest that one straightforward strategy for meeting the environmental commitment is to convert the central heating plant to a combined cycle gas turbine to generate both heat and electricity. Although this approach has been followed at other universities, no such investment is under active consideration at the university. Because alternative approaches include combinations of improving efficiency through building renovations, it is essential for TCI to increase the use of renewable energy on campus, ensure that new construction is high performance, improve the fuel efficiency of the university fleet, and to develop strategies that change individual energy use behaviors. Highlights of past work include:

- *Create learning through doing:* TCI replaced 3,000 inefficient incandescent light bulbs with more efficient and long-lasting compact fluorescent bulbs in desk lamps, task lights, and chandeliers.
- *Create matching funds:* TCI and the Division of Operations partnered to purchase a Toyota Prius, an electric-hybrid vehicle, for campus use.
- *Cutting edge new buildings:* TCI spearheaded the “greening” of a “solar residence hall” and secured renewable energy funding in the amount of \$500,000 from the Massachusetts Technology Collaborative and \$167,000 from university funds.
- *Demonstrate innovative technology:* TCI installed over one hundred vending misers to reduce energy use from vending machines.
- *Demonstrate renewable technology:* TCI and the Facilities Department partnered with the Million Solar Roofs initiative to install a 500 watt photoelectric system on a campus house.
- *Electric Ox:* TCI worked with Operations and the Tufts Institute of the Environment to purchase an electric mower that will reduce emissions, as well as point-source and noise pollution.
- *Energy efficient renovations:* TCI worked with Facilities to renovate Schmalz House to include energy efficient upgrades, solar thermal hot water heating, lighting controls, and efficient appliances.
- *Fuel switching:* TCI worked with the Tufts Deferred Maintenance program to convert several small university properties from oil to gas in order to increase efficiency and decrease the emissions associated with oil.
- *Institutional structures:* A university-wide Energy Affairs Council, a joint effort between TCI, the Energy Manager, and the Director of Facilities, was established to address the connections between energy, environment, and energy cost within business decisions.
- *Institutional investment:* The Division of Operations made significant investment (\$700,000) in energy efficiency measures.

Efficiency Projects in the Division of Operations

The Tufts Division of Operations oversees and funds all new building projects on campus; additionally, this division is also responsible for all maintenance and renovations that occurs on the campuses as well as dining, vehicles, and washing machines. The division consists of the following departments: Facilities, Construction, Mail Services, Dining Services, and Public and Environmental Safety. The staff in each of these departments has vast experience in their particular areas. Therefore, it is essential that TCI works closely with the various Operations managers and staff in order to include the upgrades that are necessary to meet Tufts' reduction goals. Since its beginning, TCI has played an important role in advocating for improved energy efficiency, alternative fuels, and green building practices in Tufts' major renovations and new construction.

At times TCI has used externally raised funds to support a portion of the project, such as building commissioning that might not take place otherwise or pilot test technology such as solar hot water systems or vending misers. TCI also serves as an information clearinghouse that Operations can turn to when they need to learn more about their options for efficiency and emissions reductions. Considering this important support role, the climate change goals are useful to keep these departments focused on the importance of efficiency.

TCI now has nearly five years of experience in working to reduce the university's emissions. Based on this experience, TCI's opinion is that true reductions in emissions will happen only through the hard work and dedication of the Division of Operations and by continuing, and increasing, commitment from staff at all levels of the university. While it may be easy to consult on a new green building or to purchase more fuel efficient vehicles, it can be more difficult to incorporate changes in existing buildings or existing processes, or to work within limited budgets and competing demands. And, based on past experience, climate change action is most directly linked to the Division of Operations because it manages the day to day operations of the university. By working closely with them and continuing to build on current relationships, TCI can influence the actions of the university every day, not just on a few projects. Nonetheless, to reach the university's goals, TCI must continue to be a part of the planning process and the university must continue to invest in new technologies and processes.

The Division of Operations is the place where climate change action takes place; this is where the most significant CO₂ reductions can be achieved. This can be seen in this sample of projects that the division has spearheaded:

- *M&V Building Energy Project*: an \$18 million project that consolidated 80 HVAC systems into one and was paid for by the savings
- *4 Colby Street*: Retro-commissioning, which is the process of visiting an existing building to determine how to improve its operation, has been completed in partnership with the utility companies.
- *Building 20 at the School of Veterinary Medicine*: TCI secured partial funding for an energy study in this building.
- *Gifford House*: The President's residence is in the process of an energy assessment to improve comfort and reduce energy use.
- *Lighting in Machine Shop*: A major new installation of high-intensity energy-efficient lights was installed.
- *Occupancy sensors*: Occupancy sensors help control the building light levels throughout all three campuses.
- *Pearson Chemistry renovation*: Improved chiller, air handlers, and controls had a 2 year payback due to reduced energy costs.
- *Steam trap replacement*: \$60,000 pilot test for a \$500,000 project. This project has an estimated 5-year payback.

- *The Fletcher School*: Recent renovations have considered thermal comfort, efficiency, and energy delivery.
- *Vending Misers*: Tufts has installed more than 100 Vending Misers on campus vending machines. These devices utilize a motion detector to turn off the machines when no one is around which can save as much as 50% of the energy the machines use.
- *Washing machines*: Dining Services is modifying its contracts to lease energy efficient front loading washing machines for student use throughout the Medford campus which should lead to reduced electricity and water usage.

Climate Change Action in New Construction

Measures that reduce emissions and reduce the costs of operation and maintenance include a wide variety of energy reduction strategies, some of which can be achieved during building renovations, and some are most appropriately introduced in the planning stages for new buildings. The following list includes several examples of this strategy.

Wildlife Clinic

When a new Wildlife Clinic at the School of Veterinary Medicine was in the planning stages in 1999, the clinic's director invited TCI to assist in identifying opportunities for reduced impacts to the environment. Although TCI came to the table during the design phase and some concepts were judged "too late" to include, several of the ideas advanced by TCI and its consultants were incorporated. In all, the building is estimated to use approximately 50% less energy as a result of these changes; the university will also realize significant cost savings from this project. Many valuable lessons emerged from the Wildlife Clinic experience. It became clear that decision makers were unaccustomed to thinking of buildings as systems. In the absence of such a systems construct, it was difficult for some participants in the process to understand, for example, why decisions on windows had an impact on boiler sizing. The systems issues were magnified when decision makers wanted to compare costs of energy efficient measures with the conventional approaches. To have produced an entirely satisfactory cost comparison would have required designing the building twice, something that there was neither time nor money to do.

Energy Efficiency Upgrades for the Wildlife Clinic

- simplified roof design
- heat recovery
- variable air volume systems
- building commissioning
- front-loading washing machine

Sophia Gordon Hall

TCI's experience with the Wildlife Clinic helped to pave the way for a more comprehensive "green" residence hall, now in design. Using past experience, TCI has been able to participate in the process from the original building request into design. The building is expected to meet LEED Silver standards (a national green building standard). A 30 kilowatt photovoltaic system and a large-scale solar thermal hot water system are planned. TCI has been instrumental in spearheading the design effort to "green" the planned residence hall so that it will include these features as well as a high level of energy efficiency. Significant staff time is needed to oversee the implementation and administration of this project. Thanks to a successful TCI grant proposal, the Massachusetts Technology Collaborative has provided \$500,000 in funding to supplement an additional \$167,000 in Tufts funding; this funding supports the additional green elements of the building. This commitment to green building also gives Tufts a new feature to offer prospective donors. This project also serves as an opportunity for TCI to learn the most effective



Courtesy of Graham Gund Architects

methods for including green building on campus. This project shows Tufts' commitment to reduce the emissions in its new buildings.

Construction Standards

TCI is working with the Construction and Facilities departments, as well as the Energy Manager, to include high performance building standards in all Tufts building projects. It is much more cost-effective to include high performance, high-efficiency designs and equipment when a building is first built or during a major renovation than to attempt to retrofit an improperly designed building later. While the university has strict standards on the type of toilets or door locks a building can have, there are no standards for efficiency. By including these standards in all contracts, TCI can be sure that energy efficiency is built into all university projects from the beginning. Considering that university buildings typically have long life spans, this sort of investment will generate cost savings for the university for years to come.



Transportation

Some of TCI's most visible work has been in the area of reducing emissions from transportation. This work is important because the emissions generated by students and staff commuting to and from campus, combined with Tufts-operated vehicles, constitutes approximately 6% of Tufts' total emissions.

Electric and Hybrid Vehicles on Campus

In an effort to reduce the share of the university's emissions that are caused by transportation, TCI has worked to procure vehicles that produce little or no emissions. In April 2001, TCI brought the first electric-gas hybrid vehicle to the university's fleet. This silver colored, sporty-looking (it's decorated with TCI's logo!), and sometimes silent vehicle is being driven around the Medford campus by the Tufts superintendent of Buildings and Grounds, John Vik. This very efficient vehicle gets its best mileage in stop-and-go conditions, making it perfect for many on-campus fleet vehicle applications. The Prius has provided significant transportation emissions reductions for the university while also promoting the work of TCI – truly a win-win situation!



The university has also partnered with Toyota to use RAV4 electric vehicles to campus. These vehicles produce no emissions from the tailpipe and work great for a small area such as a college campus. Public Safety and Mail Services are using these vehicles

now. Additionally, Zipcar has placed one of the vehicles on the Medford campus and another on the Boston campus for use by faculty, staff, and students as well as the general public. The veterinary school, in Grafton, is using a GEM electric vehicle for maintenance and public relations functions. This vehicle has proven to be an excellent fit for working around the rural campus.

Alternative Fuels

TCI has looked at various alternative fuels for campus use. Biodiesel is a type of fuel that is made from natural, renewable plant stock and can be used in a standard diesel engine. It is typically blended with standard diesel fuel in a 20% biodiesel/80% diesel fuel blend call B20. Tufts completed a pilot test of biodiesel in campus diesel vehicles with excellent results. Facilities managers did not report any problems associated with the fuel during their tests. This fuel would help reduce the greenhouse gas emissions from Tufts vehicles, but considering the small amount of diesel fuel used at Tufts, the reductions would not be significant.

After a request from the police department, TCI explored using compressed natural gas (CNG) for the police fleet. While there were some emissions advantages to this fuel, TCI determined it did not help reduce greenhouse gas emissions because even minor natural gas leaks would offset CO₂ gains. TCI has also been a part of Boston Breathes Better, a region-wide consortium that, among other things, looked at alternative fuel usage in fleets throughout the Boston area. TCI continues to explore other emissions-lowering alternative fuel options for Tufts.

Research and Monitoring

Researching the applicability of new technologies and evaluating the implementation of past projects is important for assuring that TCI capitalizes on new opportunities and learns from its mistakes. Highlights of TCI's past work in this area include:

- Comprehensive greenhouse gas inventory
- Installation of meters in several locations
- Research about vending misers leading to subsequent installation
- Research about solar thermal and photovoltaic technologies

TCI conducts research for specific projects or initiatives about the availability of technology, its application at Tufts, reference checking on products or methods, etc. The goal is to have the research directly inform university action while providing educational opportunities for a variety of students. Much of TCI's research over the past five years has been conducted by student research assistants. This is a sample of the topics that students have researched:

- Alternative fuels
- Climate change action at other schools
- Co-generation
- Construction standards
- Electric lawn mowers
- Energy efficient washing machines
- Fume hood technologies and energy efficient lab design
- Green building technologies
- Heating and cooling policies
- Other greenhouse gases such as nitrous oxide
- Solar power and solar hot water (including research specifically for the new dorm)
- Vehicle research
- Vending misers
- Wind power

Some of this work will become the background work for funding proposals needed to fully support more comprehensive studies.

TCI also conducts research about potential relationships and concepts that could help us reach our reduction goals. For example, the TCI staff has spent considerable time looking into buying or selling carbon credits. As early as 2000, staff members were in detailed conversations with the Carbon Neutral Network about being a "sink" for its "carbon-neutral gasoline" product sponsored by Sunoco. After considerable time, TCI decided that it was not a worth-while relationship.

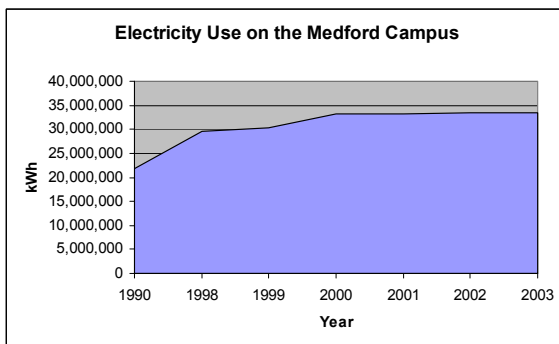
TCI staff worked with Solar Boston, a regional solar advocacy organization, to undertake an evaluation of a potential solar thermal system at the Large Animal Hospital on the Grafton campus. The evaluation included a site visit by solar design professionals. While this system was not completed, TCI is committed to bringing in outside specialists to supplement its staff's capacity when the need arises.

More recently TCI has discussed a carbon trading and carbon sink project with Mass Energy and with the Climate Trust as well as completing the necessary in-depth research and administrative tasks required to participate in the Chicago Climate Exchange.

Greenhouse Gas Inventory

Conducting an inventory of the university's emissions of greenhouse gases has been a critical first step in developing a strategy, examining alternatives, planning actions, and tracking progress. A greenhouse gas inventory is simply an accounting of the output of Tufts' activities. The inventory involves determining the amount and types of fuel used to heat and cool the campus and the type of fuel used to generate our electricity even though electrical generation is off campus. The inventory is a basic road map that allows TCI to be proactive rather than reactive. With the goal-oriented inventory in place, staff members can develop action plans for key elements.

TCI completed a greenhouse gas emissions inventory for Tufts University in January 2001 with yearly updates since then. From this preliminary inventory, notable observations include an overall increasing trend of energy use – especially electricity plug loads. These energy increases are not only on a university-wide basis, but also on a per student and per facility square foot basis indicating that the university is becoming more energy intensive. This inventory allows TCI to know precisely what university emissions are which is necessary if the university is going to reduce its emissions.



The Tufts inventory shows that electricity was a source of 43% of 1990 emissions and 46% of 2002 emissions, with additional increases projected. Electricity use has continued to increase at the same time that use of fuels to heat and cool buildings has decreased. However, because of TCI's actions, the increase on the Medford campus has been reduced as the graph shows. Coincidentally, the cost per unit of electricity has increased dramatically in the last two years, so that the university has a significant fiscal motivation for curbing electricity use that directly complements the environmental

commitment. The convergence of sustainability and fiscal imperatives helps increase the attention given to the issue.

Monitoring Results

Monitoring of existing demonstrations and efforts is critical. As Tufts enters the second or third heating season for many of these projects, TCI will begin to see some important results. The effect of the very warm winter of 2001-02 will also be considered. See Appendix A for more details.

Lessons from Other Universities

TCI conducts ongoing research into the experiences of other universities and their applicability here. TCI has examined university energy-related policies and the applicability of distributed generation projects, co-generation projects, an electric vehicle fleet, and internal funding mechanisms. TCI maintains an active informal relationship with similar initiatives at universities throughout the country.

On-Campus Actions

A major focus of TCI's efforts is outreach to the Tufts community, and beyond, about the realities of climate change, the lessons it has learned, and the actions needed to address this important problem.

Tufts Energy Affairs Council

In the spring of 2001 TCI worked with the Energy Manager and Director of Facilities to spearhead the formation of a high-level, university-wide Energy Affairs to give broad-based buy-in for energy issues and to look at university policies, expectations, and participation in energy efficiency efforts. The Council reports to the University's Administrative Council on a regular basis. The Administrative Council serves as the steering committee for the Energy Affairs Council.

The Energy Affairs Council was instrumental in creating the Energy Reserve Fund, a funding mechanism to advance money to energy projects with a five-year payback. The fund is replenished by charging the project cost back to the schools' operating budgets over the life of the savings. After the project's cost is paid back, the schools benefit from the ongoing savings.

Computer Energy Saving Initiative

TCI has worked with the Tufts Information Technology Service on technical and behavioral solutions to reducing the amount of energy that is used by computers at Tufts. Tufts, like other American universities, has seen an explosion of computer usage in the past decade. The university now owns more than 4,000 computers and university estimates have determined that there are at least 3,000 student-owned computers in use on the Medford campus alone.

TCI has taken two approaches to this usage. The first is technical and involves the power management features of modern computers as well as purchasing power-saving flat screen monitors for campus use. The second approach has been behavioral. This has meant overcoming lingering myths about computers as well as reminding users to turn off their monitor. TCI has produced a brochure that discusses this issue and what students and staff can do. This brochure, and a similar brochure about lighting, was distributed to every member of the Tufts community during Earth Day 2002. In addition, all new employees receive the information.



These two actions can help save the university a large amount of money as well as reduce the amount of emissions we produce.

Switch Your Bulb! Program



This program encourages Tufts community members to switch their inefficient incandescent light bulbs for high-efficiency compact florescent light bulbs. By reducing the number of incandescent bulbs on campus, TCI can reduce the amount of electricity and heat that is wasted by these electric heating devices (only 10% of the energy used by an incandescent bulb is used for light!). The compact florescent bulbs reduce the amount of energy used for lighting by as much as 80%. TCI offers these bulbs to students, faculty, and staff to replace the incandescent bulbs in their desk or floor lamps as well as to departments who want to switch the bulbs in their buildings.

This program has given away more than 3,000 bulbs since its inception. This effort has resulted in widespread use of compact florescent lamps; even the university president has compact florescent

lamps in his office. It should also be noted that Tufts has been a part of EPA's Green Lights Partnership since 1990 and the Facilities department is always working to upgrade the lighting on campus to be as efficient as possible.

Do it in the Dark!

TCI, along with the Environmental Consciousness Outreach (ECO) student environmental organization, initiated a program called *Do it in the Dark!* This event, which happens each fall, pits residence halls against one another in an effort to see which halls can reduce their energy use the most and prizes are awarded to the top residence hall. The contest is heavily promoted among students to let them know about the contest and steps they can take to reduce their energy use. The program has helped TCI learn about what it takes to get the attention of students when it comes to energy use. This program is a very visible exercise that helps raise environmental and energy use awareness on campus. This program has been replicated at other universities and colleges around the country.

Eco-Reps

The Eco-Reps are a group of undergraduate students that work to bring environmental awareness to their peers. The student members of the Eco-Reps program work together to increase environmental awareness in their residence halls. Student members are trained as environmental advocates and are paid a small stipend for their work. These students have monitored recycling in the dorms, posted informational signs to bring attention to different environmental issues, and helped increase green purchasing at Tufts. The Eco-Rep program is a great example of TCI's outreach work; in addition to the program on campus, Tufts' materials have been used by at least 3 other universities to start similar programs of their own. TCI's programs continue to be catalysts for change elsewhere.



Green Power at Tufts?



Students at a number of colleges and universities have organized themselves to purchase green power directly or as offsets for the institution's electric power. Several students are interested in exploring this here at Tufts. TCI is working with these students and the green power providers to host a comprehensive symposium in the Fall of 2004 to learn about green power, explore the reality of purchasing green power for all or part of Tufts' demand, quantify the benefits for the environment, and calculate the financial trade-offs and opportunity costs. TCI will continue to work with students following the symposium to evaluate green power options (e.g. student fees, off-sets, or other funding mechanisms). TCI also continues to explore the potential for Tufts to generate renewable energy from solar or wind and to reduce its emissions through a combined heat and power system.

Teaching Employees How to Take Action at Home

Last year, TCI piloted three seminars (one on each campus) for Tufts employees that detailed ways that they could save energy in their homes. The seminars were well received by those who attended. This year, TCI expects to expand these offerings and provide staff with access to additional support material and services. These seminars offer TCI an opportunity to get out the message that university employees can save themselves money at home while reducing emissions which is good for everyone.

Student Projects

Over two hundred fifty students have been involved in projects related to TCI's emission reduction commitment. Faculty in various departments throughout the university have sponsored projects. TCI has hosted numerous student projects since its inception. These projects give students the opportunity to gain practical knowledge in the areas of energy efficiency, renewable energy, and high performance buildings, among other topics. TCI has learned that creating student projects that meet academic objectives and provide high quality and timely information to decision makers can be extremely challenging.

Departments that have Hosted Research

- Political Science
 - Chemical Engineering
 - Civil and Environmental Engineering
 - Urban and Environmental Policy and Planning
 - Economics
 - International Environmental Policy
- (See Appendix B for a list of research topics)

Staff Training

TCI, in addition to working with students, has also worked closely with university staff to incorporate emissions-reducing methods into the everyday work of Tufts employees. Some of the work includes:

- Paid for consulting engineers on several projects including the new Wildlife Clinic to be sure the building met the highest efficiency standards possible.
- Held a half-day symposium for Tufts Facilities and Construction managers on high performance buildings.
- Held a half-day workshop on high performance buildings.
- Secured travel funds and the conference registration fee for several Facilities staff members to attend the NESEA conference in 2001, 2002, 2003, and 2004.
- Provide a breakfast seminar on construction standards for operations staff.

Combining Efforts with Other Departments

Here at Tufts, climate change has not been embraced to the exclusion of other issues, and in fact, TCI has found that many environmental issues can be incorporated in the climate change framework or benefit by association. One of the attractive features of using climate change as an organizing theme for campus sustainability efforts is the opportunity to develop, plan, and implement strategies that have long range strategic implications. In contrast to early campus stewardship efforts that tended to be opportunistic, maturing programs can benefit from the pedagogical and environmental advantages of programs that address systems issues, and are subjected to regular evaluation against clear goals.

A focus on climate change encourages faculty, students and administrators to consider the larger context at the same time that TCI poses a challenge: how can Tufts reduce its contribution to the problem? From a faculty perspective, the international scope and the long term intergenerational impacts predicted for climate change expand the range of issues that can be examined, while excluding few traditional concerns of campus environmental programs.

TCI's outreach coordinator's time (and salary) is shared with the Department of Facilities where she oversees campus recycling efforts. This partnership provides opportunities to offer linked recycling and energy-related messages to students, staff, and faculty. This partnership has continued for two years and has resulted in a close working relationship that provides benefits to both departments.

Courses

The following is a listing of the courses that have been taught by TCI affiliates.

- Elements of International Environmental Policy: Dr. William Moomaw
- Harvard Extension course: taught with Dr. Tim Wieskel
- Clean Energy Technologies and Policy Issues. Engineering course, taught by Prof. M. Flytzani-Stephanopoulos and Prof. W. Moomaw. This course also focuses on small group projects. Sample topics included: Applicability of Fuel Cells As Co-Generation Energy Plant at Tufts University, Boilers and Water Heaters in Tufts-Owned Wood Frame Houses
- "Media"-rology: TV, Policymaking, and Climate Change. Undergraduate course, taught at the Ex-College by Andrew Freedman, a Tufts senior. This course looked at both the meteorology of climate change, in particular, global warming, and the ways in which the media deal with it. Students considered how mass media influence public opinion and decision-making on global warming.

Lectures

TCI staff members have given lectures as part of classes in the following departments:

- Urban & Environmental Planning and Policy
- Economics
- Chemical Engineering
- Civil and Environmental Engineering
- Education for Public Inquiry and International Citizenship (EPICC)
- International Policy
- Political Science

These various outreach efforts demonstrate TCI's commitment to educating the Tufts community on the issues surrounding climate change as well as the solutions the community can help implement.

Off-campus Education and Outreach

Climate Change and Civil Society: Acting Now to Protect Our Future

Climate Change and Civil Society was held on the Tufts campus on April 24, 1999. This conference brought together more than 200 participants from all over New England. The day's events included discussions and talks from more than 20 experts in the area of climate change. The topics that were covered included political leadership, what colleges can do, and methodology for voluntary reduction of greenhouse gases, among others. This event led to the formation of the Clean Air Cool Planet organization. TCI was instrumental in the organization of the event. Climate Change and Civil Society demonstrates TCI's commitment to educating all members of our community on this pressing issue.

Reporting on Nature's Deadline

Held on January 13, 2001, Reporting on Nature's Deadline drew a diverse audience that included 143 representatives from media, government, NGOs, academia, and funding agencies. Nearly twenty panelists from academia and industry as well as national and international policy makers and analysts were invited to speak on how climate change affects politics and policy, the economy, human health, and social equity. A diverse group of presenters represented the many different views on this large and complex topic. The conference sessions examined the issue from political, economic, and social perspectives. This outreach event raised TCI's visibility and credibility with an important constituency.

The TCI Website

The TCI website (www.tufts.edu/tci) continues to be a major outreach vehicle, receiving approximately 1,500 hits per month. In addition, TCI staff respond to numerous email and phone inquiries regarding the TCI approach. Each month a number of these inquiries result in face-to-face meetings with representatives from other universities, government agencies, and the media. For example, several years ago WGBH staff met with TCI staff to discuss reducing their own environmental impacts and plans for a potential television series. In addition, TCI has received correspondence from people around the world who have questions about Tufts' efforts and have learned about TCI through the Internet.

Development of Targeted Materials

Building on the success of TCI's materials on greenhouse gas inventory techniques, vending misers, and computer power management, staff members have developed targeted written and web-based materials that can be used by many other colleges and universities. These materials include computer and lighting brochures, Eco-Reps Manual, material for building curators, heating and cooling policy material, energy committee information, and other materials of use to climate change advocates seeking to undertake similar initiatives on their campuses.

External Speaking and Articles

TCI speakers have been featured at numerous events at universities and non-profits around the country. Some of the universities and colleges TCI speakers have presented at include: Ball State, Boston College, Bowdoin, Harvard, MIT, Occidental College, Simmons College, University of Massachusetts, University of Vermont, Wellesley, Williams, and Yale. Additionally, TCI speakers have been featured at the New England Governors/Eastern Canadian Premiers and at the US Green Building Council of Connecticut.

TCI authors are regularly published. These publications include articles for newspapers, conference proceedings, and other sources. For a complete list of articles published by TCI authors, as well as those that specifically reference TCI, see Appendix B.

Advocacy

TCI spearheaded Tufts University President John DiBiaggio's May 2001 letter to President Bush concerning the Bush-Cheney energy plan. The letter was co-signed by 42 other college and university presidents, urging him to revise his energy policy to place greater emphasis on conservation and finding alternatives to fossil fuels. The letter received considerable publicity including coverage by the *Chronicle of Higher Education*, *U.S. Newswire*, and the *Associated Press*.

Publications

TCI affiliates have been published widely.

- *Book to be published by the MIT Press*: TCI project manager Sarah Hammond Creighton and faculty member Ann Rappaport have recently received a contract to write a book about university action in favor of climate change. While this grant will not fund the book writing project, the book will be a vehicle for spreading the lessons of TCI.
- *SCUP Special Edition on Sustainability*
- *White Paper – The Science of Climate Change*: In October 2001, TCI compiled an educational primer entitled "The Science of Climate Change." This document provides an introduction to the causes and impacts of climate change and provides readers with an opportunity to calculate their personal contribution to greenhouse gas emissions.

Press

TCI's efforts have received substantial media attention. TCI has been featured in the following publications:

- *Boston Globe*
- *The Chronicle of Higher Education*
- *The Medford Mercury*
- *Associated Press* coverage
- articles and editorials in *The Tufts Daily*

This continued outreach broadens the visibility of the university and defines TCI as a national leader on climate change issues at the university level.

Lessons Learned

The nature of the climate change goal makes it challenging to make progress.

Tufts' commitment to reduce net emission of greenhouse gas to the global environment is difficult when the university expands. This means that even when new very efficient buildings are constructed our net emissions still increase unless older less efficient buildings are demolished. The concept of a net reduction is challenging for a culture that has historically valued growth, and achieving a net reduction poses practical challenges. However, total emissions of greenhouse gases must be reduced if the climate problem is to be addressed.

Meeting the goal is possible, but requires commitment and resources.

The technology to meet the goal exists, but implementing this technology is challenging because of limited dollars and staff time. In order to meet the goals, there must be leadership from the university administration. This support must include support for excellence and innovation.

Energy issues must be linked to the university mission in order to receive the resources needed.

The university has very limited resources and energy issues must compete for those resources. Furthermore, energy action is viewed as a support function for the core university functions of teaching and research. Successful action will link energy with core university functions.

Energy analysis, energy efficiency, and adoption of new technology take staff time and expertise (of staff and outside experts).

These important issues compete with regular maintenance and crisis management (leaking roofs, etc.). Often, time is the resource that is short supply. Expertise is needed to do the needed analysis and design. Student researchers rarely have the expertise to fill in this gap.

Existing buildings and energy systems must be a major focus of any effort if the goal is to be met.

Issues mentioned above are more acute in existing buildings.

The work of university operations staff is essential to meeting the goal.

Recognition of this by any individual or group is critical. The people who build and run the buildings must believe in the climate change goals or no substantive change can occur.

Ideas from students can make a difference.

While students often are not around the university long enough to see real change created, a student coalition with a voice can arouse the attention of the university. This can create action where there was none previously. Unfortunately, most students look for sexy, quick fixes where none exist. TCI can also play an important role here as well by educating these activists on the possible.

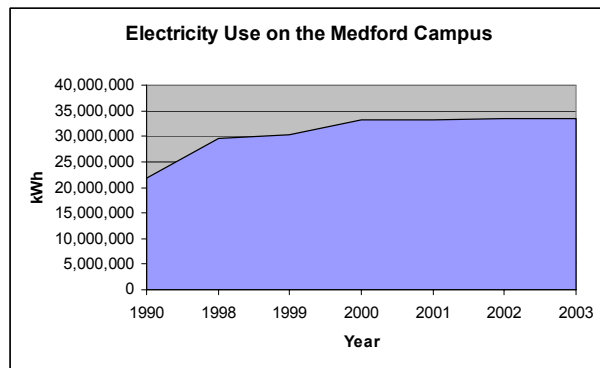
Appendix A

Tufts University Greenhouse Gas Emissions Summary – Updated July 1, 2004

Tufts' greenhouse gas emissions continue to climb. In 2003, Tufts total emissions were **20,375** metric tons carbon equivalent (MTCE). This is 10.8% higher than 2002's 18,382 MTCE. It must be noted that 2002 was the fifth-warmest winter on record. The difference can be attributed to increased heating demand in 2003.

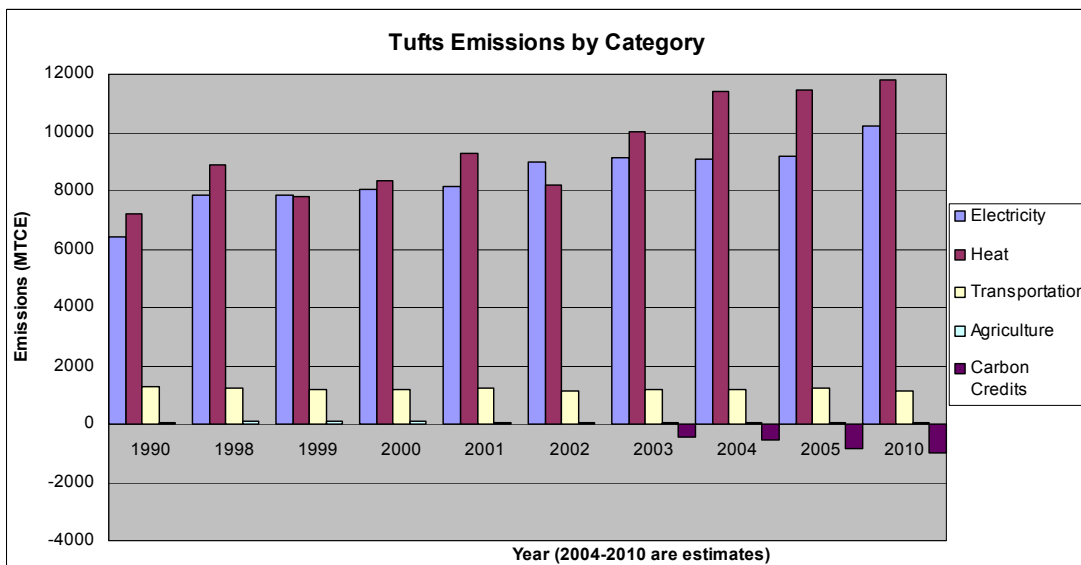
Electricity usage reached **57,625,776** kWh, slightly below 2001's record usage of 57,886,654 kWh. The use of #6 fuel oil (used to produce steam on the Medford campus) rose significantly to **888,491** gallons in 2003 from 679,646 gallons in 2002. This was the most fuel oil ever used on campus by nearly 100,000 gallons. It reflects the cold winter of 2003.

TCI has paid particular attention to reducing electricity usage on the Medford campus. While electricity use continues to increase slightly, the rate of growth has been slowed. Usage in Medford in 2003 was 33,414,807 kWh. This was less than 2002's 33,519,986 kWh and slightly above 2001's 33,130,164 kWh. The graph at the right shows how the growth rate has slowed over time. This reduced growth rate means that Tufts saved **\$146,347.05** on electricity on the Medford campus in 2003 when compared to our original projected growth rate.



While we are heartened to see this reduction in usage, Tufts has not yet begun to turn its usage back, especially in comparison to the stated reduction goals of 14,000 MTCE.

As we consider the direction TCI will take over the next five years of the organization, it is important to consider the graph below. While the years 2003, 2005, and 2010 are projected (and based on



previous performance, it is likely the actual emissions will be less than our projections), this graph clearly shows that TCI's focus must be on reducing heating-related emissions. This also makes sense because Tufts directly controls the emissions from the steam plant while the emissions created by Tufts' electricity usage are based on the utilities' fuel mix. Also, because the utilities' emissions factors change over time, this has an impact on our emissions that Tufts cannot control.

Another approach, embraced by some universities, is the purchase of carbon offsets. Tufts currently owns offsets that it received as a gift towards our commitments to the Chicago Climate Exchange from International Paper (these are represented by the negative values in the graph above). At the current price of emissions offsets, Tufts could meet its Kyoto goals with the purchase of approximately \$21,370 of credits each year at the current price of \$0.92 per ton of CO₂. However, this would not directly create any change on the Tufts campus.

We believe that Tufts can still reach its stated reduction goals. Tufts is currently recognized as a national leader in the area of climate mitigation. Our actions over the next five years will determine whether we maintain that position.



Appendix B

Student Research

- Climate change-related cost benefit analysis of choice at Tufts (seven group projects as part of undergraduate course in Environmental Economics)
- Two student projects in Environmental Communications developed targeted strategies for TCI
- One student group in Civil Engineering-81 designed a photovoltaic system for the proposed Wildlife Clinic
- A group of five graduate students examined energy efficiency measures (among other "green" building elements) that can be undertaken during the renovation of Massachusetts public schools
- Urban and Environmental Policy field project: Developing an outreach strategy for TCI
- Urban and Environmental Policy field project: High performance Building Technologies at the Lincoln Filenes Center
- Feasibility Study for a Co-generation Plant (undergraduate mechanical engineering group project)
- Feasibility Study for Solar Hot Water Application (undergraduate mechanical engineering independent study)
- Wind Farm Design Report (undergraduate civil and environmental engineering group project)
- Survey of Tufts undergraduates' knowledge of climate change (undergraduate political science survey design course project)
- Audit of a residential wood-frame house (undergraduate environment and technology group project)

Visiting Lecturers

- Amory Lovins, Rocky Mountain Institute
- Jaycie Chitwood Mason and Mary Nickerson, Advanced Technologies Group, Toyota
- David Orr, Professor of Environmental Studies, Oberlin College
- Doug Sacra, HMFH Architects
- Richard Sandor, President, Chicago Climate Exchange
- Steven Strong, President, Solar Design Associates

Major Events

- **Climate Change and Civil Society April 24, 1999**
- **Reporting on Earth's Deadline January 13, 2003**
- **Climate Speakers Training Workshop** - A day-long intensive training in writing and speaking publicly about global climate change was held at Tufts on Saturday, October 7, 2000. TCI and the Massachusetts Climate Action Network (MCAN) co-sponsored the event.
- **Northeast Sustainable Energy Association Annual Conferences** – 2001 & 2002, at Tufts University in Medford, MA, co-sponsored with the Northeast Sustainable Energy Association (NESEA).

Various Articles

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