

**SUSTAINABLE ACTION PLAN:
ROADMAP TOWARDS CARBON NEUTRALITY**

NORTHEASTERN UNIVERSITY



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INTRODUCTION

In 2007, Northeastern University (NU) President Joseph Aoun made the following statement about Environmental Sustainability at NU:

“Environmental sustainability is an issue of local, national, and global significance. The consequences of inaction would be shared by all humanity. Therefore, all individuals and institutions share responsibility for taking action to create a sustainable environment. The leadership of Northeastern University is fully committed to this effort.

Over the last several years this university has taken steps to address environmental sustainability and become a "greener" institution. These include usage of low flow water fixtures and compact fluorescent bulbs, and recycling of asphalt and other construction materials. We have been aggressive with energy conservation measures by cutting our consumption of oil, gas and electricity. We burn primarily natural gas in the central heating plant. We provide campus-wide recycling programs for paper and plastics. These important steps provide a foundation upon which we will build.

Going forward, we will accelerate the greening of all of our facilities in Boston and elsewhere. I have made it a top priority for our university to assess our options and define assertive and responsible actions to speed our progress towards environmentally friendly policies, systems and facilities. Sustainability will factor into our all of our decisions and plans for new services, building designs, and product choices. I appeal to all faculty, staff, and students to take their own individual steps towards making Northeastern an exemplar in sustainability.

Institutions across the nation are recognizing the urgency of this issue. Although each will address it in its own way, it is important to demonstrate that we are united in a common effort. To that end, I have decided to sign the American College and University Presidents Climate Commitment [ACUPCC], pledging Northeastern University’s commitment to environmental sustainability. Given our pioneering efforts in this domain, it is appropriate that Northeastern should be a founding member of this movement.”

<http://www.northeastern.edu/president/messages/041207.html>

EXECUTIVE SUMMARY

As part of its 2007 signatory commitment to the American College and University Presidents Climate Commitment (ACUPCC), NU adopted two new policies that are being implemented:

- a green building policy that states all building renovations greater than 50,000 square feet (sf) and all new buildings are to be certifiable at or comparable to the Silver level under the U.S. Green Building Council (USGBC) Leadership in Energy and Environmental Design (LEED®) rating system; when renovations to existing buildings occur they must include a full assessment of the project’s environmental impact; and
- a purchasing policy that requires all products that are purchased by Northeastern University and for which the U. S. EPA ENERGY STAR® is available, shall be ENERGY STAR® qualified when practical.

In September 2008, Northeastern submitted a Greenhouse Gas (GHG) Emissions Inventory. Since then, additional GHG inventories have been developed going back to 1990.

Curriculum, research, and education, continues to be developed to further integrate sustainability into programming and research area targets. Community outreach now includes representation on the City of Boston's Climate Action Leadership Committee that is charting Boston's collective response to climate change.

The next step in the ACUPCC process is development of a Climate Action Plan that would reduce the University's greenhouse gas emissions and eventually lead it to carbon neutrality. The following list outlines the University's short-term mitigation strategies with a goal of 20% reduction in metric tons of Carbon Dioxide equivalent (CO₂e)/sf of financially controlled space by 2015 (when using 2005 as a baseline), and long-term mitigation strategies that will lead Northeastern towards carbon neutrality).

Short-Term CO₂e Mitigation Strategies

A list of action items have been identified to achieve the short-term goal of a 20% reduction per gross square foot (gsf) in CO₂e output by 2015 using 2005 as our baseline. The items range from educational outreach to mechanical system upgrades. A general listing of proposed action items follows:

- Green Building – Continue to incorporate green building practices into renovations and new construction.
- Educational Outreach and Awareness – Educate the community on energy conservation and sustainable practices on campus .
- Building Recommissioning – Advanced recommissioning of existing buildings will ensure that mechanical equipment is operating correctly and existing spaces are adequately controlled.
- Heat/Cooling Recovery – Where applicable, to recover waste heat and cooling energy from the building's exhaust air stream and preheat and cool incoming supply air
- Lighting Controls – Survey the existing lighting controls to ensure correct operation and add occupancy and/or daylight sensing technology where non-existent or where appropriate.
- PC Load Management – Use technology to allow computers to enter a low energy state after a period of non-use.
- Energy Efficient Motors – Survey existing electric motor inventory and, where appropriate, replace existing with premium efficiency models.
- Variable Frequency Drives - Survey existing electric motor inventory not currently on variable frequency drive control and install controls if practicle.
- Fuel Switching – Continue to convert primary combustion equipment and purchase lower emitting fuels in lieu of oil.
- Demand Control Ventilation – Maximize energy efficiency by matching building occupancy levels with outside air supply volumes.
- Energy Efficient Equipment – Continue to specify high efficiency equipment when equipment is replaced or added (i.e. chillers, boilers, and air handlers).

- Future Technologies – Continue to investigate future technologies and implement when economically practical.

Long-Term CO₂e Mitigation Strategies Towards Northeastern University's (NU) Carbon Neutrality Goal

- Upgrades to Energy Management System
- Window replacements, building envelope and insulation upgrades
- Convert existing steam radiation systems to hot water
- Take advantage of new and emerging technologies
- Renewable energy procurement
- Re-investigate on-site Renewable Energy and Combined Heat/Power (CHP) where appropriate and cost effective
- Renewable Energy Credits (RECs)
- Green Offsets
- Other future financial investment instruments to offset the University's Carbon footprint

GREENHOUSE GAS INVENTORY

Organization and Geographic Boundary of the NU GHG Inventory

Northeastern University, founded in 1898, is a private research University located in the heart of Boston and a leader in interdisciplinary research, urban engagement, and the integration of classroom learning with real-world experience. Northeastern offers a comprehensive range of undergraduate and graduate programs leading to degrees through the doctorate in six undergraduate colleges, eight graduate schools and two part-time divisions. Northeastern has a student enrollment of approximately 22,944 FTE as well as over 4,200 employees.

The main campus and additional satellite campuses managed by Facilities Division represent 5,857,000 gross square feet of buildings that are under the university's financial control. An additional 478,000 gross square feet of mixed use space has recently been constructed and opened in September 2009.

For this inventory, the boundaries of emissions reported are for those facilities that are under financial control by the facilities department. Financial control is defined in the **Climate Registry – General Reporting Protocol V1.1** by the following:

*“An entity has **financial control** over an operation if the entity has the ability to direct the financial policies of the operation with an interest in gaining economic benefits from its activities”.*

The desired economic benefits would include reduced energy consumption and lower emissions resulting in lower operating cost and reduction in the carbon footprint for the university.

Greenhouse Gases Reported

Greenhouse gases to be reported include all six internationally-recognized gases regulated under the Kyoto Protocol. These gases include: carbon dioxide (CO₂), methane (CH₄), nitrous oxide (N₂O), hydroflourocarbons (HFCs), perflourocabons (PFCs) and sulfur hexafluoride (SF₆). For the purpose of this inventory PFCs and SF₆ are excluded since these types of emissions are not likely to originate on the Northeastern University campus.

Methodology

The University has adopted “best practices” accounting principles as defined by The Climate Registry’s General Reporting Protocol, version 1.1. These principles are the same as those published by the World Resource Institute (WRI)/ World Business Council for Sustainable Development (WBCSD) *GHG Protocol Corporate Accounting Standard*. This standard encourages: relevance, completeness, consistency, transparency and accuracy. In addition, the University has followed existing GHG programs and protocols documented by the Registry from the International Organization for Standardization (ISO) 14064-1, The California Climate Action Registry, and the U.S. Environmental Protection Agency.

Scope 1 and Scope 2 emissions will be reported. A data source that is below 5% of the total campus emissions will be estimated based on the original estimated value until such time that the ratio of the emissions source exceeds 5% of the campus total. Scope 3 emissions will not be included at this time because the data that is obtained even through best practices is of very low quality, is completely unverifiable and the emissions could potentially be reported by a separate entity. Secondly, Scope 3 commuter emissions are not under the financial control organizational boundaries of the university as defined by the Climate Registry – General Reporting Protocol V1.1.

TABLE 1: MTCE BY ENERGY SOURCE

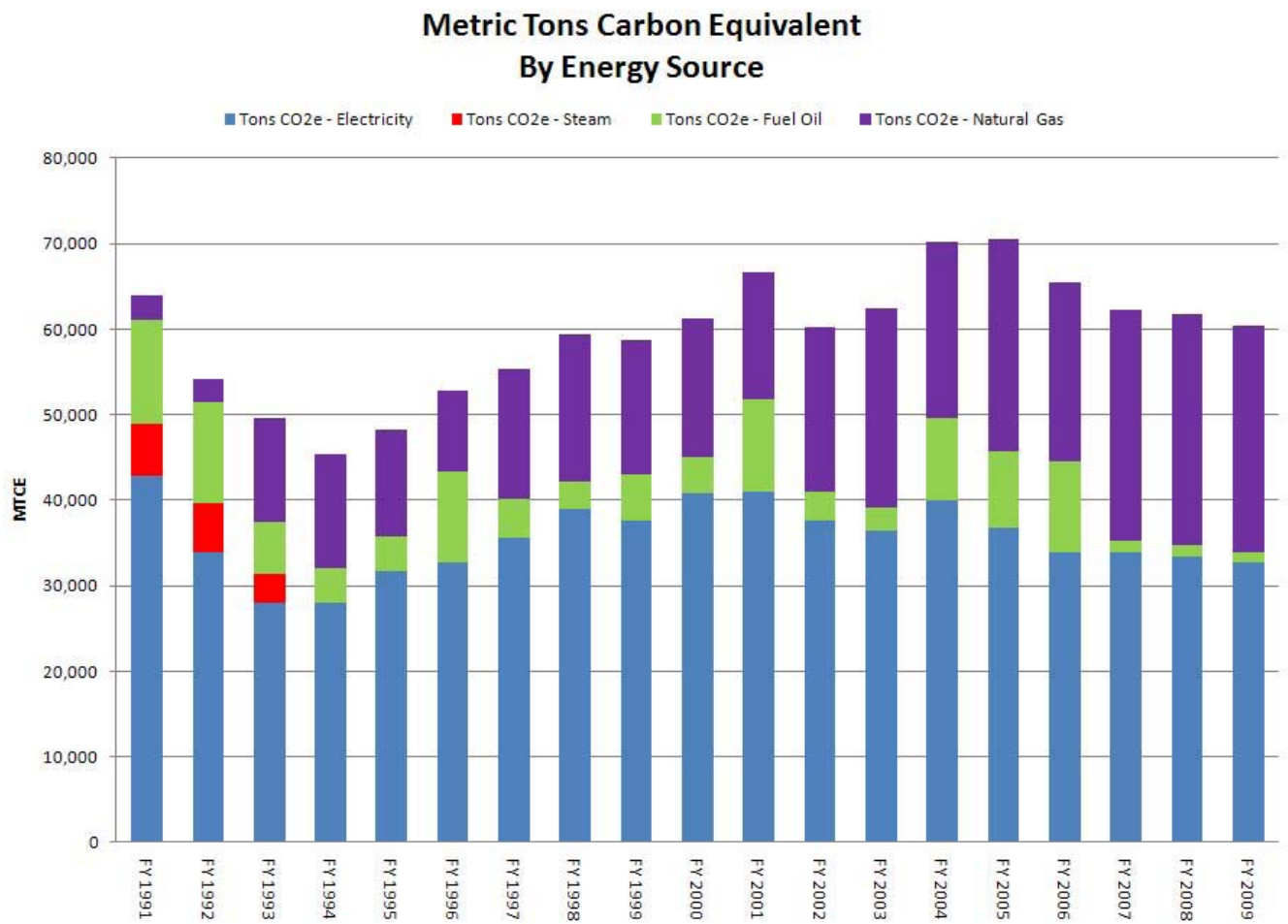
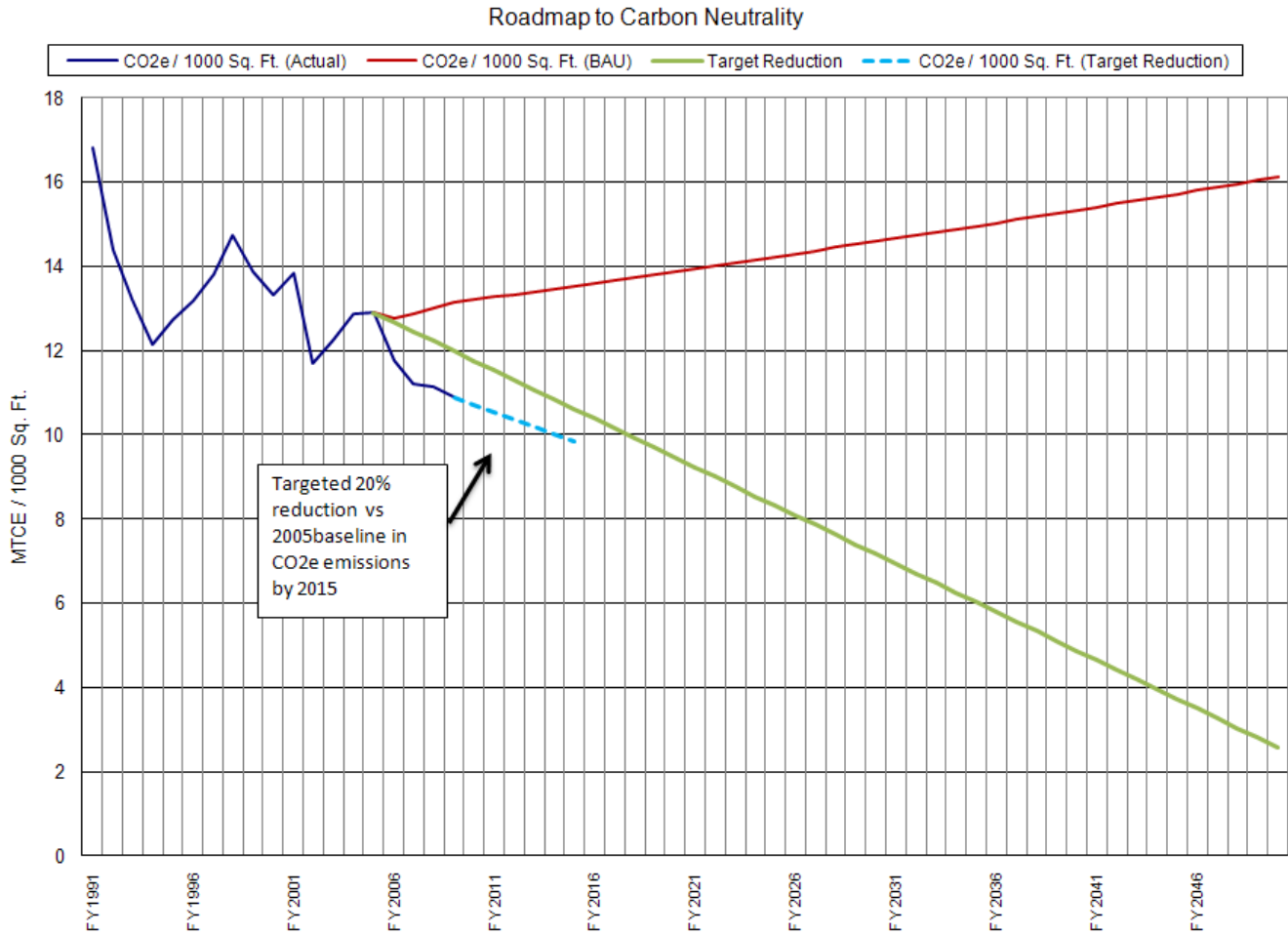


TABLE 2: RESULTS, TRENDS AND PROJECTIONS



Carbon and Climate Change

Northeastern University completed its first greenhouse gas emissions (GHG) inventory in September 2008. The total annual Scope 1 and Scope 2 GHG emissions (in metric tons of Carbon Dioxide equivalent, or CO₂e) for each fiscal year are as follows:

- 2009: 62,082.8
- 2008: 63,455.7
- 2007: 63,972.3
- 2006: 67,561.5
- 2005: 72,563.7

Scope 3 emissions were not included in the GHG emissions inventory because Scope 3 emissions may be reported by more than one reporter. Consequently, the Carbon Registry – General Reporting Protocol V1.1 advises “Scope 3 emissions should never be summed across Reporters or mixed with Scope 1 and Scope 2 emissions. The Registry does not add Scope 3 emissions together or mix Scope 3 with Scope 1 or 2 emissions.”

Using 2005 as a baseline year, Northeastern has pledged to GHG emissions reduction of 80% by 2050.

GHG emissions figures on a per-thousand-square-foot basis for the past three years are as follows, with *Per-Thousand-Square-Foot Emissions = Total CO₂e in metric tons / Total maintained building space in thousands of square feet*:

2009: 10.60
 2008: 10.83
 2007: 10.92
 2006: 11.54
 2005: 12.66

TABLE 3: 2005-2009 GHG EMISSIONS BY EMISSION SOURCE (MTCE)

| Emission Type | Emission Source | MTCE (2005) | MTCE (2006) | MTCE (2007) | MTCE (2008) | MTCE (2009) |
|---------------|--|-----------------|-----------------|-----------------|-----------------|-----------------|
| Scope 1 | Natural Gas | 24,833.5 | 21,015.8 | 27,099.5 | 27,100.7 | 26,566.3 |
| Scope 1 | #2 Fuel Oil | 9,412.3 | 10,996.3 | 1,350.7 | 1,260.6 | 1,223.1 |
| Scope 1 | Vehicle Fleet* | 608.9 | 608.9 | 608.9 | 608.9 | 608.9 |
| Scope 1 | Emergency Generators* | 50.6 | 50.6 | 50.6 | 50.6 | 50.6 |
| Scope 1 | HFC Emissions (Fugitive)* | 959.9 | 959.9 | 959.9 | 959.9 | 959.9 |
| Scope 2 | Electricity | 36,698.6 | 33,930.0 | 33,902.6 | 33,475.0 | 32,674.0 |
| Scope 3 | Business Air Travel* | 1,709.5 | 1,709.5 | 1,709.5 | 1,709.5 | 1,709.5 |
| Scope 3 | Business Automobile Travel* | 29.9 | 29.9 | 29.9 | 29.9 | 29.9 |
| | Total Scope 1 & 2 Emissions** | 72,563.7 | 67,561.5 | 63,972.3 | 63,455.7 | 62,082.8 |

*Values were calculated for 2008 footprint and found to be de minimis. The 2008 values were calculated using upper-bound simplified methods and are carried through subsequent years to provide a complete estimation of the emissions attributed to the operation of the university. The values will be recalculated periodically as emission sources change.

**Scope 3 emissions were not included in total GHG emissions inventory because Scope 3 emissions may be reported by more than one reporter. Consequently, the Carbon Registry – General Reporting Protocol V1.1 advises “Scope 3 emissions should never be summed across Reporters or mixed with Scope 1 and Scope 2 emissions. The Registry does not add Scope 3 emissions together or mix Scope 3 with Scope 1 or 2 emissions.”

TABLE 4: 2005-2009 GHG EMISSIONS BY MTCE/FTE AND SF

| Year | Full Time Equivalent (FTE) | MTCE / FTE | Campus Square Feet (SF) | MTCE /1000 SF |
|---------|----------------------------|------------|-------------------------|---------------|
| FY 2005 | 20,426 | 3.55 | 4,861,725 | 14.9 |
| FY 2006 | 20,780 | 3.25 | 5,060,769 | 13.35 |
| FY 2007 | 21,284 | 3.01 | 5,429,418 | 11.78 |
| FY 2008 | 22,880 | 2.77 | 5,363,940 | 11.83 |
| FY 2009 | 22,944 | 2.71 | 5,709,139 | 10.87 |

Other calculations include GHG emissions figures on a per-full-time-student basis for the past three years, where *Per-Student Emissions = Total CO₂e in metric tons / Total number of full-time enrolled students.*

2009: 2.71
2008: 2.77
2007: 3.01
2006: 3.25
2005: 3.55

Energy Conservation and Efficiency – What we have done so far

The University has a history of establishing programs and using new technology in existing buildings to improve energy efficiency. Since the late 1980s, the University has used energy efficiency as an important metric when specifying new equipment and when replacing existing equipment. The facilities staff are educated, trained, and certified in a number of energy saving, carbon reduction, technological, and sustainability disciplines including:

Certified Energy Auditors;
Certified Energy Managers;
Certified Energy Procurement Professionals;
Certified Sustainable Development Professionals;
Certified Carbon Reduction Managers;
Certified Building Commission Professionals; and
LEED accredited professionals.

For more than two decades, NU has been very aggressive in its efforts to encourage energy conservation and reduction. The conservation program uses a variety of programs and initiatives such as several major campus-wide energy efficiency retrofits, a “no idling” campaign for those using fleet vehicles, periodic email reminders to conserve energy, close windows, and shut off unnecessary plug-load equipment during unoccupied periods, and advancing curriculum changes that address sustainability and energy issues. In addition, Northeastern’s Recycling Program, now in its 21st year is a highly successful program augments our conservation actions on campus. NU’s student groups, such as the Husky Energy Action Team (HEAT), have also been pro-active with campaigns and contribute a number of creative initiatives designed to help reduce energy consumption campus-wide. In addition to media campaigns, newspaper articles, and public forums addressing these issues, publicity around dorm competitions and HEAT’s Trash to Treasure program during 2009 move-out have used education, awareness, and action to highlight the issues and engage the campus community in action.

In new construction and major renovation projects, Northeastern ensures that design and equipment specifications maintain high levels of efficiency and promote technological developments that are sustainable. Some examples include sustainable site selection and development, water efficiency, refrigerant management, optimized energy performance, recycling and waste management, use of regional materials, indoor air quality and thermal comfort, and innovation in design. New building systems are highly efficient and use comprehensive monitoring and control strategies to ensure system efficiency performance and to minimize impact on the environment.

To supplement its efforts, in 2008 the University contracted a reputable energy services company with extensive experience in implementing energy efficient improvements, to conduct a facilities-wide energy audit. The audit’s Executive Summary stated that the “University’s current energy infrastructure condition revealed far fewer opportunities than we had expected to identify considering the age and size of the campus. This is a direct result of the facilities staff’s efforts to manage energy consumption and maximize the use of technological improvements as they become available”.

Technology has always been carefully studied and on many occasions, the university has led the way by being the first installation of a new technology. The willingness to spend the time to become educated on new technologies and then find proper site applications on campus has paid dividends for many years. The university led the way with installations of Variable Frequency Drives (VFDs) in the late 1980s. Northeastern was also the first American installation to utilize digitally controlled micro-modulating combustion systems at its central heating plant.

More recently, between November 2008 and January 2009, a campus-wide installation of 70,000 low wattage T-8 fluorescent lamps was completed. Today, VFD control of chillers is offered as an option on many packages, and digital combustion controls are helping many boiler plants run more efficiently and reduce emissions and the re-lamping project has spawned a nationwide case study.

There will be many more improvements in the near future as lighting technology continues to advance. The effort to eliminate the last few halogen lamps on campus is attainable thanks to recent advancements in Light Emitting Diode (LED) technology. The university continues to use halogen lamps for specialty illumination such as art, retail and dining service applications because fluorescent lighting does not allow the colors to be properly rendered, and the Ultraviolet (UV) rays that they emit would degrade artwork. The new LED lamps available in the near future will address the problems with better color rendition and significant reductions in UV rays. Advancements in LED technology also offer the opportunities for outside lighting to switch from High Pressure Sodium, Metal Halide, and induction lighting systems to LEDs when cost effective.

The effort to increase efficiency and reduce energy use and carbon emissions will be an ongoing future challenge but cannot be accomplished without investment in new technologies.

1. University policy is to specify ENERGY STAR® appliances wherever possible. All laundry machines on campus have earned the ENERGY STAR®, use approximately 40% less energy than a standard washing machine, and save an estimated 250,000 gallons of heated water annually. In 2007, 284 residential dishwashing machines were replaced with ENERGY STAR® qualified models. In addition, all 117 cold beverage vending machines on campus are ENERGY STAR® qualified and are equipped with VendingMiser® Technology. Also, all new copiers and desktop computers are ENERGY STAR® qualified.
2. Variable Frequency Drives (VFDs) have been installed throughout campus. A VFD is able to save energy by reducing the speed of a fan or pump to match the workload that is required at varying conditions.
3. High efficiency electric motors have been installed throughout campus during VFD installations, replacement of failed motors, retro-fit programs and all new construction on campus.
4. The central heating plant (CHP) on campus supplies steam to approximately 80% of the total main campus area. The six boilers at the CHP are equipped with micro-modulating burners and a digital control system to continually adjust operating parameters and maximize system efficiency. These boilers provide steam for thermal and domestic heating loads for research, process heating and for steam absorption (air conditioning).
5. Lighting controls are installed wherever applicable on campus and exist on campus in several locations:
 - Motion control sensors have been installed campus-wide in offices, classrooms, conference rooms, study rooms, and instructional labs, etc.
 - Outdoor lighting is controlled by both time clocks and photosensors.
 - In the past two years, a concerted effort has been made to control unnecessary lighting in public spaces. Currently, hallway lighting in academic areas is controlled by the energy management system (EMS). EMS control of public lighting ensures both public safety by scheduling lighting off during unoccupied times and reduces energy consumption. Plans are in place to expand EMS lighting control to public dormitory spaces (hallways) and outdoor lighting.
6. All fluorescent lamp exit signs on campus have been replaced with LED fixtures.
7. HVAC technologies are utilized in many areas on campus. Highlights from the past two years include:

- Matthews Arena uses one chiller system to keep the ice surface frozen and also condition the air in the building as needed during the hockey season and during campus events during the off-season. An engineering firm was hired to model proposed energy efficiency upgrades to study the effect of several upgrade strategies to optimize energy savings. The resulting project replaced the existing shell and tube heat exchanger with two efficient plate and frame units, installed VFDs on the fan motors on both cooling towers, both glycol pumps and the primary compressor. A new control strategy was implemented to take advantage of the variable flow characteristics of the glycol pumps and further reduced energy consumption.
 - Burners were replaced on 12 boilers to upgrade the old technology with fully modulating burners that are able to match changing thermal load conditions more efficiently, thereby saving energy by reducing the firing rate at low load conditions.
 - The single chiller system that provides air conditioning to our law complex was replaced with three modular units. These modular units provide greater efficiency by combining VFD control with magnetic bearings to better match the cooling load (by running only as many chillers as necessary to respond to the cooling load).
 - The single chiller system in the Dana Research Center was replaced with four modular units. The new system offers the same benefits as the system installed in the law complex as noted above.
 - Electrical demand limiters have been installed on many chiller units on campus. An electric chiller is normally most efficient when it is less than 100% loaded. The demand limiter prevents the chiller from reaching 100% loading, ensuring that the system operates in a more efficient loading zone.
 - Three new high efficiency condensing hot water boilers were installed during summer 2009.
8. A campus wide relamping was completed in early 2009. A new fluorescent lamp technology replaced the existing high performance fixtures that were 30 watt, T-8, 4-foot fluorescent; 30 watt U-Bent fluorescent; and 40 watt PLL lamps. The new fluorescent lamps consume only 25 watts and contain half the mercury of the older technology, and are the lowest mercury level available for that type of fluorescent lamp. A total of 70,000 lamps were replaced on campus with an estimated savings of 1.4 Million kW and 686 tons of carbon annually.
 9. Thousands of new T-5 and High Performance T-8 energy efficient lighting fixtures have been installed throughout campus.
 10. LED lamps were installed to replace MR-16 bulbs as a pilot project at the Snell Library InfoCommons. InfoCommons is open 24 hours a day as a study area for students and was a perfect choice to test the new technology. The existing 60 MR-16 bulbs (50 watts) were replaced by 5 watt LED lamps resulting in annual savings of 23,500 kilowatt hours and almost 10 metric tons carbon equivalent (MTCE).
 11. An energy management system controls equipment covering 73.13% of our total campus square footage. The percentage of retro-fit EMS is 40.42% with the balance of 32.71% installed during new construction. EMS control of all large energy using equipment has been achieved by the facilities division and smaller units and systems are continually being integrated into the existing system.

Most recently, at the building level, NU has utilized a variety of energy efficient technologies. In the last three years alone, since 2006, the university has gone beyond existing energy efficiency standards and installed in our facilities:

- 5 energy recovery units (heat wheels);
- 83 high efficiency motors – representing over 1,200 motor horsepower;
- 83 variable frequency drives;
- over 2,100 tons of efficient air conditioning equipment;
- over 8,300 lighting fixtures (T-5, high performance T-8, LEDs);
- over 250 new occupancy sensors;

18 efficient boilers;
12 new burners; and
several custom HVAC-design solutions to reduce energy use (chillers and free-cooling plate/frame heat exchangers).

All of these installations went beyond existing energy codes. Since 2006, over \$673,000 in utility rebates were obtained from local utility companies to reduce the incremental cost associated with purchasing this highly efficient equipment. The resulting savings are over 6,200,000 kWhrs/year in electricity and 51,625 mBTUs in fossil fuels (combined total reduction of 2,902 MTCE/year).

Building Automation System

The University's High Performance Building Automation direct digital control and electronic metering systems are the heart of our energy management program for efficient operation and energy saving opportunities which result in CO₂ reduction. The system allows us to set up schedules of operation for equipment and lighting systems, so that energy savings can be realized during occupied/unoccupied modes. With the system, we use various algorithms for temperature reset schedules for efficient operation and trending of heating plants, cooling equipment, motors, pumps, fans, and lighting systems. The system is also capable of optimum start/stop, and "economizer cooling" where significant energy savings can occur. The system is used for load shedding in order to cut back on power consumption at peak demand, space temperature resets, and demand limiting control. The system also sends alarms to alert HVAC technicians of developing problems and system failures.

Cogeneration

In 2003, the University performed a feasibility study to investigate the potential installation of a 4,000 kW cogeneration system. A third party review indicated that there were several barriers that limited cogeneration's potential, including:

- Gas pressure limitations – the local distribution company's gas pressure was too low for a high pressure gas turbine;
- Air quality – the potential plant location was too close to the adjacent buildings' outside air intakes;
- Infrastructure – underground utility congestion would make the connection of generated electricity to our internal grid difficult and very costly;
- Maintenance cost – the proposed high pressure steam turbine would require greatly increased staffing and maintenance costs.
- Existing utility rate structure – demand penalties caused by down time associated with equipment malfunction or maintenance could potentially cancel out all savings.

Despite the risks associated with the initial study, regulatory changes have occurred regarding utility standby rates and financial incentives, and the University is planning to re-open the investigation for the potential of cogeneration on a smaller scale.

On-site combustion

At Northeastern, 527,258 MMBTUs of energy for heating and cooling are generated from on-site combustion. Of this total, the two main sources are Natural Gas (510,620 MMBTU or 96.8%), and Oil -distillate fuels (16,638 MMBTU or 3.2%). Northeastern purchases a total of 410 MMBTUs of non-electric energy from renewable sources, representing 0.077% of the total non-electric energy used. Diesel containing 5% biodiesel is used for its diesel fleet vehicles and emergency generators. Additionally, gasoline purchased for fleet vehicles contains up to 10% ethanol.

Retrocommissioning

The University practices continuous recommissioning of our energy systems in order to seek improvements in efficiency. Our recommissioning efforts begin by benchmarking energy usage on a building by building basis using our electronic sub-metering system. This allows us to establish real-time energy “load profiles” for each building and identify abnormalities in building energy consumption. Once this diagnostic monitoring is performed, we verify the sequence of operation in the buildings’ equipment and develop a list of findings. We then implement plans which address repairs, equipment recalibration, prioritize operational improvements, and verify results.

The benefits that the University achieves by continuous recommissioning are improved system maintenance, equipment performance, energy savings, carbon reduction, occupancy comfort, and increased indoor environmental quality.

Tune-ups

All of the University’s primary combustion systems (boilers) are tuned-up at least twice per year. We document our combustion efficiencies and emissions including NO_x, CO, and particulate matter. In addition, our central heat plant which consumes approximately 80% of our total fossil fuel use, is equipped with a continuous emission monitoring system (CEMS) which monitors emissions and combustion efficiency.

The University has also developed an overall operations and maintenance strategy and implemented a computerized maintenance management system. This system identifies equipment, generates work orders to schedule preventative maintenance, and system tune-ups based on best working practices for operations and maintenance.

Renewable Energy Generation

Approximately 0.03125% of Northeastern’s electrical consumption is generated on-site by renewable energy which, in this case, is solar photovoltaics. The Curry Student Center is equipped with a photovoltaic system. The system was originally installed in 1994 as an 18 kW system; at that time, it was the largest glass-on-glass solar installation in New England. In 2005, the 90-panel system was upgraded to a system capacity of 26 kW and currently produces in excess of 21,000 kWh/year of clean renewable power.

Capital Investments in Efficient Equipment and Renewable Energy

At present, the University believes that capital investments in highly efficient equipment offer a carbon reduction strategy that is more transparent and cost effective than the purchase of Renewable Energy Credits (RECs). The University currently invests endowment funds in renewable energy projects. These investments stimulate and contribute to a shift in power generation from fossil fuels to new, clean renewable power. This investment strategy promotes new renewable power development that is transparent while preserving the University’s financial position.

Green Building

As part of its signatory commitments with the ACUPCC, NU has adopted and is implementing new policies that state all building renovations greater than 50,000 square feet and all new buildings are to be LEED Silver certifiable or comparable. In existing buildings, all renovations now include a full assessment of the projects

environmental impact. The University seeks ways to ensure sustainability in regards to energy and water use efficiency, waste stream management, materials used, construction activities, air quality, and by innovations in operations and maintenance.

In addition, future roof replacement projects will consider "cool roof" designs as part of the University's sustainable building efforts. In existing buildings, all renovations now include a full assessment of the project's environmental impact.

Currently, there is one building that has been approved with LEED gold certification, and one building with pending Gold certification. The Dockser Hall Law School renovation was approved for LEED Gold certification by the U.S. Green Building Council on 40 LEED rating points. Dockser Hall, a 42,604 sf building, is a complete renovation project that allows for expansion of the law school. The Dockser Hall Law School renovation was so extensive that it qualified under LEED as a new building rather than EB.

Northeastern's newest building, International Village, opened September 2009 and has been proposed for LEED Gold certification. International Village is a 478,000 sf mixed-use, 1,200 bed dorm/office building located adjacent to a heavily used commuter rail and subway station. Of special interest regarding the building's sustainability, environmental stewardship, and reduced carbon footprint is the dining hall's Green Restaurant® certification, approved July 2009, along with its proposed LEED Gold certification. Once LEED certified, this may likely be one of the first certified Green Restaurant® university dining services in a LEED Gold building in the country. In addition, the building includes retail space that will be proposed for LEED Gold certification.

Currently, there are several buildings that qualify for the ENERGY STAR®. Northeastern's Facilities Division is also working with a consulting Engineer to facilitate the submittal process.

Previous examples of existing building retrofits include high albedo roof installations that minimize the "heat island effect": 2006-2007 on Smith Hall, a 300 bed dormitory; Dockser Hall; Dodge Hall; Kennedy Hall; and Willis Hall. The area totals 67,138 sf.

CURRICULUM, RESEARCH, EDUCATION AND COMMUNITY OUTREACH

The following section serves as a response to the two questions (listed below) that are required for the curriculum, education, and research component of the Climate Action Plan, and the question pertaining to community outreach and involvement in climate change:

- 1. Please describe your institution's plans to make sustainability a part of the curriculum for all students.**
- 2. Please describe your institution's plans to expand research efforts toward the achievement of climate neutrality.**
- 3. Please describe your institution's plans to expand community outreach efforts toward the achievement of climate neutrality.**

Curriculum in the area of sustainability

Our intent is to offer a rich variety of sustainability programming to meet the interests of our students rather than to implement a specific sustainability requirement. Sustainability programming is already in place in many units and we anticipate that it will increase as we hire additional faculty with sustainability-based research interests (as discussed in the second query). Current sustainability programming includes:

Information Literacy

Information literacy instruction for all entering freshmen, provided by our library staff, includes a sustainability focus.

Experiential Learning

A number of undergraduate research projects center on sustainability, including an Engineers without Borders project to design and build sustainable water distribution systems for underserved villages in Honduras and other locales.

NU has a number of co-op (cooperative education) opportunities in the area of sustainability. We are creating additional opportunities as student interest grows and are also partnering when possible with companies with green practices.

NU School of Law is targeting the development of cooperative education opportunities in environmental law in conjunction with its dual degree programs with Vermont Law School and with Brandeis University (both described below).

Majors and Minors

All B.S. Environmental Science majors complete at least two courses with a sustainability focus: ENVR 1101 Environmental Science, and either ENVR 5210 Environmental Planning or ENVR 5250 Geology and Land Use Planning.

All B.A. Environmental Studies majors complete at least 3 courses with a sustainability focus: ENVR 1101 Environmental Science, HIST 2342 Environmental History of North America, and ENVR 5210 Environmental Planning.

A Sustainability Cluster is available within Environmental Studies Major, where the students choose 6 of the following courses:

ENVR 4515 Sustainable Development

ENVS 2342 Eating and the Environment

ENVR 4505 Wetlands OR INTU315 Wetlands - Ecology & Hydrology

HIST 1222 History of Science and Technology

HIST 2321 Technological Transformations in Society

HIST 3412 Global Environmental History

HIST 4620 Topics in Historical Geography

HIST 5295 Population in History

ENVR 3200 Water Resources

Integrated interdisciplinary majors are available in: Computer Science & Environmental Science, Information Science & Environmental Science, Environmental Studies and History, Environmental Studies and International Affairs, Environmental Studies and Philosophy, and Environmental Studies & Political Science.

Minors are available in Environmental Studies and in Environmental Science.

In the College of Engineering, sustainability issues are woven throughout the curriculum for Civil and Environmental Engineering and for Mechanical and Industrial Engineering, including courses focused entirely on renewable energy and on environmental issues in manufacturing and product use.

Sustainability and climate change issues are woven through much of the Biology curriculum, especially in ecology and marine biology, and throughout much of the Earth and Environmental Studies curriculum.

The School of Architecture is starting a Landscape Urbanism degree program.

The School of Law has a dual degree program with Vermont Law School, in which Northeastern J.D. students may simultaneously pursue a Masters in Environmental Law and Policy (MELP) at the leading environmental law school in the country. A co-op experience in environmental law at Northeastern is counted as the field experience for the Vermont degree. Students earn both degrees in three years.

The School of Law offers a dual degree program with Brandeis University's Heller School for Social Policy and Management in Sustainable International Development (Masters). Students earn both degrees in four years, and pursue one or more co-ops that are relevant to international sustainable development.

The School of Law offers a dual degree program in which students earn a J.D. from Northeastern and a Masters in Public Health from Tufts University Medical School. Students earn both degrees in 3 and one-half years, take relevant course work in both institutions, and do field work / coops for both degrees.

Courses with a Sustainability Focus

ARCH 3170 1960s Urbanism. Addresses the architectural and urbanistic consequences of the utopian planning associated with urban renewal, the architecture of Brutalism, and other difficult-to-transform architecture of the 1950s, 1960s, and 1970s. Focuses on how to adapt and integrate such buildings and urban landscapes to meet contemporary needs.

ARCH 5120 Comprehensive Design Studio. Focuses on the materials and making of architecture. Considers architectural connections at all scales, from the nut and bolt to the scale of a door or window to the scale of the whole building and the city. Grounds design proposals upon a tectonic strategy, unlike traditional design studios that produce a schematic design before considering constructional ideas.

ARCH 5210 Environmental Systems. Explores the ways in which architectural form can create particular conditions of light and shadow; provide shelter from heat, cold, and rain; and incorporate systems that provide for water, electricity, and sanitation. Provides a series of simple and straightforward small-scale design projects.

ARCH 5220 Integrated Building Systems. Studies how to integrate into students' building designs all the environmental and tectonic systems that they have covered in previous architecture courses.

ARCH 6340 Sustainability Techniques. The professor presents his or her research related to a sustainability and exposes the students to methods of research and topics in current and ongoing research in the field. The students have an opportunity to engage in related and parallel research projects during the course of the semester.

BIOL 1145 Environment and Humankind. Offers an ecological analysis of human interaction with other organisms. Presents the necessary foundation of biological principles.

BIOL 2311 Ecology AND BIOL 2315 Benthic Marine Ecology. The issues of sustainability and climate change are central ones in both these ecology courses. At present much of the focus is on over-exploitation issues in marine fisheries and how we can examine these dynamics with quantitative models. There is also a focus on invasive species and biodiversity, both of which are central to ecological sustainability. Global warming and anthropogenic contributions to this warming are also addressed and continue to be developed.

BIOL 5527 Marine Conservation Biology. Examines several critical issues facing marine ecosystems, such as invasive species, marine pollution and eutrophication, fisheries impact, physical alteration of habitats, and global climate change. Field time is spent surveying intertidal and subtidal habitats within the Wrigley Marine Life Refuge, and in adjacent habitats outside the reserve as part of a long-term monitoring effort.

CHEM 5669 Environmental Analytical Chemistry. Describes the application of instrumental methods for analyzing environmental samples for major, minor and trace components of toxicological concern. Topics include sampling strategies for natural systems, determination of trace metals in natural waters and biologicals, determination of xenobiotics by GC, LC, GC-MS, and LC-MS, remote sensing of atmospheric pollutants, molecular biomarkers, and detection of protein and DNA adducts.

ECON 3423 Environmental Economics. Applies the tools of economics to environmental issues. Explores taxonomy of environmental effects; externalities; the commons problem; taxation, regulations, marketable permits, and property rights as a solution; measuring benefits of cleaner air and water, noise abatement, and recreational areas; global issues including tropical deforestation and acid rain; and the relevance of economics to the environmental debate.

ENVR 1101 Environmental Science. Focuses on the complex mix of interlocking problems that are reaching crisis levels on Earth. Topics include population, resources, environmental degradation, and pollution. Focuses on food and land resources; air, soil, and water resources and pollution; and energy alternatives. Some emphasis is placed on culture, politics, worldviews, ethics, and economics.

ENVR 4515 Sustainable Development. Focuses on the development of communities in an environmentally sustainable way and on the division of natural resources within these communities and the global system. Defines and discusses "sustainable development" and its global role today. Exposes students to a history of developmental methods while learning about the interconnectedness of development and the environment.

Encourages students to draw conclusions about the environmental impacts of these methods and to consider more equitable uses of natural resources.

ENVR 4504 Environmental Pollution. Offers students necessary tools to critically understand fundamental sources, pathways and sinks for today's most ubiquitous and/or noxious pollutants. This course surveys the Earth, exploring its atmosphere, hydrosphere, and biosphere while highlighting areas of greatest vulnerability to pollution. Discusses and examines contemporary air and water quality issues while allowing students access to environmental pollution databases. These databases are a critical tool for those actively involved in the environmental field. Reviews federal legislation of air and water pollution and discusses control technologies for treating air and water pollutants.

FINA 2720 Sustainability in the Business Environment. Looks at a variety of environmental problems, including global warming, use and disposal of toxic substances, and depletion of natural resources such as water and petroleum. Many of these problems arise because these are resources that are available to all and so their overuse is an externality that is not included in manufacturing costs. There are a number of ways to address environmental problems. While government regulation is often seen as a solution, there are also market solutions. Businesses have been involved in both identifying sustainability issues in their individual organization and providing a variety of innovative solutions. We will examine some of the ways that companies are finding to reduce their impact on the environment. Using a combination of readings and case analyses, the course assesses how both government regulations, such as taxes, subsidies, building codes, prohibitions of use, and business solutions, including zero emissions, green design, producer take-back, life cycle assessment, and corporate environmental reporting, address these problems.

HONR 3342 Topics in Contemporary Issues: Food and Politics. This course explores the politics and public policy dimensions of food, with a particular focus on the perspective of an urban consumer. Northeastern is a typical urban university, and few students and faculty have a connection to agriculture or food production. But it is the consumer who must better understand how food is produced, processed, and delivered, as well as the public policy dimensions of food, if Americans generally are to develop a fuller understanding of the impacts of food production on the society, human health, and the environment. We will examine the policy dimensions of food production, covering topics like agricultural policy, land use, economics, international trade, environmental and scientific issues (e.g., genetically modified organisms), and the tensions inherent in societal demands for cheap and pure food. We also examine the policy dimensions of eating and nutrition, looking at cultural and societal influences on consumption, how marketing and packaging affect eating habits, the interplay of factors such as work and commuting on how we eat, and, finally, the effects of consumption patterns on the society at large.

LPSC 7312 Cities, Sustainability and Climate Change. Provides an overview of the various aspects of urban sustainability planning. Examines sustainability as an urban planning approach with both ecological and social justice goals. Covers sustainable planning and offers students an opportunity to understand it within the context of smart growth and the new urbanism. Focuses on the two areas in which cities can reduce energy consumption and greenhouse gas emissions—the built environment and transportation. From there, the course examines planning efforts to reduce demand on water and sewer systems and to create employment in renewable energy and other “clean-tech” occupations. The course ends by placing urban initiatives in the context of state and national policy.

PHIL 1180 Environmental Ethics. Focuses on a current ecological crisis and addresses the values that underlie our concern over this crisis, whether the values at issue are anthropocentric or biocentric. Explores the ethical implications these ecological concerns have for our individual lifestyles, and for our role as members of communities.

PHIL 3480 Environmental Philosophy. Examines philosophical issues that arise in the context of human interactions with the natural environment. Emphasis is on the conceptual dimensions of these issues. Although many of these issues are ethical, they are also metaphysical and epistemological. There are also a number of significant methodological questions that arise in addressing them.

PHYS 1132 Energy, Environment and Society. Provides nonscience students with a practical knowledge of our present use of the earth's energy resources and the environmental consequences. Topics include solar energy, nuclear energy, global warming, oil politics, pollution, and electric cars. Draws upon current events, multimedia presentations, a tour of MIT's fusion reactor, and Web-based sourced. No knowledge of physics is assumed.

POLS 2395 Environmental Policy and Politics. Examines the policymaking processes, historical and socioeconomic factors, political forces, governmental institutions, and global trends that shape environmental policy at national and subnational levels in the United States. Gives attention to a wide range of environmental policy areas, with comparisons made between the United States and other nations.

POLS 7331 Environmental Policy and Politics. Explores debates surrounding the making of environmental policy in the United States and other nations. Examines the nature of environmental problems, how the structures of political systems affect policymaking, and the competing interests at work in environmental politics. Also discusses environmental policy in cross-national and international perspectives.

SOCL 1246 Environment and Society. Examines the political economy of the global environmental crisis. Topics vary and include such issues as world resource availability, energy, pollution, ecological degradation in the Third World, environmental policy, and social movements. Involves practical experience in environmental problem solving.

SOCL 3485 Environment, Technology and Society. Explores the complex relationships among human society, technology, and the natural environment. Students are asked to write weekly journals as they develop an interdisciplinary approach to global environmental issues and integrate this approach with their own perspectives.

SOCL 4522 Political Ecology and Environmental Justice. Analyzes the global ecological crisis and state of environmental politics. Includes analyses of history and nature; the logic of economic growth and ecological degradation; the human/environmental impacts of technology; globalization and the export of environmental hazard; imperialism and the ecological destruction of the Third World, with a particular emphasis on Central America; the role of ecological programs in the current economic and social crisis of the United States (and other countries); ecological stratification and environmental injustice; the crisis of the labor and ecology movements; and the future of environmental politics.

LAW 2329 Environmental Law. Focuses on federal and state environmental laws and explores legislative policy and regulatory decisions as well as enforcement issues. Topics include pollution control, waste management, cleanup of contaminated land and water, questions of environmental justice and the strategic use of legal tools in working to ensure safe and healthy surroundings for diverse groups of people.

LAW 2514 Natural Resources Law. Addresses legal requirements and institutions dealing with animal and plant species, biological resources, habitats, and ecosystems. Major themes include biological diversity, endangered and threatened species, public and private rights in migratory resources, public trust doctrine, the allocation of power among federal, state, and local governments, and the roles of administrative agencies in ecosystem management.

LAW 2394 Land Use Law. Surveys legal issues relating to regulation of the use of real property, including takings by public agencies, the scope of the police power as it affects land use, basic techniques of zoning and subdivision control, and techniques to encourage housing development and low income housing.

LAW 2491 Human Rights in the Global Economy. Focuses on the potential use of human rights law to address basic human social and economic needs (food, housing, health, education, and cultural expression) and the major international and regional human rights treaties.

LAW 7335 Health Law. This course examines the legal regulation of the provision of health care services. Much of the focus is on the relationship between law and health care policy. Topics include access to health insurance and health care, health care financing, malpractice liability, the organization and responsibility of health care institutions, especially hospitals, the regulation of the quality of care and the formulation of health policy.

LAW 7494 Bioethics and Law. Focuses on the intersection of law and bioethics and considers how different ethical theories may guide legal decisions.

LAW 2541 Global AIDS Policy Seminar. Explores selected policy options for reversing and responding to the tide of infection.

LAW 2512 Problems in Public Health Law. Explores the rationales for using law to protect and preserve the public's health, the legal tools that may be used to achieve that end, and the conflicts and problems that may result from legal interventions.

The law school also offers clinical courses in Poverty Law, Domestic Violence and Public Health, all of which are related to the intersection of law and sustainability.

Northeastern Research in Sustainability

Sustainability constitutes one of the three major research areas targeted by Northeastern. We anticipate additional faculty hiring in the area of sustainability as well as continued high level productivity from the current sustainability researchers whose work is summarized below.

Sustainable Water Resources

A healthy water environment is critical for human and ecological life. However, water systems are often stressed by humans, and in the urban environment the interaction between water and human systems is intense and associated problems acute and severe. The water environment is impacted by historical legacy (i.e. Superfund), contemporary (present wastewater discharges) and future (terrorist attacks, global warming) activities and events. Critical problems include adequate source, treatment and delivery of potable drinking water; treatment, disposal and reuse of wastewater; the sustainable management and restoration of natural surface and

groundwater resources, and the sediment] based ecosystem. Contaminants of emerging concern (e.g., endocrine disrupting compounds, nanoparticles, and PPCPs) and novel technologies (e.g. molecular tools, nanotechnology, cyber-infrastructure) cut across these problem areas.

Current faculty projects include:

- Akram Alshwabkeh: Electrokinetic remediation, BOD/DO and tracer transport, bioremediation and public health effects;
- Slava Epstein and Kim Lewis: The role of microbial synergies in the immobilization of metals;
- April Gu: Biological water/wastewater treatment, microbial ecology, biodegradation of emerging contaminants and bioremediation;
- Ferdi Hellweger: Water quality, eutrophication/biogeochemical modeling, urban hydrology, agent-based modeling;
- Thomas Sheahan: Contaminated sediment remediation and public health effects;
- Irvine Wei: Water treatment, advanced oxidation processes, environmental chemical processes; and
- Vladimir Novotny: Diffuse pollution, water quality management, restoration, socio-economic issues of water quality abatement.

Energy Innovation

The Northeastern University Center for Renewable Energy Technology, or NUCRET, conducts research on renewable energy alternatives and aims to be at the frontier of science and technology of clean energy conversion and storage. The range of its efforts includes materials science, advanced in situ spectroscopy, micro-fabrication methods and manufacturing technology. NUCRET Professor Sanjeev Mukerjee and Eugene Smotkin of the Department of Chemistry and Chemical Biology are working on highly efficient, ultra-small fuel cells. Besides research, NUCRET's overall activities include education, outreach and entrepreneurship. The center represents a multi-disciplinary team effort including chemists, physicists, engineers and economist/policy analysts. NUCRET's collaborative efforts include worldwide partners dedicated to clean energy and water.

- Professors Brad Lehman, Alex Stankovitch and Ali Abur of the Electrical and Computer Engineering Department are researching more efficient conversion and transmission of electrical energy.
- Professor John Kwoka studies industrial electricity use and markets with a view on conservation.
- Professor Yiannis Levendis of Mechanical and Industrial Engineering is studying the process of clean burning trash.
- Professor Hameed Metghalchi of Mechanical and Industrial Engineering performs research on the combustion process of jet engines to lead to a more complete, cleaner burning process.

Industrial Sustainability

In the NSF-funded Center for high-rate Nanomanufacturing, Mechanical and Industrial Engineering Professor Jacqueline Isaacs leads a Research Thrust area on Societal Implications of Nanotechnology that has a significant component of sustainability, in terms of using Life Cycle Assessment tools to result in sustainable nanomanufacturing.

The Laboratory for Responsible Manufacturing (LRM) in the College of Engineering is dedicated to conducting basic as well as applied research in manufacturing which covers areas such as Environmentally Conscious Manufacturing, Mass Customization, and Sensor-assisted Monitoring and Diagnosis. The modeling techniques used range from Neural Networks, Multi-agents, Stochastic models, Multi-criteria Optimization, Petri-nets and Graph Theory. The group members have expertise in different areas of research and are capable of working on research and developmental projects in collaboration with the industrial partners and governmental agencies.

Professor Sara Wadia-Fascetti has recently acquired support (NSF \$3M/5 yrs) for an Integrated Graduate Education and Research Training (IGERT) program on Intelligent Diagnostics of Aging and Environmental Systems dealing with a much needed comprehensive approach to maintaining our aging civil infrastructure.

Professors Sagar Kamarti and Abe Zeid of Mechanical and Industrial Engineering study approaches to holistic lifecycle management and related product monitoring.

Chemistry Professor Pam Mabrouk is developing a suite of novel, environmentally benign methods for synthesizing conducting polymers.

Sustainable Marine Resources

- Biology Professor Matt Bracken studies the consequences of species losses for marine ecosystem functioning.
- Biology Professor Don Cheney studies seaweed uptake and bioremediation of organic marine pollutants.
- Biology Professor Geoffrey Trussell studies the potential impacts of continued warming on rocky shore communities.
- Biology Professor Steven Vollmer studies ecological drivers of coral disease and coral evolution.

Urban Sustainability and Economic Development

Law, Policy & Society Professor Joan Fitzgerald carries out research on "Emerald Cities," dealing with how cities around the world are using sustainable green technology both to reduce their carbon footprint and to boost their economic development.

Architecture Professor Kiel Moe studies integrated design in contemporary architecture and has written the forthcoming book, *Thermally Active Surfaces*, on new ways for architects and designers to heat and cool buildings for dramatic energy savings.

Peter Wiederspahn, Kiel Moe, and Ivan Rupnik of the School of Architecture; and Ali Touran, Sara Wadia-Fascetti, and David Brady of the College of Engineering are working on creating new structural, insulated panels for use in efficient pre-fabricated construction.

Environmental Ethics and Environmental Justice

Philosophy professor Ronald Sandler conducts research on environmental ethics, environmental justice, and the ethics of technology, including its environmental dimensions.

Sociology Professor Daniel Faber's research is focused in the areas of climate change, environmental sociology and policy, social movements, environmental justice, philanthropy, and globalization.

In the Center for Urban and Regional Policy, Stephanie Pollack is continuing work on sustainability that she initiated at the Conservation Law Foundation (CLF).

The Northeastern Environmental Justice Research Collaborative (NEJRC) is made up of scholars dedicated to building a more transformative environmentalism in the United States and around the world. Based at Northeastern University, and directed by Sociology Professor Daniel Faber, NEJRC Associates collaborate with policy makers, elected officials, environmental advocates, foundation officials, scholars, students, community activists, the media, and the general public to provide timely research and commentary on critical social and environmental justice issues, and to promote an alternative political ecology for the new millennium.

Economic and Social Rights and Sustainability

Building on the UN model of sustainability, the School of Law's Program on Human Rights in the Global Economy (PHRGE) focuses on social and economic rights both domestically and internationally. PHRGE recently received notice of funding from the Ford Foundation.

Professors of Law Martha Davis, Hope Lewis, Lucy Williams, Margaret Woo focus their research on social and economic human rights and the ability of the law to further these socio-economic rights. Professor of Law Karl Klare is working on projects related to constitutional issues related to furtherance of social and economic rights in South Africa.

Professor of Law Lee Breckenridge focuses her research on allocation of rights and jurisdictional barriers to sustainable management of natural resources, with particular attention to water rights and aquatic ecosystems.

Professors Woo and Stephen Subrin work on issues related to the Rule of Law and related development, particularly in China.

Professor of Law Daniel Danielsen's work focuses on law and development in the international context.

Professor of Law Sonia Rolland is conducting research in the relationship of international trade and regulation, including regulation of risks to people.

Professors of Law Wendy Parmet, Richard Daynard, and Brook Baker all study various aspects of public health and law.

The Institute on Urban Health Research, directed by Professor Hortensia Amaro, is focused on understanding the social and environmental conditions of urban living that affect public health.

Community Outreach and Climate Change

Northeastern University is represented on the City of Boston's Climate Action Leadership Committee by Stephanie Pollack, Associate Director of Northeastern's Kitty and Michael Dukakis Center for Urban and Regional Policy. The Committee was formed in March 2009 by Boston's Mayor Thomas M. Menino. The Boston Climate Action Leadership Committee, a 22-member group representing Boston's diverse local communities, is charged with charting Boston's collective response to climate change. Mayor Menino requested that the Leadership Committee tackle the following tasks within 1 year:

- Review the City's existing Climate Action Plan
- Set goals for community-wide reductions in greenhouse gas emissions
- Recommend actions necessary to meet climate action goals
- Evaluate the risks to Boston from sea-level rise and other consequences of climate change, and recommend actions to reduce these risks;
- Prepare materials to motivate and assist Boston residents and businesses to take action; and
- Identify opportunities for expanding the green economy and green jobs in Boston

The Leadership Committee will meet six times between March 2009 and March 2010, and will be supported by a Technical Advisory Panel along with a Community Advisory Committee.

Community Education

During October 2009, Northeastern held its first Campus Sustainability Week. Eleven events were offered in five days and presented significant educational opportunities to faculty, staff, students, and in some cases, the public. Key themes throughout the week included climate change, reduction of carbon emissions, and energy, as well as green chemistry/toxics reduction, food/agricultural production, green business, and art. The Art and Sustainability exhibit included nearly 60 artistic expressions of climate change, sustainability, and the human impacts from environmental destruction.

Other venues are also used to educate the campus community about issues surrounding climate change, greenhouse gas emissions, and energy. For example, the documentary "Taking Root" was screened in December 2009 and January 2010 as it shows the power of one person, in this case Nobel Peace Prize Laureate Dr. Wangar Maathai, in affecting positive change. Dr. Maathai's Kenyan-based Greenbelt Movement has planted over 35 million trees since its inception in 1977. The organization now employs approximately 150,000 people in community development jobs such as bee-keeping, seedling nurseries, tree-planting, and food production. The planting program has resulted in positive changes in the daily lives of many Kenyans and ultimately Kenya's impact on climate change. We will continue to show other films and documentaries that educate the campus community about climate change and how Northeastern's faculty, staff, and students can take action individually and as part of larger communities to reduce their carbon footprint.

There are future events and programs planned to engage the campus community in climate change issues and energy conservation including Trash 2 Treasure, a highly successful recycling effort conducted during spring 2009 move-out and fall 2009 move-in; and a new Green Office certification Program. In 2010, Northeastern will participate in Recyclemania, a friendly 10 week competition and benchmarking tool for college and university recycling programs to promote waste reduction activities to their campus communities. Research is being conducted into alternatives for reusing sneakers and used dorm mattresses which could reduce greenhouse gas emissions associated with their disposal at the end of their life cycle. Earth Day's 40th birthday will be used as another educational opportunity to highlight the issues surrounding climate change and Northeastern's efforts to reduce its own greenhouse gas emissions.

Co-op/Community Service

Northeastern is one of the most prominent universities nationwide that integrates Co-operative and Experiential Learning into its educational process. Historically, Northeastern has emphasized experiential and service learning since it was founded. Northeastern is actively developing definitions of, and parameters for “Green Co-ops” and other Sustainability-based Experiential Learning opportunities that are offered to students through various departments and programs. In October, 2009, Northeastern’s Career Services held a “Green Careers” workshop for students to discuss different ways to enter environmentally oriented and “green” jobs.

Another way by which Northeastern demonstrates a strong commitment to community service and outreach is through its regular collection drives. Numerous initiatives are held throughout the year including collections for cell phones, toys, and food:

Cell phone collection - September - annual, parts sold for money that purchases calling cards for US servicemen/women overseas; September - annual

Cell phone collection - October, annual - Help Survivors of Dating and Domestic Violence - Community Advocacy Program

Holiday Food Drive for Rosie’s Place, which offers emergency and long-term assistance to homeless women - November, annual - Kappa Sigma

Holiday Toy Drive (33rd annual) - December, annual -The Office of Government Relations and Community Affairs

Teddy Bear Collection for children in hospitals- December, annual - Alumni Association

Thanksgiving Food Drive - November, annual

Toy Drive - November, annual - Latino Cultural Center

PROCUREMENT/PURCHASING

Purchasing considerations include issues such as energy efficiency, raw materials utilized, and manufacturing processes. Currently, there is a Green Purchasing Guideline which reads as follows:

“In 2007 President Aoun signed the American College & University Presidents Climate Commitment. The goal is to achieve climate neutrality for our planet.

The Purchasing Department supports this effort by selecting goods and services that provide the best value to the university while protecting the environment for future generations. Purchasing deliberations shall consider issues such as energy efficiency, raw materials utilized, manufacturing processes and the lawful disposition of obsolete equipment. Concurrently, we will continue to examine our internal business policies and procedures, seeking the most efficient way to conduct business.”

Northeastern policy also specifies ENERGY STAR® ratings for all new equipment and highly efficient equipment when ratings for equipment are not available. All computer equipment purchases as well as appliances including air conditioners, stoves, and refrigerators, have earned the ENERGY STAR®. The ENERGY STAR® policy is listed below:

“All products purchased by Northeastern University and for which the U. S. EPA ENERGY STAR® certification is available shall meet ENERGY STAR® certification, when practical. When ENERGY STAR® labels are not available, choose energy-efficient products that are in the upper 25% of energy efficiency as designated by the Federal Energy Management Program (FEMP).

All purchasing decisions for desk and laptop equipment are made in accordance with standards such as the Electronic Product Environmental Assessment Tool (EPEAT). Not only are these products EPEAT Gold compliant but they have earned the ENERGY STAR® as well. We use Dell as our preferred vendor for personal computers, and work with them on our standard lab-use and faculty/staff computer configurations. Our standard configurations are:

| | | |
|-----------|-----------------------|---|
| Desktop: | Dell Optiplex 960 | Certified by EPEAT with GOLD rating, ENERGY STAR® version 5.0 |
| Monitor: | Dell E1909W or E2009W | Certified by EPEAT with GOLD rating, ENERGY STAR® version 4.1 |
| Notebook: | Dell Latitude 6400 | Certified by EPEAT with GOLD rating, ENERGY STAR® version 5.0 |
| Tablet: | Dell Latitude XT2 | Certified by EPEAT with GOLD rating, ENERGY STAR® version 5.0 |

Consumable Products

Since approximately 2004, all toilet paper, paper towels and other paper products are 100% post-consumer recycled content and chlorine free. In addition, for the past 10-15 years, Northeastern has met or exceed all EPA guidelines for post-consumer content specific to toilet paper and paper towels. In addition, the paper products supplier sources forests that are managed according to the demanding standard of Forest Stewardship Council (FSC) for responsible forest management, and meets the stringent Swedish FSC guidelines as well. Starting in approximately 2006, all cleaning products purchased by Northeastern for all dormitory and academic buildings were Green Seal certified.

TRANSPORTATION

Northeastern is located in a dense, urban environment with access to an abundance of public transportation services, which serves its commitment to using alternative fueled vehicles and alternative forms of transportation.

- As of 7/01/07, all diesel fueled equipment (which includes trucks, skid steers, street sweepers, track driven snow plows, landscaping trucks, and emergency generators) is fueled by ultra-low sulfur bio-diesel fuel which goes beyond the Massachusetts Department of Environmental Protection regulations.
- An alternative fuel pilot program was implemented utilizing compressed natural gas for several maintenance vehicles. Though it was determined not to be an economically viable solution at this time, the University is well poised to take advantage when rapid-fill CNG stations become more prevalent.
- The University's urban setting and proximity to four subway stations, eighteen bus routes and three shuttle services allow easy access to public transit.
- The University also encourages employees and students to reduce the number of single occupant vehicles by publicizing and implementing carpool/vanpool matching, preferential parking for vanpools, bicycling incentives, providing transit passes, and posting bus/train schedules, rates and routes.
- Since 1998, the number of single occupant commuters to campus has been reduced by over 37%.

In addition, Northeastern's policies support a pedestrian-and-bike friendly campus as outlined in the Institutional Master Plan containing two chapters on environmental sustainability and transportation demand management. The only vehicles permitted to access the center of campus are emergency vehicles or those dropping off equipment. Otherwise, the campus center is restricted to pedestrians, bicycles, and electrically powered maintenance vehicles.

Approximately 89% of Northeastern faculty, staff, and students use public or alternative transportation each day to access the university. Based on a commuter survey for a Ridesharing Update Report submitted to the Massachusetts Department of Environmental Protection in 2008, the University's total number of Drive Alone Commute Trips (DACT) decreased approximately 50% since 2004; between 2006 and 2008, the DACT decreased by 10% from 21% to 11%. The 2008 commuter travel mode breakdown for faculty, staff, and students was as follows:

- Public transit - 42%
- Walking -34%
- Drive Alone - 11%
- Bicycle – 5%
- Telecommuting – 4%
- Car Pool – 2%
- Other – 2%

The growing residential student population lends itself to the high rate of transit and alternative transportation users. During 2008-2009, 96% of freshmen lived on campus, a 10% increase compared to 1998-1999 when approximately 85% of students lived on campus. In total, an estimated 7,400 students live in university-owned or leased residence facilities, representing approximately 33 % of the 22,944 FTE students at Northeastern and a 56% increase from the 4,175 students in 1998-1999 who lived in university-owned or leased residence facilities.

Northeastern's institutional motor vehicle fleet includes 162 vehicles. Of these, there is 1 hybrid, 36 electric vehicles including (4) electric forklifts, (2) Zamboni machines for ice arena resurfacing, and (29) maintenance vehicles; and 26 biodiesel vehicles that include bobcats, transportation trucks, Bombardier and other snow removal equipment, grounds equipment, grounds/landscaping vehicles, street sweepers, etc. There is also 1 propane forklift. Additionally, 27 Public Safety staff members from the Northeastern University Police Department are certified to use the department's 16 patrol bicycles year-round as an alternative to vehicle use on patrols.

The average estimated GHG emission rate per passenger mile of our institution's motorized fleet is 0.95 pounds per passenger mile equivalent (CO₂e) per passenger mile traveled, representing approximately 609 MTCE/year.

Transportation Alternatives

NU is involved with programs designed to reduce drive-alone commute trips. These include collaboration with the Medical Academic and Scientific Organization (MASCO) regarding private shuttle bus services from key public transition stations to the local MBTA commuter/bus rail station; membership in the Urban Ring Community Advisory Committee; and coordination with the Boston Redevelopment Agency on pedestrian paths through campus to access the Museum of Fine Arts and Longwood Medical Area.

Northeastern offers a number of carpool programs. There is a carpool/rideshare program system designed for Northeastern students that is accessible only to students. It is available on the "Experiential Learning/Co-op" tab of the student portal, "my NEU".

Carpool and Vanpool Matching is done through the University's participation in the MassRides program for interested faculty, staff, and students. This information is publicized in posters and other literature distributed campus-wide, and is available through the Office of Environmental Health and Safety website links, through Commuter Student Services, and the University's promotion of the Guaranteed Ride Home program offered through MassRides.

Preferential Parking is provided for carpools and vanpools. A number of parking spaces have been established for faculty and staff with daytime decals who travel with at least three total occupants.

In addition, faculty and staff can take advantage of pre-tax transit monthly transit purchases. Students are eligible for semester pass discounts with the Massachusetts Bay Transportation Authority (MBTA) along with reductions on AMTRAK trains.

Northeastern also provides free transportation around campus. NU is located in a dense, urban area with access to multiple public transportation routes. Complementing this is a personal escort service made available to students by the Northeastern Public Safety Division. This service is offered 24 hours per day, seven days per week. For students residing within a one-mile radius of the campus center, service is available from 7:00 P.M. to dawn. Off-campus escorts are solely to students' residents and exceptions are made under emergency situations only. Additionally, there is a Dial-A-Ride program available at night when local transportation is unavailable. This program is offered in conjunction with the MBTA and state agencies.

Bicycles and Bicycle-sharing

To foster even more campus bicycling activity, bicycling incentives are provided by a number of means. In FY 2009 and FY 2010, a total of 50 new bike racks were installed. Bicycle racks are available at selected campus locations and at resident halls. Additionally, secure bicycle storage space is provided on the ground level of one of the campus garages. A total of approximately 450 bicycle storage spaces are available at convenient locations throughout campus. Showers and lockers are available at two athletic centers conveniently located on campus. Additional bicycle locks are being placed on the public street accessing one of the main campus administration buildings, and staff is revisiting a campus connection to surrounding bicycle corridors that transect surrounding communities.

In 2009, the Student Government Association started collaborating with university staff to develop a bicycle sharing/rental program with a goal of implementation in FY 2010. Initially, approximately 20-30 bicycles would be made available. This program is being initiated as a result of a student survey that was conducted and indicated significant student interest in a program of this type.

Car-sharing Program

Since approximately 2005, Northeastern has an agreement in place with, and is a member of Zipcar, a nationwide alternative car rental company that offers a car-share program to individuals, business, and universities. Approximately twenty Zipcar spots are available adjacent to NU's campus. Zipcar reduces congestion by eliminating the need for car ownership and on-campus parking (see <http://www.zipcar.com/>).

Northeastern has 15 Zipcar accounts including ones for departmental use by Northeastern employees, which gives business users a discounted Zipcar rate to be paid for by the University (usually through a University issued purchase card). There are also affiliate accounts open to students, faculty, and staff, and offers the benefit of a discounted joining fee of \$25. Northeastern members who join under the Affiliate Program set up their own personal account and pay for their own driving at regular rates.

LANDSCAPING

Landscaping is another aspect of climate and energy reduction because of the different types of chemicals that are often used. The NU Landscaping Program follows Integrated Pest Management principles as a framework from which all landscaping decisions are made. Approximately 70% of NU landscaping is done organically without

chemical applications. The principles of organic production support healthy practices that aim to increase the quality and durability of the environment through specific management and production methods, and management methods selected to restore and sustain ecological stability within the enterprise and surrounding environment.

WATER CONSERVATION AND IRRIGATION

Water-conservation is another means by which Northeastern has promoted conservation. A variety of water conservation technologies have been implemented in existing buildings (e.g., low-flow faucets, low-flow showerheads, waterless urinals, dual-flush toilets, and laundry technology). Examples include:

1. University policy is to specify ENERGY STAR® appliances wherever possible. All laundry machines on campus have earned the ENERGY STAR® and use approximately 40% less water than a standard efficiency washing machine.
2. All shower heads on campus were changed from Low Flow (2.5 Gallons Per Minute) to Ultra Low Flow (1.6 Gallons Per Minute) over the Summer of 2009. The shower heads have reduced heated water consumption during showering by approximately 35% as compared to standard low-flow fixtures.
3. Installation of low flow and dual flush flushometers.
4. A recent water systems audit conducted 2008-2009 showed that approximately 96.6 % of the bathroom fixtures on campus are either dual flush or low flow automatic flush models. The remaining 3.4% will be replaced pending plumbing modifications and/or replacement of existing porcelain and fixtures.
5. A recent water systems audit within the last 12 months showed that approximately 97.4% of lavatory sinks are equipped with low flow aerators. The remaining 2.6% were retrofitted by maintenance personnel over the summer of 2009.
6. The Utilities Department tracks water consumption at each building and also sub-meters irrigation, cooling tower, and boiler make-up water in order to ensure efficient water usage throughout the campus.
7. Storm water that had been piped into city storm drains has been connected to groundwater recharge systems to raise groundwater levels, reduce the impact of heavy rainfall on the existing storm water conveyance system, and mitigate the effect of impervious surfaces on campus.
8. With the development of West Campus, beginning in 1999, groundwater recharge systems were installed in the University's West Campus A, F, G and H Residence Halls (1,390 beds), Smith Hall, the Asian American Center, and 142-146 Hemenway Street (a block of 4 dormitory buildings). Groundwater recharge systems return storm water to the ground, recharges the aquifers, preserves the integrity of wooden piles under historic buildings and structures, and reduces the volume of water sent to treatment plants.
9. Irrigation systems have been upgraded across campus from a simple time clock system to a computer controlled system using rain sensing technology to inhibit irrigation during rain events. The system is also able to detect malfunctioning sprinkler heads to further reduce water consumption.

TABLE 5: WATER CONSERVATION TECHNOLOGY

| Technology | Number of Buildings/ Systems | Number of Fixtures | Type of Fixture | % Building Space |
|-------------------------------|---------------------------------|-----------------------|--|------------------|
| ENERGY STAR® Laundry Machines | 38 | 532 | ENERGY STAR® Washing Machine | 100.0% |
| Ultra Low Flow Shower Heads | 40 | 1907 | 1.6 Gallon / Minute Shower Head | 100.0% |
| Toilets / Urinals | 82 | 2624 | Low Flow Automatic or Dual Flush Toilets | 96.6% |
| Sinks | 82 | 4300 | Low Flow Sink Aerator | 97.4% |
| Groundwater Recharge | | | Custom System | n/a |
| Irrigation | 35 | | Computer-controlled irrigation system | 100.0% |

RECYCLING

RENU, Northeastern’s recycling program, began in 1989 and has since expanded to include the recycling of more than 13 different categories. NU provides single-stream recycling for all plastic, glass, and cans. However, due to the paper industry’s estimates of 10-20% paper loss (which in NU’s case would equate to 31-62 tons), NU chooses to offer separate recycling containers for paper and corrugated. The program is self-managed and recycles items such as bathroom fixtures (i.e. sinks, tubs, and toilets) but mainly materials such as computers/electronics, batteries, carpeting, toner cartridges, and construction/demolition debris. RENU is based on continuing education that emphasizes separation of recyclables rather than comingled recyclables. Trash and recycled materials are collected by the Solid Waste/Recycling team which increases efficiency and minimizes carbon emissions throughout the collection process.

In addition, “Compost Here”, an aggressive food composting initiative started at NU in spring 2008 (previously called “Project Clean Plate”), has resulted in approximately 594 tons of food waste being composted annually; this amount is expected to increase dramatically after September 2009 with the opening of International Village, a 1,200 bed mixed use dorm/office building. Dining Services also recycles cardboard, bottles, and cans. RENU recycles the following traditional materials out of the 15 materials regularly recycled: aluminum, cardboard, glass, paper, and plastics (#1 and #2). Other materials recycled by NU include:

- asphalt/concrete;
- ballasts and dry batteries;
- bottles;
- cans;
- carpet;
- clothing;
- construction and demolition debris;
- cooking oil;
- food;
- furniture, through refurbishing to avoid new purchases;
- kitchen grease;
- lamps;
- landscaping waste;
- mixed debris;
- metal (including brass, copper, tin);
- toner cartridges;
- universal waste;

wet cell batteries; and
wood.

Antifreeze/Refrigerants

All antifreeze that was previously recycled has been replaced with nonhazardous polypropylene glycol for vehicles and emergency generators.

In 2008, 1,075 pounds of R22, a HCFC refrigerant, were reclaimed along with 600 pounds of R11. Refrigerants are known to have significantly higher impacts on greenhouse gases compared to Carbon Dioxide (CO₂). R22 has an atmospheric life of 11.9 years, with a global warming potential (GWP) of 1,700 compared to CO₂. R11 has an atmospheric life of 45 years, with a GWP of 4,600 compared to CO₂. If either of these gases were to escape into the atmosphere, the equivalent in tons would be 2,083 metric tons carbon equivalent¹, or MTCE, which is a significant amount.

Dining

Northeastern recycles 47.92 tons of grease from dining services' kitchen grease traps and inside pump chambers. The grease is recycled in a local treatment plant into sustainable biofuel for large manufacturing plants, qualifying for Green Credits. Other dining-related recycling efforts include approximately 4,300 gallons (17.2 tons) of used cooking oil that is recycled from food service operations and reformulated into biodiesel and remade candles.

Northeastern, through its contracted food service provider, offers reusable dishware and/or recyclable to-go containers at all locations, has eliminated the use of Styrofoam products from most campus food outlets, and is in the process of investigating compostable coffee lids. Other incentives to encourage reuse of drink containers include reduced rates for coffee when customers provide their own mug. Excess food is donated to the Second Helpings Program in Boston.

(Non-food) Composting

NU composts all of its grounds waste. In 2009, 268 tons, or 100% of grounds waste was composted and collected in a receptacle located in the Camden Parking Lot.

Although Northeastern is located in a dense urban environment that is inappropriate for a campus-wide composting site. Composting receptacles are located in all dining halls as part of the "Compost Here" Initiative which currently composts 594 tons annually; this volume is expected to increase in FY 2010 with the opening of International Village, a new 1,200 bed mixed-use dorm/office building. A food waste pilot will begin 2010 in the Curry Student Center's food court.

¹ Source: The Climate Registry, General Reporting Protocol, Version 1.1, May 2008. Calculations for GWP are as follows: R22: (1,075 pounds used x 1,700 GWP)/2,202 pounds/ton = 829.9 MTCE; R11: (600 pounds used x 4,600 GWP)/2,202 pounds/ton = 1,253.4 MTCE. Total GWP for R22 and R11: (829.9 + 1,253.4) = 2,083 MTCE.

Construction and Demolition

The overall FY 2009 diversion rate of all campus recycling effort was 63.5% including solid waste and construction and 36.6% without construction and demolition. The amount of non-hazardous construction and demolition waste diverted from landfills is 91.769% and 85.97% (see below).

During International Village's construction in FY 2009, 5,325.13 tons of material was generated, of which 4,886.82 tons or 91.769% was recycled, including:

1,642.1 tons of comingled waste,
278.86 tons of metal,
13.60 tons of wood,
22.76 tons of steel sheeting, and
2,929.50 tons of asphalt, concrete, and granite.

The Dockser Hall Law School renovation generated 1,704 tons of material which included comingled waste, metal, wood, asphalt, concrete, and brick, of which 1,465 tons were recycled, yielding a total project recycling rate of 85.97%.

Electronic Waste

Northeastern also recycles electronic waste including:

- Batteries (approximately 20 wet cell batteries, or approximately 1,200 pounds);
- Cell phones (Northeastern's Government Relations Department coordinated collection of 912 cell phones FY 2008/2009 that were sent to a domestic violence program that was not a shelter and was based in 6 CCHERS partner community health centers in Boston);
- Computers (49.01 tons of computers/electronics);
- Light bulbs (17.5 tons of lamps);
- Printer cartridges (400 bushels of toner cartridges); and
- Televisions; and other electronic devices and machines.

Oils/Solvents/Metals

In addition, all used motor oil is 100% recycled. Aqueous nonhazardous parts cleaning solutions are recycled through a closed loop recycling system. Silver, mercury, and metals are sent to metal recyclers, and flammable solvents generated in research laboratories go to various industrial facilities for fuel blending. Finally, NU provides a chemicals recycling list on its website to recycle laboratory chemicals within the academic departments on campus:

http://www.ehs.neu.edu/hazardous_waste/waste_minimization/recycling_list/index.php

Source Reduction

Northeastern offers a number of source-reduction initiatives such as end-of-semester furniture or clothing swaps and collections. Several clothing drives are held throughout the year and donated to local charities, including: cell

phone collection drives coordinated by NU Government Relations; toy drives organized by the Latin Cultural Center and Government Relations; food drives coordinated by Government Relations; and a coat drive coordinated by the Curry Student Center. Approximately 35 bushels of leftover clothing was reused and recycled through collections during FY 2008/2009, including the highly successful Trash to Treasure program held during spring 2009 move-out and fall 2009 move-in and organized by the Husky Energy Action Team (HEAT) student organization. Finally, furniture is refurbished as another means by which NU addresses source-reduction.

SUSTAINABILITY

In 2009, the following definition for sustainability at NU has been approved by the Executive Sustainability Committee, to use as a decision-making tool across the university:

“At Northeastern University, sustainability is an ongoing process that harnesses the unique talents of students, faculty, staff, and the Northeastern community to develop technological, economic, and environmentally responsible policies and innovations that will balance the needs of present consumption without sacrificing the needs of future generations”.

Committees

There are a number of committees at Northeastern that advise on and implement policies and programs related to sustainability. A total of 69 people comprise all the committees, including 28 active members of the Administrative and Finance Sustainability Subcommittee which is key to making recommendations for consideration by the Executive Sustainability Committee.

An Executive Sustainability Committee, formerly chaired by the Senior Vice-President for Administration and Finance, and now chaired by the Vice-President of Facilities, meets quarterly to review recommendations made by the Administrative and Finance Sustainability Subcommittee. The Executive Sustainability Committee reports and makes recommendations to the Senior Vice-President of Finance. It also oversees the implementation of campus sustainability efforts. The committee is dedicated to cultivating and implementing sustainable policies and practices throughout all University operations including administration, academics, research, student group activities, and residential life. The Executive Committee is comprised of senior administrators, as well as faculty, staff, and students, including: Vice-President for Facilities (Chair); Senior Vice-President for Administration and Finance; Executive Vice-Provost; Director, Communications; Director - Physical Plant Operations; Associate Director Sustainability and Energy Management; Sustainability Program Manager; Energy Manager; Director, Dining Services; Senior Buyer; Associate Director, Environmental Health & Safety; Associate Professor - Mech. and Industrial Engineering, College of Engineering; Associate Professor - Physics, College of Arts and Sciences; Director, Student Programming & Communications Office of the Vice-President for Student Affairs; two representatives from Marketing and Communications; and a Student Representative from the Husky Energy Action Team (HEAT).

The Administration and Finance Sustainability Subcommittee is chaired by the Sustainability Program Manager, makes recommendations to the Executive Sustainability Committee, and reports to the Vice-President of Facilities. This committee meets monthly to discuss the ways in which facilities, energy efficiency and management initiatives, landscaping practices and procedures, and cost-savings efforts may be greened, and makes recommendations accordingly to the Executive Sustainability Committee. Its membership includes staff from: business services (purchasing and dining services); environmental health and safety; facilities division; library services; the Internet Technology department; student affairs; and student representation from HEAT, Resident Student Association (RSA), Student Government Association (SGA), and other interested students and student groups wanting to participate or present specific initiatives. There are 28 active committee members.

The Administration and Finance Sustainability Subcommittee has addressed the following issues since August 2008:

Banners recycled into shopping bags;
Boston Earth Hour;
Building Green Trial run;
Carbon Inventory;
Composting;
Dining Services' transition to biodegradable utensils;
Do It InThe Dark (dorm energy reduction competitions);
Dorm recycling bins;
ENERGY STAR® Policy;
Environmentally Friendly Purchasing Policy;
Environmental Policy Development;
Farmers Market;
Green Co-op data collection project;
Green Restaurant® certification for International Village dining facility
Green IT policy;
Green Living Guide;
Green Roofs;
LEED buildings;
Massachusetts Bike Commute;
Non-smoking policy;
Pay for Print;
Purchasing's replacement of liquid with foam soap;
Recycled Banner initiative;
Relamping project;
Renewable Energy Fund development;
Space Temperature Guidelines;
Space Utilization;
Sustainability Coordinator hiring process;
Sustainability Definition;
Sustainability Forum;
Electric & Thermal metering;
Trash to Treasure;
Ultralight Startup Society symposium (ULS is a technology based entrepreneurship group that holds monthly meetings to discuss emerging technologies, business models, and concepts that help startups – including renewable energy firms - launch cheaper and quicker)
Ultra low flow showerhead installations;
US Green Building Council Student Pilot Program;
Variable Frequency Drives;
VendingMiser®;

Progress made on each of these issues since August 2008 includes:

Banners recycled into shopping Bags: over 90 banners that previously lined Huntington and Columbus Avenues were recycled/refashioned into over 300 shopping/tote bags that were sold in the bookstore and to the alumni organization
Boston Earth Hour – participated March 2009
Building Green Trial run: began fall 2009
Carbon Inventory: completed September 15, 2008

Composting: initiated, expanded to all dining facilities, currently 594 tons collected annually
 Dining Services' transition to biodegradable utensils: completed 2008
 Do It In The Dark: held 2008 and 2009 dormitory energy reduction competitions
 Dorm recycling bins: purchased for distribution to dorms with kitchens for fall move-in 2009
 ENERGY STAR®: 6 buildings qualify, benchmarked building on website
 ENERGY STAR®: being implemented
 Environmental Purchasing Guideline: being implemented
 Environmental Policy Development; recommended for management review
 Green Co-op data collection project: initiated, parameters set, first survey submitted to over 5,000 students
 Green Restaurant® certification for International Village dining facility: approved
 Green IT policy: quantitative analysis underway to prepare for policy development
 Green Living Guide: 3 versions completed, to distribute in 2010 to freshmen, upper class (dorms), upper class (off-campus)
 Green Roof: installed
 Farmers Market: planning and development underway, to be implemented 2010
 LEED buildings: Dockser Hall, now open, proposed LEED certification – Gold; International Village, opening September 2009, proposed LEED certification – Gold.
 Massachusetts Bike Commute: participated May 2009.
 Non-smoking policy: implemented and being revised
 Pay for Print: implemented
 Purchasing's replacement of liquid with foam soap: completed
 Recycled Banner initiative: completed (see <http://www.northeastern.edu/sustainability/news/greentotes.html>)
 Relamping project: completed (70,000 lamps replaced in two months November 2008-January 2009)
 Renewable Energy Fund development: adopted by Board of Trustees, implemented
 Space Temperature Guideline: implemented
 Space Utilization: reviewed along with energy conservation measures
 Sustainability Coordinator hiring process: Sustainability Program Manager hired, started January 2009.
 Sustainability Definition: completed and recommended to Executive Sustainability Committee (see attachment)
 Sustainability Forum: held 2008, fall 2009.
 Electrical and Thermal metering: installed and ongoing
 Trash to Treasure: held during move-out spring 2009, move-in fall 2009 (and another planned for move-out 2010)
 Ultralight Startup Symposium: held July 16, 2009 with approximately 150 attendees
 Ultra low flow showerhead installations: mostly completed
 US Green Building Council Student Pilot Program: participating and initiated
 Variable Frequency Drives: installed and ongoing
 VendingMiser®: installed

There is also an Academic Sustainability Committee that is chaired by the Vice - Provost for Undergraduate and Cooperative Education, makes recommendations to the Executive Sustainability Committee, and reports to the Provost's Office. The committee meets at least once during each quarter but in fall 2009 has been meeting monthly. This committee focuses on the integration of sustainability into academic, curriculum, and course-related development and requirements. The committee is working to identify, list, and organize all courses and programs that integrate sustainability. The committee is comprised of seven faculty members, three staff persons, and student representation from Husky Energy Action Team (HEAT).

An informal Library Green Group was established to find ways to be more sustainable throughout the library. The group's goal is to make their workplace as sustainable as possible. They are currently working on numerous projects.

The Food Advisory Committee, chaired by the Director of Dining Services, provides a forum that addresses sustainability and food, and engages students in campus sustainability efforts. The committee develops recommendations for consideration by Dining Services and Business Services, which oversees Dining Services. This committee meets monthly with participation from the following organizations: HEAT, the Progressive Student Alliance, Northeastern University Vegetarian United, Resident Student Association, Students for Environmental Action, and the Student Government Association.

In addition, the Northeastern University Chapter of the American Society of Civil Engineers has been actively engaged in community service projects since 1975. While the group has not yet coordinated with the Administration and Finance Sustainability Subcommittee, it serves a prominent role representing Northeastern and continuing the University's history as a community service-based institution. Most recently, NUASCE completed design and construction of an erosion mitigation project near the Eliot Bridge in Cambridge, MA (see <http://www.nuasce.neu.edu/?cat=6>).

Northeastern has sustainability policies that are focused on greening facilities, management initiatives, energy efficiency, practices and procedures in dining, landscaping, and purchasing, and overall cost-savings. Quantifiable sustainability goals are being developed. Previous to January 2009, sustainability work at Northeastern was coordinated by a number of people. The Office of Sustainability and Energy Management was initiated late 2008 and reports to the Vice-President of Facilities. Since January 2009, this new Office has included the new Sustainability Program Manager. In April 2009, the sustainability website was launched and is being upgraded throughout 2009, with plans to include links through other departments. The website URL is: <http://www.northeastern.edu/sustainability/>

A new, full-time Sustainability Program Manager position was created and filled starting January 2009; the Sustainability Manager coordinates NU's sustainability efforts campus-wide. The position, located within the Facilities Division, reports directly to the Associate Director of Sustainability and Energy Management, a newly created position. In addition, the University created or redefined three other positions to advance sustainability campus-wide: the Associate Director of Sustainability and Energy Management, responsible for overseeing sustainability and energy efficiency initiatives campus-wide; an Energy Manager position to coordinate energy efficiency initiatives on campus and facilitate energy use data collection; and a Building Operator position to control energy usage more efficiently through the energy management system. In total, approximately seven full-time University staff in Utilities and Recycling work on sustainability initiatives campus-wide. Additionally, more than six full-time staff from Facilities, Purchasing, Environmental Health and Safety departments and the Trades (i.e. HVAC, Electrical, Plumbing, and Energy Management) provide part-time coordination, basic framework, and benchmarking of past and present sustainability efforts, implementation, and development of future proposals campus-wide.

Strategic Inclusion of Sustainability

Sustainability is addressed in two separate chapters of the Institutional Master Plan (IMP). Chapter 4, Mitigation, of the February 22, 2000 IMP, provides a comprehensive discussion about transportation demand management. Chapter 9 of the IMP Amendment, October 20, 2006, overviews multiple aspects of Environmental Sustainability at Northeastern.

In addition, the University's Academic Plan is designed to establish clear priorities for the institution and set the context for future decision-making. This strategic framework will be used to guide development of the next IMP. <http://www.northeastern.edu/planning/draftplan/index.html>

In 2007, President Aoun signed the American College & University Presidents Climate Commitment. The goal is to achieve climate neutrality for our planet. The Purchasing Department supports this effort by selecting goods and services that provide the best value to the university while protecting the environment for future generations. Purchasing deliberations shall consider issues such as energy efficiency, raw materials utilized, manufacturing processes and the lawful disposition of obsolete equipment. Concurrently, we will continue to examine our internal business policies and procedures, seeking the most efficient way to conduct business.

<http://www.northeastern.edu/purchasing/greenpur/index.html>

Dining

Dining Services offers events through the year that highlight their sustainability initiatives and educate participants in sustainability and carbon reduction as it relates to food and dining services. Northeastern Dining Services' green dining document summarizes their initiatives being implemented (see <http://www.dineoncampus.com/fall2009greenplan091109.pdf>). Dining Services also offer Exhibition Kitchen events such as PETA's Vegan College Cookbook, held October 2009, to demonstrate and educate different ways of lowering one's dietary impact on greenhouse gas emissions. During Northeastern's first Campus Sustainability Week, October 19-23, 2009, Howard Lyman, the keynote speaker, spoke about food and sustainability, and low carbon meals were served in dining facilities for lunch during the week (October 22, 2009).

New Student Orientation

Sustainability is included in all freshmen orientations for students and parents that are held by the Vice President and Dean - Student Affairs. In addition, in fall orientation programs for incoming freshmen, HEAT volunteers will provide sessions on sustainability, energy conservation, and environmental awareness.

Since 2007, the library integrates sustainability into library presentation sessions for all classes in the English Department's First Year Writing Program. Through this class, students conduct sample searches for library materials (books, journals, and websites) across disciplines, making the entering freshmen aware that the concept is interdisciplinary. Approximately 180 library sessions are taught per year in the spring and fall, thereby reaching approximately 2,500-2,800 students in the First Year Writing Program.

Facilities Division and HEAT are cooperatively producing a "Sustainable Living Guide" for distribution during move-in. A freshmen version has been developed as well as one more specific to juniors and seniors who may live off-campus. It is anticipated that the guide will be available in 2010.

Student Involvement

A sustainability-themed residential community is being developed at Northeastern by Residence Life. In addition, Northeastern has programs to promote sustainability behavioral change on campus. HEAT, the RSA, and SGA are all actively involved in promoting sustainability and environmental awareness in residence halls. The Resident Assistants and Resident Hall Directors also include environmental awareness and energy conservation in their programs. Additionally, during fall 2009, a student group started developing a Green Office Certification Program.

Northeastern has a number of active student-run organizations devoted to sustainability efforts on campus. These include:

Engineers Without Borders: Supports community-driven development programs worldwide through the design and implementation of sustainable engineering projects, while fostering responsible leadership. The EWB NU Chapter has made progress on each issue/program since August 2008: Designed and implemented a sustainable water distribution system in El Chaguite, Honduras, and recently began design on sustainable water system in Bbanda, Uganda.

Website: www.ewb.neu.edu

Contact: Ann Marie Polaneczky, President

Food Advisory Committee: works to enhance services and options within campus dining facilities.

Website unavailable

Contact: Ryan Fox, Coordinator, fox.r@neu.edu

Graduate Environmental and Geo-Environmental Students (GEGES): The purpose of this group is to improve the quality of the graduate environmental and geo-environmental experience at Northeastern University. Seminars, workshops, field trips, and other events will be organized to introduce and further the knowledge of various topics in environmental and geo-environmental fields. It will provide a forum for networking with graduate students, faculty, professionals and societies in the environmental and geo-environmental fields and leadership to younger students interested in joining the environmental program.

Website: <http://www.coe.neu.edu/environment/NUGEGES/>

Contact: Nehreen Majed, President, nmajed@coe.neu.edu

Husky Energy Action Team (HEAT)'s mission is to help the university reorient itself towards a more just, healthy, and sustainable future through its operations, practices, awareness, and education. As a student group working towards environmental sustainability and carbon neutrality at Northeastern University, HEAT is part of Campus Climate Challenge (campusclimatechallenge.org), a nationwide coalition of over 500 schools all working to reduce greenhouse gas emissions on their campus. By educating and promoting energy saving practices to the Northeastern community while working alongside the administration, HEAT is creating a greener campus.

Websites: <http://www.heat.neu.edu/> and <http://www.facebook.com/group.php?gid=2222320731>,
email: nuheat@gmail.com

Contact: Dave Charnuska, Executive Director, davecharnuska@gmail.com

Northeastern University Vegetarian United – advocacy group that works towards increasing access to vegetarian food campus-wide; no website available; contact Ryan Fox, Food Advisory Group Coordinator, fox.r@neu.edu

Legal Environmental Advocacy Forum (LEAF) is dedicated to creating a forum in which contemporary legal issues pertaining to the environment may be examined and debated. The forum has brought several notable speakers to Northeastern and has held numerous fundraising/outreach events in order to increase awareness about cutting-edge legal and political issues. Plans for the future include, inter alia, an interactive Web site, lobbying for eco-friendly policies in federal, state and local, governments, and an environmental law journal.

Contact: leaf-officers@weboard.slaw.neu.edu

Resident Student Association (RSA) is an advocacy and programming organization that serves as the official liaison between the students living in Northeastern University residence halls and the staff and administration of University offices.

Website: <http://www.rsa.neu.edu/wordpress/>

Contacts: Mike Becker, Executive Vice President, becker.mi@neu.edu

Students for Environmental Action (SEA) is one of the pioneering student environmental groups on campus.

Although its mission statement has changed over the years, its main focus has always been raising awareness and

making changes on campus. It has been mentioned on Northeastern University's sustainability report card for the past 2 years as being a source of environmental activities on campus.

Website: <http://commugreen.wetpaint.com/page/Students+for+Environmental+Action>

Contact: Anderson Page, agodleyp@gmail.com

Student Government Association (SGA) is the student government arm on campus that affects policy and program development.

Website: <http://www.sga.neu.edu/>

Contact: Jessica Dervin-Ackerman, Sustainability Director, jdervina@gmail.com; and Ryan Fox, President, fox.r@neu.edu

Competitions - Northeastern offers a number of sustainability challenges and competitions. One of them is Do It In The Dark, initiated in the 1980s, with a goal of energy conservation awareness and reduction on campus. It was held annual for several years in the 1980's and 1990's, then was not offered again until approximately 2007 when HEAT organized competitions again between dorms. Participants include all residence halls. Incentives are prizes such as free massages, LED key chains, gift certificates to local businesses, pizza parties, MP3 players, and energy efficient. Lasting effects of Do It In The Dark include education, awareness, increased involvement in campus sustainability initiatives, and sustained attitudinal and behavioral changes. **Website: <http://www.heat.neu.edu/>.** The percentage of energy/water/waste reduced during this competition is provided in the chart below and accompanying attachments.

TABLE 6: PERCENT OF ENERGY AND TOTAL MTCE REDUCED DURING “DO IT IN THE DARK”

| Year of DIITD Competition* | kWh reduced* | Average % reduced* | Total MTCE reduced* |
|-----------------------------------|---------------------|---------------------------|----------------------------|
| 2007 | 37,695 | 2.8 | 15.5 |
| 2008 | 117,882 | 8.8 | 48.6 |
| 2009 | 176,326 | 13.4 | 72.6 |
| TOTAL | 331,903 | 8.3 | 136.7 |

***Based on model of expected usage.**

In 2010, Northeastern will participate in Recyclemania, a 10-week nationwide recycling competition with 608 registered participants (as of February 2010). In Northeastern’s inaugural participating year, Northeastern’s goal is to increase recycling awareness amongst faculty, students, and staff, and improve tracking systems for recycling efforts campus-wide.

Renewable Energy Fund - The Renewable Energy Fund, a student funded, opt-in fee initiated by students in 2007, is used for campus-wide renewable energy projects which serve as educational opportunities. The Fund is being reviewed to accept Alumni donations. In addition, there are several alumni green funds such as Engineers Without Borders, and the Department for Earth and Environmental Science. Cost savings from the Energy Management Program are also used to fund sustainability projects at NU.

CONCLUSION

The options outlined throughout this Climate Action Plan would reduce the University’s greenhouse gas emissions and eventually lead it to carbon neutrality. Over the past several decades, Northeastern has adopted strategic and operational changes to address environmental sustainability and lower its greenhouse gas emissions. The University continues expanding its curriculum, research, education, and community outreach to further integrate sustainability and reduction of its greenhouse gas emissions. To accelerate the reduction further and achieve its short- and long-term goals, the University will have to make a number of decisions with serious consideration to their financial impacts. To accomplish this, the University will have to assess its options and define assertive and responsible actions to speed our progress towards environmentally friendly policies, systems and facilities. Technology will play a significant role in this process. Sustainability will factor into our all of our decisions and plans so that we can move Northeastern towards carbon neutrality and being an exemplary model for society.

ATTACHMENT 1: SUSTAINABILITY DEFINITION

“At Northeastern University, sustainability is an ongoing process that harnesses the unique talents of students, faculty, staff, and the Northeastern community to develop technological, economic, and environmentally responsible policies and innovations that will balance the needs of present consumption without sacrificing the needs of future generations”.