

Leading by Example

A Report on Sustainable Programs and Practices at Massachusetts State Agencies

2003-2008



Prepared for Eric Friedman
Director of the Leading by Example Program
Executive Office of Energy and Environmental Affairs

Submitted by the
Bentley University Service Learning Center



About the Report

This report details the progress of the Massachusetts Leading by Example Program which oversees efforts undertaken by state agencies and institutions to reduce their environmental impacts. At a time when the public is beginning to recognize the huge opportunities available in the field of sustainability, there is much to be learned from the experience of groups, such as state agencies, that are leading the way in these efforts.

This report documents activities and operations executed throughout state government from 2003 to 2008, highlighting some of the more significant projects in a number of sustainability areas. Sections are divided into the following topics:

- climate change;
- energy efficiency;
- renewable energy;
- green buildings;
- transportation;
- environmentally preferable purchasing;
- recycling and waste;
- toxics;
- natural resources; and
- water conservation.

Each section provides background on the sustainability topic and state government activities, a list of projects implemented by agencies and institutions, and case studies on the most innovative and impactful projects.

About the Authors

For the past three years, Bentley University students have been given the opportunity to work as small consulting teams for the Massachusetts state government. Past projects have included working for the Massachusetts State Legislature on electricity prices and a potential influenza pandemic. During the Spring 2008 semester, nine students worked with the Director of the Leading by Example Program to create a report that identifies and documents state agency efforts that are leading the way in environmental sustainability.

These projects fulfill the final requirement for graduating seniors in Bentley's Honors Program. They are sponsored by Bentley's Service Learning Program whose mission is to promote academic learning through service. The service learning center believes that students' community involvement outside the classroom contributes significantly to what they study within it. Through these projects, students are able to learn about state government and important issues, while providing valuable reports in return.

The project team consisted of: Kristina Aufiero, Michael Burley, Christopher DiPietro, Matthew Hockridge, Eric Loring, Michael Perreault, Rebecca Ross (Project Manager), Thomas Schofield, and Baker Senecal. It was overseen by a faculty supervisor, Charles Hadlock. The information in this report was updated in the summer of 2008 by Jamie Pottner, a summer intern with the Leading by Example Program.

On the cover (clockwise from top left): LEED Gold building at Cape Cod Community College (Barnstable, MA); 660 kW wind turbine at Mass Maritime Academy (Buzzards Bay, MA); Global Electric Motorcar.

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Section 1 – Overview

Leading by Example Program

The Leading by Example Program (LBE) was created by Governor Deval Patrick's Executive Order 484 to facilitate and coordinate the sustainability efforts of state agencies, minimize the environmental impacts of their operations and activities, and promote innovative solutions to critical environmental problems. Although the Leading by Example Program began in 2007, state sustainability efforts are not new – Massachusetts state agencies have been implementing sustainability projects since the 1980s. The program furthers these initiatives by setting overall goals and providing technical and financial assistance, and coordinating efforts among state government.

The Executive Office of Energy and Environmental Affairs (EEA) and the Executive Office of Administration and Finance (A&F) oversee the Leading by Example Program. Within these two offices, various divisions and departments manage specific aspects of the program, including the Department of Energy Resources, Department of Environmental Protection, Division of Capital Asset Management, and the Operational Services Division.

The Leading by Example Program encompasses all of Massachusetts' executive agencies and public institutions of higher education. These agencies and institutions own 65 million square feet of buildings and 8,000 vehicles, employ over 65,000 people, and include 29 college and university campuses.

Executive Order No. 484

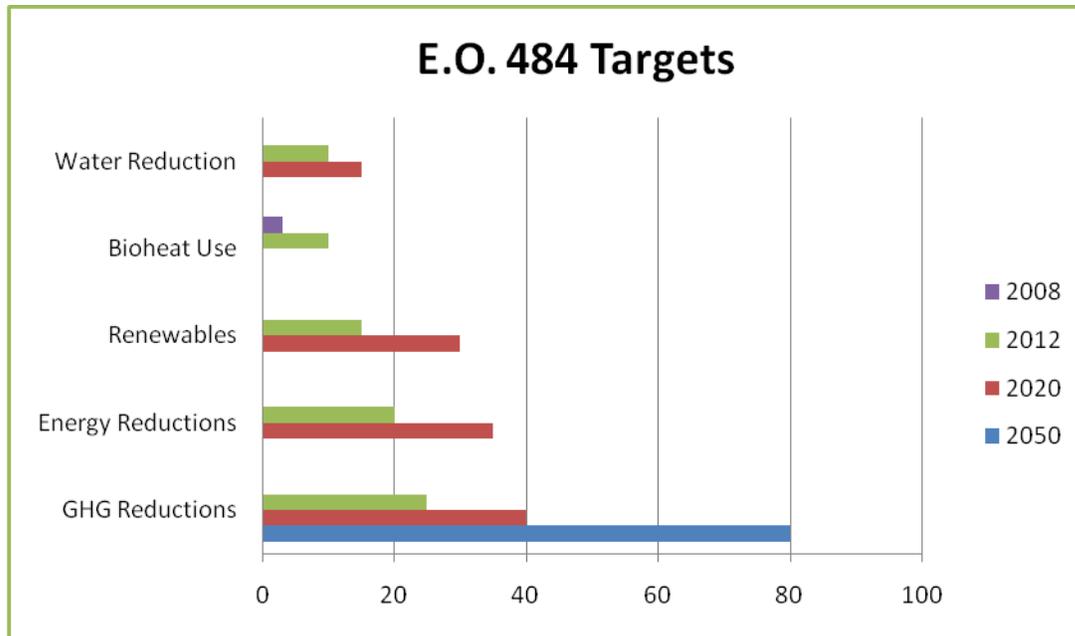
Executive Order No. 484 (E.O. 484): *Leading by Example: Clean Energy and Efficient Buildings*, issued on April 18, 2007 by Governor Patrick, establishes aggressive clean energy and efficiency goals throughout state government operations. State agencies are responsible for consuming over 1 billion kilowatt hours of electricity, 22 million gallons of heating oil, and 46 million therms of natural gas annually, resulting in the emission of over 1 million metric tons of carbon dioxide – equivalent to the emissions from more than 200,000 automobiles.

The Executive Order sets aggressive targets for all state agencies and public higher education campuses and provides recommendations on how to reach these goals.

Executive Order 484 requires that state agencies:

- Reduce greenhouse gas emissions 25 percent 2012, 40 percent by 2020, and 80 percent by 2050.
- Reduce their overall energy consumption 20 percent by 2012, from 2002 levels, and 35 percent by 2020, on a per square foot basis.

- Obtain 15 percent of their electricity from clean renewable sources by 2012 and 30 percent by 2020.
- Use biofuels for 3 percent of heating oil in the winter 2008-09 and 10 percent in 2010.
- Meet Massachusetts’s LEED-Plus green building standards for all new construction and major renovations, and consider energy performance in leasing decisions.
- Reduce potable water use 10 percent by 2012 and 15 percent by 2020.



To contact the Leading by Example Program, call Eric Friedman, Director, at (617) 626-1034 or by e-mail at eric.friedman@state.ma.us.

The Leading by Example Program homepage is: <http://www.mass.gov/energy/leadingbyexample>.

Data & Reporting

Measuring and tracking the environmental impacts of state agency operations and activities is a critical component of the Leading by Example Program and a requirement of E.O. 484. The ability to collect and manage operational data from state agencies allows the Leading by Example Program to assess the state’s progress in reaching sustainability goals and targets.

Data contained within this report was obtained by the Leading by Example Program from a variety of sources from fiscal years 2003 through 2008.

Agency Tracking and Reporting Forms

Agency tracking and reporting forms, distributed annually, are the primary method through which the Leading by Example Program obtains data from various state agencies and public higher education campuses. The form includes a section for a state agency to list numerical operational and environmental data for the most recent fiscal year and a section to provide information on sustainability projects and programs that have been implemented at facilities during the fiscal year. The LBE Program receives a significant amount of its data and information through the completion of agency tracking and reporting forms, though not all agencies and institutions submit them.

Other Reporting Tools

The Leading by Example Program also receives information directly from state facilities through the submission of sustainability plans, agency newsletters, and other agency documents. The LBE Program obtains some numerical data from individual state vendors via reports submitted to the Operational Services Division, such as for fuel oil. In the future, data provided by utilities will be tracked through online energy information system that monitors energy usage, such as electricity or natural gas, at specific facilities. Some agencies, such as the Board of Higher Education, provide useful operational and environmental data from their various sites.

Although the success of the LBE Program depends on the contributions of the state's 161 agencies and institutions, certain entities are central to the tracking and reporting process due to their scope and impact:

- Colleges and Universities – 5 UMass campuses, 9 state college and university campuses, and 15 community college campuses.
- Executive Agencies – Bureau of State Office Buildings (BSB), Chelsea Soldiers Home (CHE), Division of Capital Asset Management (DCAM), Department of Conservation and Recreation (DCR), Department of Mental Health (DMH), Department of Mental Retardation (DMR), Department of Correction (DOC), Department of Public Health (DPH), Department of Youth Services (DYS), Massachusetts Highway Department (MHD), Massachusetts Military Division (MIL), and Massachusetts State Police (POL).
- Authorities – Massachusetts Port Authority, Massachusetts Water Resources Authority (MWRA), and Massachusetts Turnpike Authority.

The Review Process

The LBE Program commits considerable resources to measuring the progress made by state agencies. Through the regular submission of tracking and reporting forms, state agencies can greatly enhance this process. As collecting data can be difficult, the report consists of the most up-to-date data available to the LBE Program and report authors.

Section 2 – Climate Change

Background

Climate change refers to the alteration of the Earth's weather patterns including temperature, precipitation, and wind due to global warming. Over the past century, greenhouse gases (GHG), most notably carbon dioxide (CO₂), have been the largest contributors to global warming.

Greenhouse gases can be released into the Earth's atmosphere through many natural processes. However, human activity has substantially increased the concentration of GHG emissions, primarily due to reliance on fossil fuels in transportation, buildings and industrial operations.

GHG emissions can be significantly reduced by:

1. Reducing overall energy consumption.
2. Purchasing more efficient products.
3. Developing and installing renewable energy generation.
4. Use of alternative fuels.

Executive Order 484 set the following GHG emission reduction targets for all state agencies:

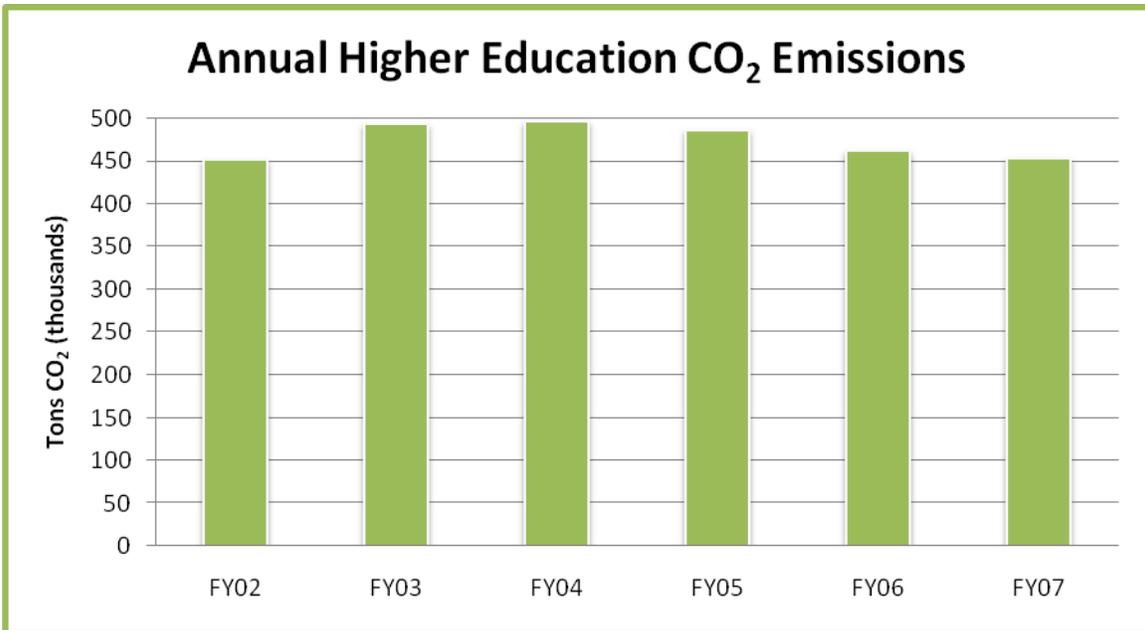
- 25% in 2012
- 40% in 2020
- 80% in 2050

In calculating emissions, E.O. 484 states that all agencies shall use FY 2002 as the baseline and all emissions reductions must be measured on an absolute basis, not adjusted for facility expansion, load growth, or weather patterns.

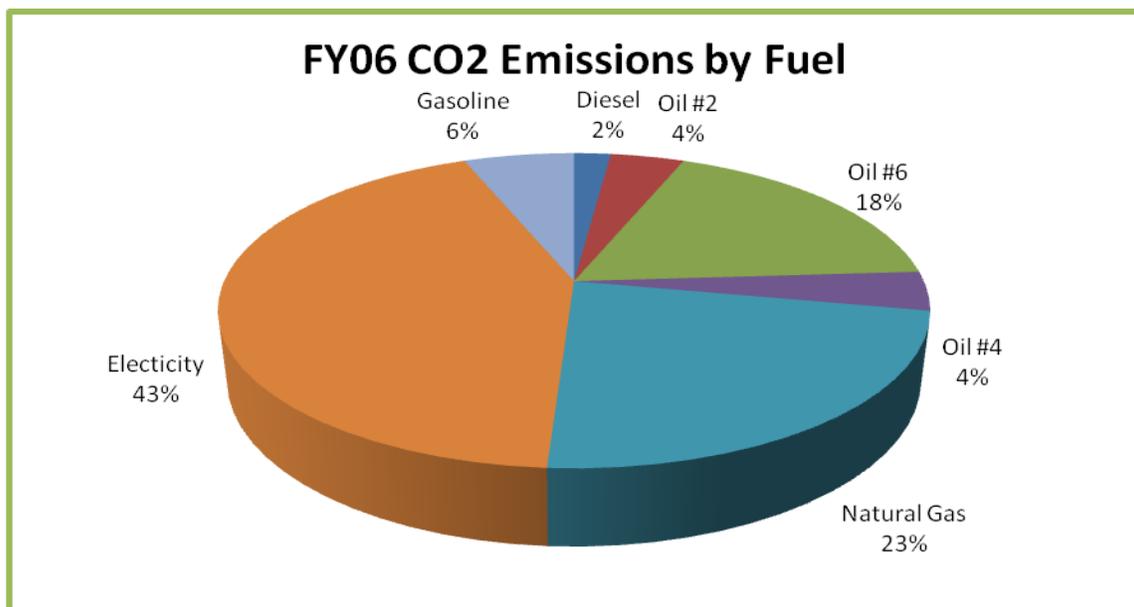
The Leading by Example Program's FY07 Greenhouse Gas Inventory of state agencies concluded that 90% of the Massachusetts state government's emissions were caused by energy consumed at state buildings, costing more than \$230 million, and resulting in nearly 1.2 million metric tons of GHG emissions. The remaining emissions resulted from transportation related activities.

The concentration of CO₂ in the atmosphere has risen from pre-industrial levels of 280 ppm to 379 ppm

(Intergovernmental Panel on Climate Change, 2005)



Since FY2003, efforts by Massachusetts Higher Education institutions have effectively reduced CO₂ emissions by a total of 8% or roughly 40,000 tons. The downward trend in emissions can be attributed to the many sustainable projects that have taken place throughout campuses since FY 2002. In 2007, all 29 Massachusetts public colleges signed the American College and University Presidents' Climate Commitment, vowing to increase efforts to further reduce greenhouse gas emissions.



In FY 2006, electricity production and consumption contributed the largest portion of state government CO₂ emissions among all fuel types with 43%. Oil and natural gas were the next largest contributors accounting for 26% and 23% respectively.

Case Study 1: Central Heating Plant at UMass Amherst

In 2007, UMass Amherst invested \$118.7 million in the construction of a new 45,000 square foot combined heat and power (CHP) central heating plant. The new plant will replace the existing coal burning facility which was built in the 1940s.

An advanced co-generation system will produce both heat and electricity in the most efficient manner possible, resulting in lower energy costs and reductions in GHG emissions. It will significantly reduce emissions of harmful pollutants, including sulfur dioxide and nitrogen oxide, because it will burn natural gas rather than coal and implement selective catalytic reduction technologies. Natural gas is a much cleaner fossil fuel and emits fewer pollutants and particulate matter into the atmosphere. Overall, the campus expects to reduce CO₂ emissions by 30% from its 2004 peak level. UMass anticipates a reduction in emissions of about 18% from FY07 emissions once the new CHP is online. Based on the campus' FY07 total emissions of 143,000 tons, an 18% emissions reduction averts 7,740 tons from the atmosphere.



October 2010 Update:

UMass Amherst achieved a 25% reduction in emissions from FY02-04 (baseline) emission levels with its new co-generation power plant.

The facility will also use recycled municipal wastewater for its boilers; thereby reducing the demand on the Amherst public water drinking system by 200,000 gallons per day.

UMass Amherst's former Chancellor John Lombardi stated, "This investment is environmentally friendly, energy efficient, and attractively designed. It represents a major step forward for UMass Amherst as we rebuild our campus infrastructure."

UMass Amherst's CHP Specifications include:

- 10-megawatt combustion gas turbine capable of producing 10 million watts of electricity at 13.8 kilovolts.
- Heat-recovery steam generator combined with three auxiliary package boilers that are estimated to produce 450,000 pounds of steam per hour.
- Two steam turbine generators totaling 4.5-megawatts fed off of 200 and 600 psig steam headers to meet additional heating, cooling, and electricity needs.
- Two 20-inch main stream transmission lines that will connect the plant to the existing campus distribution system.
- Pursuing addition of a biomass boiler

Case Study 2: Presidents' Climate Commitment

Massachusetts' public colleges and universities are at the forefront of the nationwide climate change initiative with all 29 public higher education institutions signing the *American College and University Presidents Climate Commitment (ACUPCC)*. Established in December 2006, this pledge encourages colleges and universities nationwide to make a commitment to become climate neutral, meaning that their carbon footprint will eventually be reduced to zero. To reach this goal, colleges and universities must minimize GHG emissions wherever possible, install renewables, and use carbon offsets to eliminate the remaining emissions.

558 higher education institutions nationwide have signed the commitment, as of December, 2008.

Participating institutions agree to take the following actions to reduce the environmental impact of their campuses:

- Complete an emissions inventory within one year and update every other year.
- Set a target date and interim milestones for becoming climate neutral.
- Take immediate steps to reduce greenhouse gas emissions through short-term actions.
- Integrate sustainability into the curriculum, making it a part of the educational experience.
- Make the action plan, inventory, and progress reports publicly available.

The Climate Commitment is not only concerned with making changes to reduce higher education's carbon footprint, but it also seeks to educate a broad range of people about challenges and opportunities. As Dr. Kathleen Shatzberg, the President of Cape Cod Community College who served as a member of the Presidents Climate Commitment steering council, said "It is also about education, about educating people to think differently and to live differently."

As one of its first steps in the President's Climate Commitment, the University of Massachusetts Medical School conducted a campus-wide carbon footprint assessment in 2007. Developed by ENSR, a private consulting firm, the study includes data on the school's fuel and onsite vehicle usage. The results will help guide the construction and design of its co-generation power plant, as well as improve the operation and maintenance of the school's facilities.

For further information regarding the ACUPCC, including a complete list of all signatories, please visit <http://www.presidentsclimatecommitment.org>



Section 3 – Energy Efficiency

Background

Energy efficiency is the substitution of existing practices with new technologies, behaviors, and equipment to maintain energy output, while reducing the energy input. With the rise in energy costs and increased concern about climate change, energy efficient practices and technologies are becoming more financially and environmentally viable.

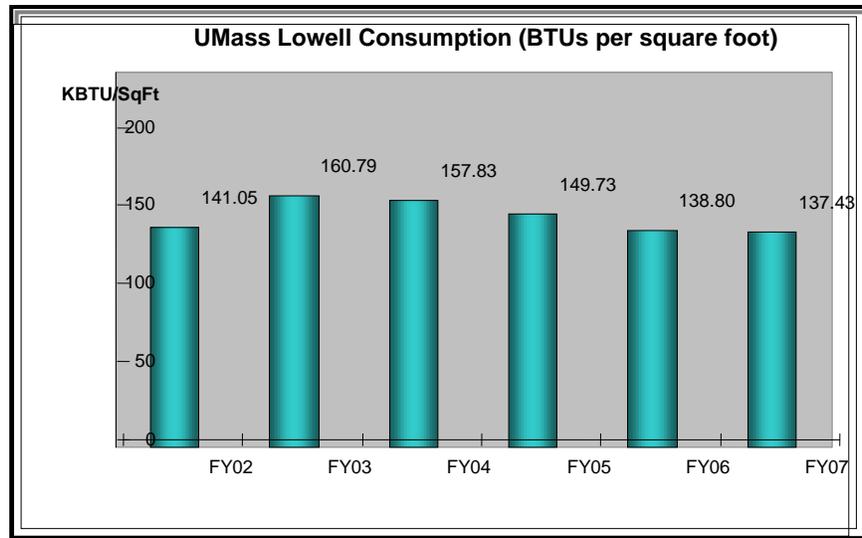
In fiscal year 2007, Massachusetts state agencies consumed:

Electricity	1.2 billion kWh
Natural Gas	36,500,000 therms
Heating Oil	23,350,855 gallons
Gasoline	9,912,878 gallons
Diesel	2,701,069 gallons

Executive Order 484 set the following energy consumption reduction targets for all state agencies based on a BTU per SF basis using a 2004 baseline:

- 20% by 2012
- 35% by 2020

The impact of E.O. 484 and the state's LBE efforts can already be seen in the decrease in energy consumption at a number of agencies. The Division of Capital Asset Management (DCAM) is responsible for oversight of Commonwealth construction and facilities maintenance projects, and has implemented more than 190 energy efficiency projects across Massachusetts state agencies over the past 20+ years. The Energy Efficiency and Sustainable Buildings Group administer programs to achieve energy efficiency, water conservation, and resource protection in state facilities throughout the Commonwealth. This group manages, administers, and advises energy and water saving performance contracting projects for new construction and renovations.



Since FY03, UMass Lowell has decreased its energy use (Btus per square ft) by 14.5%.

Lighting Efficiency Projects

Agency/Institution	Project Description	Environmental Benefits	Financials ¹
Bureau of State Office Buildings	Since FY06, over 2,200 incandescent bulbs have been replaced with CFLs at the State House	Annual savings is more than 350,000 kWh, reducing 146 tons of CO ₂	Cost: \$6,600 Annual savings: \$52,000
Department of Correction	Installed lighting retrofits during FY 2003 Used utility rebates for energy-savings products	Annual electrical savings of 4,300,000 kWh and reduction of more than 1,790 tons of CO ₂	Cost: \$155,590 Utility Rebate: \$110,220 Annual Savings: \$263,077 Payback: 2 months
Department of Conservation and Recreation	Replaced 6,800 traditional traffic light systems with LED optics substitutes in FY 2006 <i>*See case study</i>	Annual electrical savings of 2,870,000 kWh and reduction of more than 1,190 tons CO ₂	Cost: \$674,375 Rebate: \$485,180 Annual Savings: \$430,000 Payback: 6 months

¹ "Cost" represents the total cost of the project, unless otherwise stated. "Savings" represents the total savings of the project, unless otherwise stated. "N/A" is "not available."

Agency/Institution	Project Description	Environmental Benefits	Financials ¹
Department of Environmental Protection	After conducting a lighting audit in 2006, the Agency did a complete lighting retrofit in 2007 of its Boston Headquarters and replaced T-12 with T-8 energy efficient lamps and ballasts	Reduces energy consumption and GHG emissions	Based on previous electricity use and cost a 6 to 8 month return on investment is expected.
Massasoit Community College	Installed energy efficient light fixtures and motion sensors in FY 2007	Annual electrical savings of 1,137,500 kWh and reduction of more than 470 tons CO ₂	Cost: \$45,000 Rebate: \$10,930 Savings: \$150,310 Payback: 4 months
Mass Bay Community College	Most of the lighting in all three campuses has been upgraded to low-wattage, energy saving bulbs. Additionally, they are in the process of installing light motion sensors in many buildings and rooms	Conserves energy; reduces GHG emissions	Over 5 years, MBCC has saved nearly \$860,000 as a result of the lighting upgrades
Mass Highway Department	Mass Highway requires all new traffic light upgrades to be LED systems and has implemented a statewide replacement program to eventually replace all traffic signals with LED systems	Requires less maintenance and saves an estimated 4 million kilowatt hours per year; Reduce GHG emissions	Cost: \$150 per bulb Rebate: \$90
Mass Highway Department	Converted or replaced older fluorescent and high-output mercury vapor lighting fixtures with newer, more efficient lighting in district headquarters and various facility buildings across the state	Improved lighting quality and reduced energy consumption; reduces GHG emissions	N/A

Agency/Institution	Project Description	Environmental Benefits	Financials ¹
Mount Wachusett Community College	Installed T5 fluorescent lighting fixtures and CFL luminaries in FY 2007	Reduces energy consumption; reduces GHG emissions	Cost: \$1 million
Springfield Technical CC, Greenfield CC, UMass Medical School	Installed daylight sensors that shut off lights when daylight is present	Energy savings of 45%; Reduces GHG emissions	Cost: \$161,600 Annual Savings: \$151,686
UMass Lowell	Replaced 21,000 watts of metal halide lighting with 10,500 watts of super T8 lamps in FY 2007	Annual electrical savings of 68,000kWh and reduction of more than 28 tons CO ₂	Cost: \$20,000 Annual Savings: \$10,000 Payback: 24 months
UMass Lowell	Installed dual technology lighting sensors in FY 2007	Annual electrical savings of 18,000kWh and reduction of more than 7 tons CO ₂	Cost: \$10,000 Savings: \$3,333 Payback: 36 months
Various Agencies	Replaced incandescent lighting with compact, T5, and T8 fluorescent bulbs	Energy savings of 66%	Cost: \$130,877 Annual Savings: \$319,611

Case Study 3: Traffic Light Conversion by the Department of Conservation and Recreation (DCR)



*Light Emitting Diodes (LED's)
use 80%-90% less energy than
incandescent light bulbs.*

In 2006, utilizing research funding from the LBE Program, the Department of Conservation and Recreation launched a project to replace all traffic lights containing incandescent bulbs with light emitting diode (LED) traffic lights. Across Massachusetts, new LED optics substitutes were put in approximately 6,800 traditional traffic light systems.

LEDs have advantages over traditional incandescent traffic lights in energy usage and overall lifetime cost. An 80% decrease in maintenance costs along with an eight to ten year extension of the bulb's service life provides the state with sizable overhead and energy usage savings and notable reductions in CO₂ emissions.

With an initial project cost of \$674,375, DCR received \$485,180 in utility incentives, bringing the total project cost to \$189,175. Annual energy usage savings are expected to be \$430,000, allowing the state to yield a profit from the project in less than six months.

Along with financial savings, the DCR will see environmental savings of:

- 2,870,000 kilowatt hours of electricity
- 1,140 metric tons of CO₂ emissions
- 7.31% total reduction in agency electricity usage

The following results are achieved from using LEDs as a traffic light source:

- 80% to 90% less power usage than traditional incandescent sources.
- Functional service hours of up to 80,000 hours in a traffic light system, which is forty times longer than the life of an incandescent bulb.
- Light emitted without color slicing or color fading resulting in bright and highly contrasting light with a large visual angle ideal for viewing by motorists.

Building Envelope, Operations & Equipment

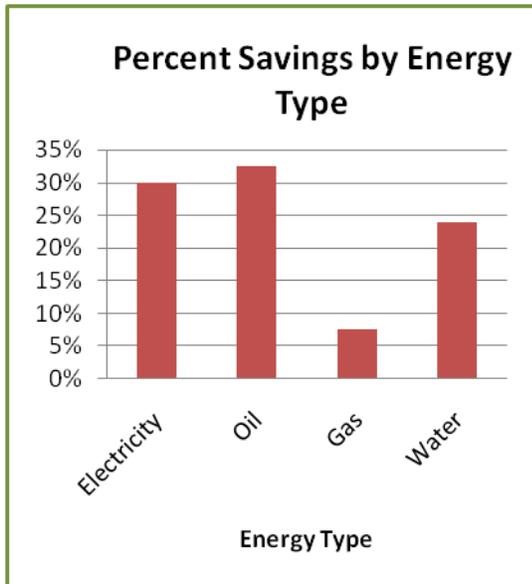
Agency/ Institution	Project Description	Environmental Benefits	Financials
Bridgewater State College	Replaced HVAC units, retrofitted 10,000 light fixtures and installed EMS system in FY 2006 <i>*See case study</i>	Annual electrical savings of 4,769,996 kWh and reduction of 2,766 metric tons CO ₂	Cost: \$11 million Annual Savings: \$950,000 Payback: 11.6 years
Bunker Hill Community College, Westfield Community College	Raised temperature on HVAC system air flow in FY 2006	Energy savings of 5% for every 5° F increase in temperature	Cost: \$0
Department of Correction	Completed installation of thermostatic control radiator valves in 2007.	Reduced fuel usage by nearly 18,000 gallons over the 2007-2008 winter	Cost: \$8,000 (from LBE) Annual Savings: \$60,000
Fitchburg State College	Since FY05, 7 residence hall buildings have been taken off the central steam plant and converted to heating and hot water with high efficiency natural gas boilers	Less hazardous air pollutants; 23,410 gallons of #6 fuel oil not burned per year; reduced GHG emissions	N/A
Fitchburg State College	In FY07 a 1,100 horsepower boiler burning #6 1% sulfur fuel oil was replaced with a dual-fuel natural gas and #6 0.5% sulfur oil-600 horsepower low emissions boiler with greater turn down abilities	311,898 gallons of #6 fuel oil not burned per year; reduced GHG emissions	N/A
Greenfield Community College	Installed 3M solar film on facility windows in FY2006	Reduces indoor heat loss by 35%	Cost: \$5,700
Greenfield Community College	Replaced electric HVAC system with natural gas starting in FY 2006	Reduces energy consumption by 50%	Annual Savings: \$98,101

Agency/ Institution	Project Description	Environmental Benefits	Financials
Mass Bay Community College	Upgraded heating/cooling system and piping for 50% of occupancy space beginning in FY 2005	Decreases electrical consumption by 21%	Cost: \$3 million
Mass Bay Community College	Converted 14 roof-top HVAC units to gas and fitted all fixtures with T8 bulbs controlled by sensor switches in FY 2007	Reduces electricity demands	Cost: \$1.3 million Annual Savings: \$145,000 Payback: 9 years
Mass College of Art and Design	Installed energy efficient chillers to replace old steam absorption machines	Reduces energy consumption; Reduces GHG emissions	N/A
Mass College of Art and Design	Installed Autoflame technology on 3 boilers capable of tracking all emissions and savings	Reduction in fuel usage by 7-12% leading to lower emissions	Cost: \$154,000 Rebate from Keyspan: \$28,000 Annual Savings: \$73,550 Payback: 2 years
Mass College of Art and Design	Automated DDC Controls to monitor building heating and cooling	Reduces energy consumption	Cost: \$3.7 million Savings: \$500,000/year Payback: 10 years
Mass College of Liberal Arts	Installed a co-generation system in FY 2005	Annual electrical savings of 2,298,000 kWh and reduction of more than 950 tons CO ₂	Cost: \$1.6 million Utility Rebate: \$200,000 Annual Savings: \$126,000
Mass Highway Department	Replaced existing windows with high R-value double pane glass windows in many buildings across the state	Reduces energy consumption due to heating and cooling; Reduces GHG emissions Enhances natural light of work spaces	N/A
Mass Highway Department	Replaced boilers with newer, more efficient	Reduces energy consumption and GHG	N/A

Agency/ Institution	Project Description	Environmental Benefits	Financials
	models in many buildings. Installed individual room heating radiator controls at Arlington headquarters to minimize heating underused areas.	emissions	
Mass Water Resources Authority	Installed new air handling systems with premium efficiency motors in FY2005	Annual electrical savings of 200,000 kWh of electricity, reduction of more than 80 tons CO ₂ and 43,000 gallons of oil	Cost: \$1,170,000 Annual Savings: \$72,286.33 Payback: 16 years
Mass Water Resources Authority	Reduced heating loop temperatures at plant operations in FY2007	Reduces energy consumption	Cost: \$0 Savings: N/A Payback : 0
Mass Water Resources Authority	Installed 8 variable frequency drives at pump stations	Annual electrical savings of 1,261,357 kWh and reduction of more than 520 tons CO ₂	Cost: \$5.32 million Utility Rebate: \$200,000 Annual Savings: \$126,000
Massasoit Community College	Replaced 3 HVAC units on student center roof with more efficient units in FY2006	Estimated energy savings of 38%	Cost: \$150,000
Massasoit Community College	Replaced 33 year old air handlers and old EMS in FY2007	Reduces energy consumption	N/A
Northern Essex Community College	Replaced existing roof with 5.5 inch insulated roof in FY2007	Reduces heat loss and energy consumption	N/A
Northern Essex Community College	Contracted with EnerNoc to shutdown campus in emergency conditions beginning in FY2007	Reduces energy consumption	Cost: \$0
Quinsigamond Community College	Installed window film, pool cover, and electronic EMS in FY2006	Reduces energy consumption and GHG emissions	N/A

Agency/ Institution	Project Description	Environmental Benefits	Financials
Salem State College	Installed and replaced 6 boilers. Upgraded 3 to dual-fuel boilers in FY2006.	Reduces energy consumption and GHG emissions	N/A
UMass Amherst	Installed centralized EMS and monitoring system in FY2006	On-peak annual savings of 7,016,454 kWh and reduction of approx. 2,920 tons CO ₂	Annual Savings: \$726,231
UMass Boston	Replaced electric boilers with natural gas boilers, upgraded EMS, and improved lighting in FY2002	Annual electrical savings of 26.5 million kWh, reduction of more than 11,046 tons CO ₂ and water savings of 14.2 million gallons	Cost: \$13 million Annual Savings: \$1.9 million Payback: 7 years
UMass Boston	Computer power management software	Pilot project results for 215 PCs showed energy reductions of approximately 54%	N/A
UMass Dartmouth	Installed controllers to shut down air handlers in the library and campus center several days a week; air handlers are also manually shut down selected locations on weekends.	Reduces energy consumption and GHG emissions	Estimated savings for a winter month are 10,100 gallons of fuel oil at a cost of \$20,000.
UMass Lowell	Retrofitted boiler with automated controls in FY2007	Reduces energy consumption and GHG emissions	Cost: \$120,000
UMass Medical School	Replaced 30 year old chilled water coils in 9 central air HVAC units occurring in FY2006	Increased efficiency due to increased chilled water pumping capacity by 25%	Cost: \$14 million
Worcester County Jail	Replaced PV1 water heater with efficient Rinnia heaters in FY2006	Reduces energy consumption and GHG emissions	Cost: \$42,839 Annual Savings: N/A Payback: N/A
Worcester County Jail	Replaced failed and obsolete boilers in FY2006	Reduces energy consumption & GHGs	Cost: \$1.5 million

Case Study 4: Energy Conservation Project at Bridgewater State College



Beginning in March 2006, Bridgewater State College (BSC), in collaboration with DCAM, contracted with Select Energy Services to complete a campus-wide energy efficiency overhaul of the college’s facilities. The cost of the project was \$11 million to be paid back over 20 years. BSC is financing the project through the state’s Energy Performance Contracting Program, allowing the college to pay for the project with their estimated future energy savings.

The Energy Conservation Project applied energy efficient improvements to most buildings on the BSC campus. The most notable changes include the retrofitting of over 10,000 campus-wide light fixtures with energy efficient lamps, the replacement of HVAC ventilation units at Kelly Gym, the integration of a

campus-wide Energy Management System (EMS), and the installation of a co-generation plant that will provide both electricity and hot water for the college’s athletic center.

The project is estimated to save BSC over \$950,000 annually – approximately 25% of their typical energy bill. The project also serves to improve the quality of life on the BSC campus by minimizing the college’s impact on the surrounding environment.

The annual environmental benefits of the project include reductions in:

- CO₂ emissions of 2,766 metric tons
- SO₂ emissions of 10.65 metric tons
- NO_x emissions of 3.67 metric tons

Energy Type	FY 06 Consumption	Projected Savings
Electricity	17,283,275 kWh	4,769,996 kWh
Heating Oil	821,595 gallons	344,294 gallons
Natural Gas	420,827 therms	34,283 therms
Water	31,922,585 gallons	9,274,311 gallons

Environmentally Preferable/Energy Efficient Products

Agency/ Institution	Project Description	Environmental Benefits	Financials
Berkshire Community College	Procured Energy Star products for campus operations in FY 2007	Reduces energy consumption	Cost: \$0
Department of Education	Installed Vending Miser power controllers on vending machines in FY 2006	Energy savings of 10% per unit	N/A
Department of Revenue	Installed computer management software to adjust electrical draw according to usage <i>*See case study</i>	Reduction of CO2 emissions by 288 metric tons	Cost: \$53,700 Savings: \$248,000 over 5 years Payback: 13 months
Mass Highway Department	Purchased and installed Energy Star air conditioners in the District 2 and 3 headquarters buildings to replace older, inefficient models	Reduces energy consumption and GHG emissions	N/A
Mass Maritime Academy	Energy misers installed on 21 campus vending machines in FY 2006	Machines now use 46% less energy	Cost: \$4,706
Mass Water Resources Authority	Replaced 441 CRT monitors with LCD monitors in FY 2007	LCD monitors use up to 65% less energy	N/A
Mass Water Resources Authority	Installed computer management software to adjust electrical draw according to usage in FY 2007	Reduces energy consumption and GHG emissions	Cost: \$34,439 Savings: \$25,959 Payback: 18 months
Massasoit Community College	Made it a bid requirement for all vending machines to have misers installed in FY 2006	Annual electricity savings of 1,000-1,500 kWh per machine	N/A

Agency/ Institution	Project Description	Environmental Benefits	Financials
Quinsigamond Community College	Removed hand towel dispensers and installed XLerator hand dryers in FY 2007	Reduces energy consumption by 80% over traditional dryers	Cost per dryer: \$380
Springfield Technical Community College; Department of Correction	Replace outdated incandescent exit signs with LED signs in FY 2005 <i>*See case study</i>	Energy savings of 80%	Cost per sign: \$30.12 Savings per sign: \$28.25
UMass Boston	Vending Misers installed on campus vending machines	30-40% energy savings on more than 50 vending machines on campus	Cost: \$14,000
Worcester State College	Installed 16 test computers with 2-3 times the life cycle of traditional computers	Reduces electronic waste	N/A
Worcester State College	Purchased Energy Star EPEAT Silver Certified replacement computers in FY 2006	Computers are 65% more efficient than traditional PCs	N/A

Case Study 5: LED Exit Signs at the Department of Correction and Springfield Technical Community College

In FY2005, the Massachusetts Department of Correction (DOC) and Springfield Technical Community College (STCC) installed hundreds of LED exit signs at their facilities. The new signs replace their outdated incandescent counterparts, which were less efficient.

The pre-existing incandescent signs used between 17 and 100 watts, while the new LED exit signs use only .72 watts. As a result of reduced energy consumption, each LED exit sign is estimated to reduce greenhouse gas emissions by nearly 3 tons over its lifespan.



Throughout the facilities, 374 signs were purchased at a cost of \$30.12 each. The Department of Correction purchased 300 LED signs, resulting in a total project cost of \$8,434. They estimate annual energy costs savings of \$7,708 and expect a full payback on their initial investment after 14 months of use. The DOC anticipates a lifetime savings of \$154,000 from the installation of these signs.

LED exit signs can save upwards of 700 kWh of energy annually.

At Springfield Technical Community College, 74 signs were replaced around the campus at a cost of \$2,229. The school expects to save 50,142 kWh of energy and \$2,091 on an annual basis with an estimated \$43,000 in savings over the next twenty years. The new exit signs at STCC will pay for themselves in less than 13 months.

STCC also purchased 10 photo luminescent exit signs, costing \$110 each, which use zero electric power and charge themselves from daylight or fluorescent lights. While more expensive than the LED exit sign, they do not require wiring for installation and there is minimal lifetime maintenance required.

Agency	Project Cost	Estimated Annual Savings	Estimated Payback
DOC	\$8,434	\$7,708	14 months
STCC	\$2,229	\$2,091	13 months

Case Study 6: Computer Management at Mass Department of Revenue

In 2007, the Massachusetts Department of Revenue (DOR) executed a project to reduce the electrical consumption of its computer network. Each year the DOR receives millions of tax returns that require electronic processing, indexing, and archiving through Taskmaster, the agency's automated data entry software. The implementation of Taskmaster software in 1997 increased the organization's need for more computers, resulting in an upsurge in energy spending during a period of rising energy prices.

DOR installed computer management software on its computer network to cut down on the system's electrical consumption. This software is designed to reduce the electrical draw of a computer after a period of inactivity. An extended idle period causes the computer to shut down unnecessary operations; thereby, reducing the amount of energy needed to power it.

The computer management software successfully decreased the amount of energy consumed by the DOR. Over the next 5 years, DOR is expected to save \$248,000 in energy cost. The new software is also expected to yield a return of 360% with a payback period of just over 13 months.

In terms of environmental benefits, the computer power management software has reduced the Department of Revenue's annual CO₂ emissions by 288 metric tons.



Installing a computer power management software reduced the Department of Revenue's CO₂ emissions by 288 metric tons.

Financial Results

- Savings = \$248,000 over 5 years
- Annual Savings: approx. \$50,000
- Return on Investment = 360%
- Payback Period = 13 months

Section 4 – Renewable Energy

Background

Renewable energy can help reduce our reliance on fossil fuels including coal, oil, and natural gas. As clean sources of energy, renewables often have lower environmental impacts than conventional fossil fuels and generation. They produce lower (if any) levels of air pollutants, wastewater, smog, and acid rain. Some of the more commonly used technologies include:

Wind Power – Wind turbines generate electricity by harnessing the wind’s energy. Wind is a local and inexhaustible resource that emits no air or water emissions.

Solar Energy – Sunlight can be converted directly into electricity using photovoltaic (PV) cells that are made of semiconductor materials. Solar power does not emit air or water emissions. In addition, sunlight can also be harnessed for heat through solar thermal technologies and passive solar building design.

Biomass – Biomass facilities burn plants and organic matter such as wood, agricultural waste and/or methane gases from landfills to generate electricity and/or heat.

There are many benefits to using renewable energy sources, making them a priority for the Commonwealth of Massachusetts. Most investments in renewable energy are spent on the materials and labor needed to build and maintain these technologies, rather than importing energy. Therefore, investments in renewable energy often lead to the creation of jobs which help support local economies. Governor Deval Patrick delivered a Comprehensive Clean Energy Strategy to the Greater Boston Chamber of Commerce on May 1, 2008, closing with “the age of fossil fuels is passing. If we act now, the age of clean energy is ours.”

Executive Order 484 set the following renewable energy targets for all state agencies:

- Obtain 15% of electricity purchases from renewable resources by 2012 and 30% by 2020.

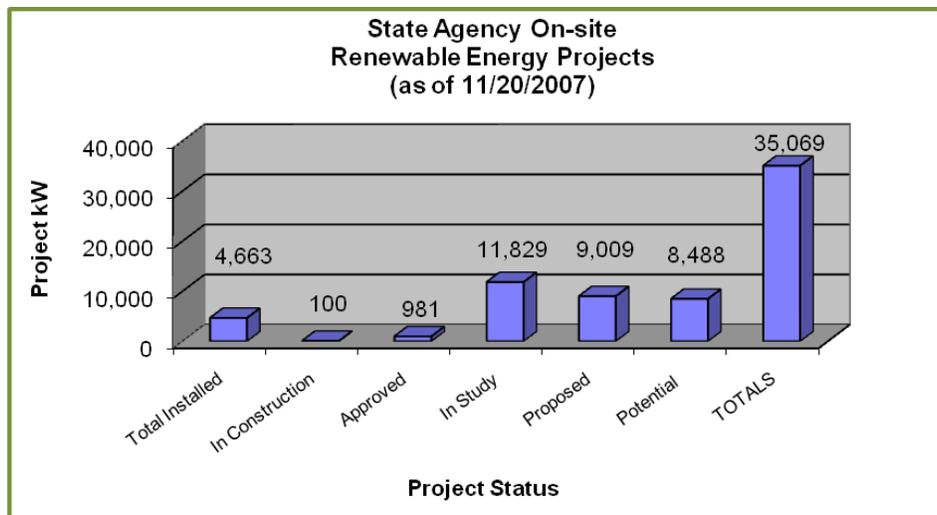
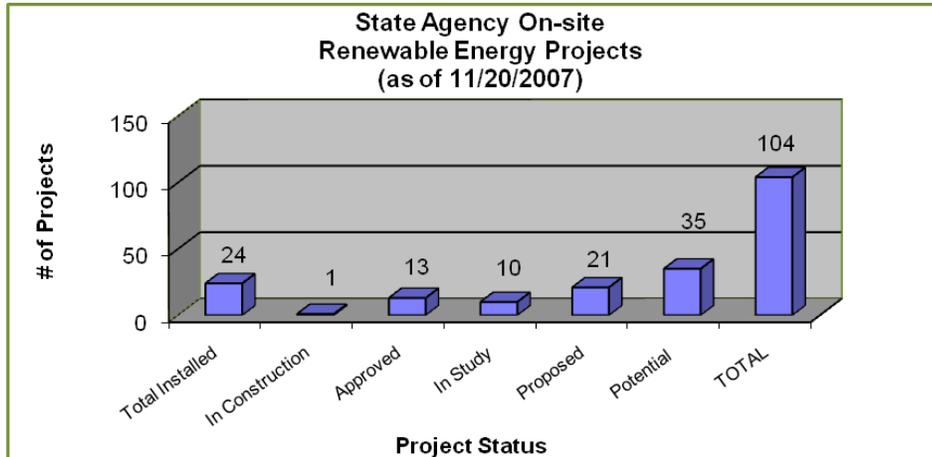
According to E.O. 484, state entities must make every effort to power their facilities with clean, renewable energy resources through:

- The installation of on-site generation.
- The purchase of renewable power from energy suppliers.
- The use of Renewable Energy Certificates (RECs) in compliance with guidelines established by the EEA.

In 2007, the Leading by Example Program performed the following tasks in an effort to help state entities reach these target statewide goals for renewable energy:

- Accessed \$8.5 million in capital from CREBS, ACP and MTC to finance 1 megawatt (MW) of PV at 12 state facilities.
- Conducted wind installation and feasibility analyses at multiple sites.
- Conducted a statewide solar roof survey for future projects.
- Initiated investigations of geothermal and biomass heat and co-generation opportunities.

The charts below detail the state’s current overall status, as of November of 2007, within regards to renewable energy.



Definitions

Potential – Identified as a possibility

Proposed – Passed initial review hurdles but needs additional study or review

In Study – Informal study process to determine final feasibility

Approved – Approved by all appropriate parties and funding is secured

In Construction – Construction contract awarded and installation begun/imminent

Installed – Completed and operational

Wind Power

Agency/Institution	Project Description	Environmental Benefits	Financials ²
Department of Conservation and Recreation	Investigating the installation of wind turbines at Harbor Islands, including Spectacle Peddocks and Georges Islands	Lowers electricity bills and reduces CO ₂ emissions	N/A
Department of Correction	Currently conducting a feasibility study for a wind turbine at the Gardner prison facility	Lowers electricity bills and reduces CO ₂ emissions	N/A
Greenfield Community College	Replaced existing 26' high .75 KW wind turbine generator with a 46' pole in FY 2006	Provides usable data to validate future capability for wind turbine electricity generation potential	Cost: \$3,000
Mass Maritime Academy	Installed 660 kW wind turbine in FY 2006 Generates over 1 million kWh per year <i>*See case study</i>	Eliminates carbon emissions by 556 tons annually, equal to 7.5% of Mass Maritime's total carbon emissions	Cost: \$1,600,000 Annual Savings: \$300,000 Payback: 5 years
Mass. Port Authority	Installed 20 building-integrated wind turbines at Boston Logan International Airport on the Logan Office Center in FY 2008	Expected annual electrical output of approximately 100,000 kWh, or about 2% of the building's monthly energy use; Demonstrates building integrated technologies	N/A

²“Cost” represents the total cost of the project, unless otherwise stated. “Savings” represents the total savings of the project, unless otherwise stated.

Agency/Institution	Project Description	Environmental Benefits	Financials ²
Mass Water Resources Authority	Conducted pre-feasibility studies for 15 MWRA sites and a full feasibility study for 4 of the top-ranked sites in FY2007. Secured FAA approval to erect 2 190-foot wind turbines (660 KW) at Deer Island Waste Water Treatment Plant.	Less reliance on fossil fuels and decreased CO ₂ emissions Will generate up to 2 million kW hours per year Offsets electricity purchases and creates a clean fuel source	Cost: \$212,400 MTC grant of technical services (\$55,000) through the Community Wind Collaborative
Plymouth County Sheriff	Finalized analysis – moving forward with 1-2 turbines >1 MW each	Turbine would satisfy a significant portion of electrical needs and reduce CO ₂ emissions	N/A
Worcester Community Sheriff	Currently taking wind measurements	Turbine would reduce campus CO ₂ emissions	N/A
Mount Wachusett Community College	Finalized analysis – moving forward with 1-2 turbines >1 MW each	Turbine would satisfy a significant portion of electrical needs and reduce CO ₂ emissions	N/A
Quinsigamond Community College	Conducted a Fatal Flaws Analysis for a Wind Turbine in FY 2006	Turbine would reduce campus CO ₂ emissions	N/A
UMass Dartmouth	Installed MET tower currently taking wind measurements	Turbine would reduce campus CO ₂ emissions	N/A
UMass Lowell	Installed three small wind turbines for combined 2.3 kW	Usage of clean energy and reduced CO ₂ emissions	Annual Savings: \$1,500

Case Study 7: Wind Turbine at Mass Maritime Academy



On April 25, 2006, the Massachusetts Maritime Academy, in Bourne, Massachusetts, became the first Massachusetts state agency or institution to install a large wind turbine. The 660 kW wind turbine generates over 1 million kWh per year, fulfilling one-quarter of the campus' electricity needs. Power generated by the turbine is expected to eliminate carbon emissions by 556 tons, equal to 7.5% of Mass Maritime's total carbon emissions.

The 164 foot Vestas tower reaches a total height of 241 feet. The turbine project was overseen by the Division of Capital Asset Management (DCAM) and received strong support from MMA President Richard Gurnon and his staff.

Financial Highlights:

- Construction cost \$1.6 million
- Received \$500,000 construction grant from the Mass Technology Collaborative (MTC) and \$650,000 grant from the state
- Payback period of 5 to 6 years

Savings associated with MMA wind turbine include:

- Reduced annual campus energy bills by over \$210,000.
- Expected additional revenue of approximately \$86,000 from energy sales to the grid and from the sales of Renewable Energy Certificates to the Massachusetts REC market.
- Anticipated to generate more than \$7 million worth of electricity for the Mass. Maritime Academy over the turbine's life.
- Produce 1.1 million kWh
- Reduce GHG emissions by

Solar Power

Agency/Institution	Project Description	Environmental Benefits	Financials ³
Cape Cod Community College	Installed 30 kW of solar PV panels on LEED Gold Technology Center and Science Center in FY 2006	Cleaner energy and reduced CO ₂ emissions	N/A
Department of Conservation and Recreation	Installed 8 kW PV panels on the visitor center at Spectacle Island in FY 2006	Cleaner energy and reduced CO ₂ emissions	N/A
Department of Environmental Protection	Moving toward a 29 kW solar array at the William X. Wall Experiment Station in Lawrence	Cleaner energy and reduced CO ₂ emissions	Net cost after incentives and grants is estimated at: \$14,540 Annual Savings: \$7,000 Payback: 2 years
Greenfield Community College	Installed pole mounted photovoltaic panel array and utility interconnection (2kW) in FY 2006 Used as a pilot site to identify PV generating capacity in planning of a 60kW+ installation	Cleaner energy and reduced CO ₂ emissions Location has created interest and public awareness for sustainability	Cost: \$27,000
Mass College of Liberal Arts	Installed a small field of 9kW PV panels in FY 2005 Serves as an important laboratory for the new environmental science programs	Cleaner energy and reduced CO ₂ emissions	N/A

²“Cost” represents the total cost of the project, unless otherwise stated. “Savings” represents the total savings of the project, unless otherwise stated.

Agency/Institution	Project Description	Environmental Benefits	Financials ³
UMass Amherst	Installed a 7.5 kW PV array on Knowles Engineering Building in FY 2006	Demonstrates the viability of net metered, on-site generation	N/A
UMass Amherst	Installed 23 PV parking lot lamps in FY2006	Reduces electricity demand by 14,150 kWh Reduced CO ₂ emissions	Savings: \$2,321
UMass Lowell	Expanded PV system to 13.5 kW at the school's engineering building in FY 2006	Cleaner energy and reduced CO ₂ emissions	N/A
Massasoit Community College	In the process of installing solar panels on the Field House to heat the swimming pool	Cleaner energy and reduced CO ₂ emissions Focal point of campus sustainability	N/A
Leading by Example Program, Division of Capital Asset Management, Department of Employee Relations, Mass Development	Unified twelve projects within Massachusetts to fund 1MW of solar energy at twelve sites using Clean Renewable Energy Bonds (CREBs) <i>*See case study</i>	Expected to annually generate a combined 1,000,000 kWh per year and eliminate an estimated 460 metric tons of carbon dioxide	Cost: \$8,600,000 from CREBS Savings: > \$150,000 Payback: Bond payments are 15 years are equal to annual savings

Biomass

Agency/Institution	Project Description	Environmental Benefits	Financials
Department of Conservation and Recreation	<p>Installed a biomass heating system at Quabbin Reservoir facility in FY2007</p> <p>Will utilize wood chips from DCR's green certified watershed forestry program to heat the building</p>	Cleaner energy and reduced CO ₂ emissions	<p>Cost: \$500,000</p> <p>DOER constructed the design</p> <p>Funded by the DCR</p>
Mount Wachusett Community College	<p>Installed the state's first public biomass heating plant in FY2002</p> <p><i>*See case study</i></p>	<p>Reduces the campus' reliance on electricity for heating by 80%</p> <p>Lower CO₂ emissions</p>	<p>Cost: \$4,337,911</p> <p>Annual savings: \$400,000</p> <p>Payback: 11 years</p>
Springfield Technical Community College	Installed a biomass heating system	Cleaner energy and reduced CO ₂ emissions	N/A
UMass Amherst	Plans to install a biomass heating system	Cleaner energy and reduced CO ₂ emissions	N/A
UMass Dartmouth	Plans to install a biomass heating system	Cleaner energy and reduced CO ₂ emissions	N/A

Case Study 8: Biomass Heating Plant at Mount Wachusett Community College

Mount Wachusett Community College (MWCC) is home to the Massachusetts state government's first biomass heating plant. The campus is able to heat virtually the entire campus by burning waste woodchips from regional mills. The biomass heating plant replaced a costly electric heating system, resulting in energy cost savings of \$400,000 per year. Since its inception in 2002, the campus's reliance on electricity for heat has decreased by 80%. Currently, the biomass plant supplies 8 million BTUs per hour of hot water and replaces the equivalent of 3.4 million kWh of electricity.



The first state-owned biomass heating plant is located at Mount Wachusett Community College.

The total cost of the project was approximately \$4 million. MWCC received \$1 million from the U.S. Department of Energy as part of the 2001 Energy and Water Development Appropriation Bill and \$750,000 from the Massachusetts Technology Collaborative. MWCC also secured approximately \$100,000 in energy rebates from their local utility and \$225,000

from the Massachusetts Division of Capital Asset Management. As a result, MWCC was left to finance \$1.8 million through a Tax Exempt Lease Purchase. Additionally, the College received a 25% bonus rebate of approximately \$22,750 from their local utility because it accelerated the installation of a number of the Energy Conservation Measures for the project.

The College entered into a shared savings agreement with NORESKO, the principal contractor for this project. The agreement guarantees that the annual energy savings associated with the project, forecasted to be \$286,467, will exceed the annual financing charge by a minimum of \$8,520. The result of this shared savings agreement was a positive cash flow in the first year of operation.

Other

Agency/Institution	Project Description	Environmental Benefits	Financials
Mass College of Art and Design	Discussions are underway with Turbo Steam and Thermal Products Inc. to establish a plan to capture wasted thermal energy from Hot Shop Kilns in FY 2007	Either reduces cost by heating water or potentially creates enough steam to turn a turbine that would generate electricity for the campus	N/A
Mass Water Resources Authority	Started to use hydropower to generate electricity at West Boylston in FY2007 Oakdale hydroelectric turbine runs when water is transferred from the Quabbin Reservoir to the Wachusett Reservoir	Cleaner energy and reduced CO ₂ emissions The turbine generated 10,134 MWh in FY07	Annual Savings: \$500,000 Net revenue: \$721,814
Mass Water Resources Authority	DI steam turbine generator was qualified as a renewable energy generator under Massachusetts Renewable Portfolio Standard in FY03 Derives energy from digester gas burned in the boilers	Cleaner energy and reduced CO ₂ emissions	Cost: \$0 Savings in FY07: \$1.35 million
Salem State College	Purchased 3,500,000 kWh of Renewable Energy Certificates annually from Sterling Planet in FY2007 as part of a 3 year contract	Reduces carbon footprint of college	Annual Cost: \$20,860
UMass Lowell	Purchased 4,000,000 kWh of Renewable Energy Certificates	Reduces carbon footprint of campus	Annual Cost: \$7,500

Case Study 9: Solar Power through Clean Renewable Energy Bonds



Governor Deval Patrick announced the first CREBs project at Deer Island in April 2008

Clean renewable energy bonds (CREBs) were originally created by the Internal Revenue Service in January 2006 as part of the Energy Policy Act of 2005. They encourage the development of new renewable energy projects across the country by facilitating zero-interest loans for government entities and electric cooperatives. Using a CREB, a borrower is not required to make interest payments because the bondholder receives a tax credit from the federal government in place of interest income.

The LBE Program, in cooperation with DCAM, DOER, and Mass Development, one of the state's primary bonding authorities, unified twelve projects within Massachusetts to fund

1MW of solar energy at Mount Wachusett Community College, Worcester State College, North Shore Community College, Springfield Technical Community College, Salem State College, Chelsea Soldiers' Home, MWRA Deer Island Treatment Plant, and five Department of Corrections facilities. The estimated total cost of the twelve projects is approximately \$8 million.

The twelve sites are expected to generate an estimated 1,000,000 KWh per year and avoid an estimated 460 metric tons of carbon dioxide every year for more than 20 years. Best projects have been installed with remaining projects expected to be completed by the end of 2009.

Financial Breakdown of Twelve Projects

- \$3.1 million in CREBs issued by Mass Development
- \$2.5 million in grants from Massachusetts Technology Collaborative
- \$3.0 million in Massachusetts Department of Energy Resources Alternative Compliance Payments

Case Study 10: MWRA Deer Island Renewable Energy Projects

Massachusetts Water Resources Authority's (MWRA) Deer Island Wastewater Treatment Plant treats an average of 365 million gallons of wastewater each day from the greater Boston area, making it one of the largest consumers of electricity in the Northeast. The MWRA is on its way to attaining the renewable energy targets mandated in EO484, currently self-generating 20% of its electricity needs, with over half of the Island's total energy demand being provided by on-site, renewable generation.

Deer Island's most prominent renewable energy projects include methane production, solar power, and hydro-electric power. The methane is generated from the sludge digestion process, and is then used in the on-site 3500kW power plant to create steam, supplying hot water and heat for the facility. Methane production saves MWRA \$15 million annually in fuel oil costs. The steam is also

Over half of Deer Island's total energy demand is provided by on-site, renewable generation

run through a steam turbine generator which produces electricity. This co-generation facility produces over 27 million kWh of electricity annually which is consumed on-site to off-set the plant's purchased electricity demand.

Since 2002, Deer Island has been operating 2 one-megawatt hydroelectric generators, which produce over 5 million kWh of electricity, and avoid approximately \$500,000 in energy costs per year. The energy is recovered by the flow of treated wastewater as it drops from the plant into the outfall tunnel shaft through the hydroelectric generators.

In 2008, Deer Island installed 100kW of PV, funded through the Clean Renewable Energy Bonds (CREBs) Program and through state alternative compliance payments (ACPs). This installation is expected to generate approximately 100,000 kWh of electricity annually and avoid \$10,000 in energy costs per year. In addition to its new PV project, following receipt of "Determination of No Hazard" from the FAA, MWRA is constructing two 190-foot wind turbines (660kW), which will generate up to 2 million kWh per year for an annual estimated savings of \$200,000. The facility is also installing a 180 kW turbine, and continuing to investigate other wind and PV opportunities.



*Tour group at the methane-producing sludge digesters (left)
Solar array on roof of Residuals Odor Control Building (right)*

Section 5 – Green Buildings

Background

According to the U.S. Green Building Council, buildings in the United States alone account for 70% of electricity consumption, 39% of energy use, 39% of all carbon dioxide (CO₂) emissions, 40% of raw materials use, 30% of waste output (136 million tons annually), and 12% of potable water consumption.

Green buildings are facilities that have been constructed or renovated to include design techniques, technologies, and materials that reduce overall environmental impact and improve indoor quality. An additional objective of green buildings is to decrease reliance on non-renewable resources.

While the materials and techniques used to develop green buildings can sometimes cost more than conventional building strategies, the higher upfront costs are usually recovered from the energy and water savings generated over the building's life. Data from a 2003 study for the state of California shows that green buildings around the country with an average first cost premium of \$3-\$5 per square foot results in financial benefits and savings of \$15 per square foot.

According to E.O. 484, all new state facility construction and major renovation projects must be energy and water efficient, conserve resources, and provide healthy and productive spaces for employees, clients, and visitors. The state has adopted a Massachusetts LEED Plus green building standard that requires:

- Increased energy performance requirements to 20% better than required by the Massachusetts Energy Code
- Reduced outdoor water consumption by 50% and indoor water consumption by 20%
- Promotion of smart growth by requiring projects to be constructed near public transportation

The Department of Capital Asset Management (DCAM) manages the construction of the majority of Massachusetts' state-owned facilities and is responsible for ensuring that state building projects adhere to the Mass LEED Plus standard through design and construction. DCAM has begun to investigate ways in which new buildings can target a zero net energy goal, and is currently working on at least two new buildings to achieve this goal. It is important to note that the incremental energy saving costs and benefits of these projects are especially difficult to calculate. The data in this report are projections based on available models and estimates.

Green Buildings Address:

Waste Minimization

Energy Efficiency

Water Conservation

Indoor Environmental Quality

Pollution Prevention

Natural Resource Conservation

Existing Green Buildings

Agency/Institution	Project Description	Environmental Benefits	Financials ⁴
Bridgewater State College	<p>New LEED-certified dorm and dining hall completed in September 2007</p> <p>3rd LEED building in state government</p> <p>Includes water conservation measures, energy efficient lighting, daylighting, and other sustainable features</p>	<p>Decreases carbon emissions</p> <p>Implements energy management system to minimize energy consumption costs</p>	<p>Annual savings from green features: \$950,000</p>
Cape Cod Community College	<p>First state-owned LEED certified green building opened in September 2006 with Gold rating</p> <p>Incorporates solar panels, rainwater collection, recycled building materials, low-volatile organic paints and glues, and permeable pavement</p> <p><i>*See case study</i></p>	<p>Reduces water consumption by 85%</p> <p>122 photovoltaic panels combined with daylight and other sensors reduce fossil fuel consumption by 35%</p>	
Department of Youth Services	<p>Completed construction of Girls' Facility in Westborough, MA in 2007</p> <p>Received LEED Silver certification</p>	<p>Reduces energy consumption costs</p>	
Holyoke Community College	<p>Completion of the Kittredge Business Center with a green roof in May 2006</p>	<p>Improved efficiency and storm water management</p> <p>Water and air purification</p>	

⁴ "Cost" represents the total cost of the project, unless otherwise stated. "Savings" represents the total savings of the project, unless otherwise stated.

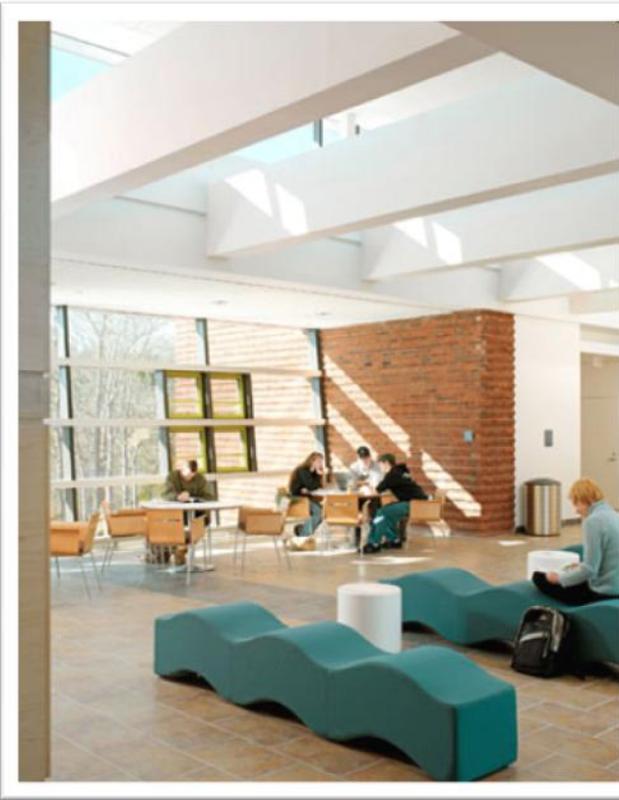
Agency/Institution	Project Description	Environmental Benefits	Financials ⁴
Mass College of Art and Design	<p>Green roof pilot project initiated through grant from LBE program for Sustainable Architecture class in spring 2006</p> <p>Expanded in FY 2007 to a total of 1,653 sq. ft.</p> <p><i>*See case study</i></p>	Reduces the amount of storm water going into the city system and reduces roof temperatures	Received a \$15,000 grant to fund 903 square foot expansion in FY 2007
Mass Maritime Academy	Established LEED design specifications for the new 30,000 square foot dormitory expansion completed in 2007	<p>Reduction of water usage</p> <p>Improved electrical savings with 81kW solar panel system</p>	
Massport	<p>Opened 686,000 square foot Terminal A at Logan Airport in March 2005</p> <p>First terminal in the U.S. to receive LEED certification</p> <p>Building includes recycled materials, natural lighting, and energy conservation.</p>	<p>Reduces energy consumption due to roofing membrane and paving that controls temperature</p> <p>Removal of pollutants from site runoff using storm water filtration devices</p>	Annual savings from green features: \$300,000
UMass Boston	“Green” campus center constructed in 2004 incorporated LEED criteria and green operations	Reduces energy consumption, reduces toxics, controls erosion, conserves water, and promotes recycling	

Planned Green Buildings

Agency/Institution	Project Description	Environmental Benefits	Financials
Department of Environmental Protection	<p>Two year project to renovate and expand the Williams X. Wall Experimental Station in Lawrence to meet LEED certification. Construction started in 2008</p> <p>Daylighting, photovoltaic cells, and a green roof are a few of the new features. Project expected to meet the LEED “Gold” certification.</p>	<p>Long-term economic and environmental benefits from energy rebates and subsidies</p> <p>Increased efficiency of a sustainable building reduces operating costs</p>	<p>Annual savings from green features: 40% anticipated savings on heating and cooling costs alone</p>
Department of Environmental Protection	<p>Collaborated with DCAM to develop and issue a “Green Lease RFR” for its Boston and Northeast Regional Offices that included energy efficient T-8 lights, motion detectors, recycled carpeting, low VOC paints and low-flow water fixtures</p>	<p>More energy efficient facility</p> <p>Improved indoor air quality</p> <p>Reduced water use</p>	<p>N/A</p>
Department of Mental Health	<p>Projected construction of new Worcester Psychiatric Hospital beginning in 2008 and expected to be completed in 2011</p> <p>Projecting LEED “Gold” certification</p>	<p>Reduce energy consumption costs through daylighting and other methods</p> <p>Conserve water using low-flow water fixtures</p>	
Greenfield Community College	<p>Planning to build zero-net energy greenhouse</p>	<p>Demonstrate thermal storage, energy conservation, and active geo-thermal heating and cooling systems</p>	

Agency/Institution	Project Description	Environmental Benefits	Financials
Mass Department of Fire Services	Expansion of Firefighting Academy in Stow, MA expected to receive LEED Gold certification (completion date 2010)	Low-flow fixtures and grey water to reduce water usage 7% of building's energy will be derived from solar energy	Total building cost: \$37.4 million Reduces overall energy consumption despite being 150% larger than current facility
UMass Amherst	UMass Amherst is in the design stage of four new facilities that will be constructed in the next few years. It is anticipated that the buildings will achieve at minimum, LEED Silver	Energy efficient— reduces energy demand/consumption	Proposed total building cost: \$293.5 million (state investment)
Worcester State College	Renovation of administration building estimated to be completed in January 2009 Expecting to receive Massachusetts LEED PLUS certification	Energy savings from utilization of daylighting and installation of an energy management system	Total renovation cost: \$21.2 million

Case Study 11: Green Technology Center at Cape Cod Community College



The building “is a statement about this institution and its leadership, and about the Cape and Islands and its commitment to the environment.”

The Lyndon P. Lorusso Applied Technology Center located at Cape Cod Community College is the first state-owned LEED certified building in Massachusetts. Completed in September 2006, the technology center cost \$8.7 million to construct and is the first new building on campus since 1974. In 2004, the project earned the DCAM Programming Study Award.

The facility has numerous cutting-edge sustainable design features that conserve resources. Site design, daylighting, renewable energy usage, water conservation, and recycled materials have all been included in the project, resulting in a LEED Gold certification. While these green features in and around the building cost about 7% more than conventional construction techniques, the cost is estimated to be recouped through energy and water savings within four to five years.

The site for the technology center was chosen because it takes advantage of underutilized parking areas at the commuter-oriented school. By choosing this location, the school eliminated the need for new parking lots. Cape Cod Community College also signed a written commitment to preserve the adjacent open space around the building.

To maximize sunlight exposure, the building is designed on an east-west axis to allow daylight to penetrate through large windows. Additionally, daylight and occupancy sensors are placed throughout the building to control the amount of light the fixtures can emit. Utilizing daylighting enhances the environment of interior spaces while reducing energy consumption.

Case Study 11 - Continued

In addition, the facility features onsite renewable energy with 122 photovoltaic panels located on the roof and above the windows of the building. These panels generate some 15% of the building's power needs. Combined with daylighting, the solar array results in a building that uses 35% less energy than a conventional facility. Also, 100% of the additional power the school needs to purchase for the building will come from a renewable energy source for at least two years.

A variety of measures are employed both inside and outside of the facility to promote water conservation. Located in the basement of the building is an 8,000 gallon tank that collects rainwater that is used in toilets, which reduces groundwater usage by 60%. When combined with a water collection and reuse irrigation system, drought-resistant plant species in the landscaping, low-flow toilets and fixtures, and waterless urinals, the water consumption of the building is 85% less than a conventional building.

The Lorusso Building is made with recycled materials and low-volatile organic paints and glues wherever possible to conserve natural resources and to improve indoor air quality. Approximately 90% of the construction waste was either recycled or reused. In addition, many of the materials were purchased from local sources to reduce transportation costs and environmental impacts.

Building Features

- Site selection maximizing sunlight exposure and minimizing erosion
- Permeable paving
- Photovoltaic panels
- No-flush, waterless urinals
- Maximizing daylight reflection
- Gray-water system
- High efficiency gas boilers
- CO₂ ventilation
- Use of recycled or high recycled content whenever possible
- Construction waste recycling



Case Study 12: Green Roof at the Massachusetts College of Art and Design



Recycled materials and native plants were used to create the 1,000 square foot garden and 250 square foot walkway.

In spring 2006, the Massachusetts College of Art and Design obtained a \$10,000 grant from the LBE Program to develop a green roof pilot project. The objective of the grant was to yield a model roof that could be easily duplicated elsewhere in the state. Students in the school's sustainable architecture program designed and constructed the permanent green roof, which was placed on top of the existing flat roof on the Tower Building.

Recycled materials and native plants were used to create the 1,000 square foot garden and 250 square foot walkway. The garden is comprised of a planting tray system made from recycled plastic milk crates and recycled steel. The walkway was made exclusively from a wood-plastic composite material. The plants used in the garden are native to the surrounding area, so students can study how each species reacts to the extreme heat and

cold, lack of wind protection, and high wind speeds associated with a high-rise roof. This data is monitored to derive best practices for landscaping tall roofs in the Boston area.

Students and staff are also developing smaller projects to highlight the environmental conditions of the space, such as small wind-driven systems to produce electricity that would power a lighting system on the roof.

Project Goals

- Demonstrate a reduction of water run-off through the use of a garden
- Reduce energy consumption costs of heating and cooling floors directly below
- Exhibit a native plant garden designed for tall roofs
- Measure roof temperatures to determine effectiveness of green roofs

Section 6 – Transportation

Background

Vehicles emit large amounts of carbon monoxide and nitrogen oxides into the atmosphere and account for roughly 50% of all man-made toxic air emissions, causing health problems and creating smog especially during warm summer months. In addition, automobiles emit carbon dioxide (CO₂), a greenhouse gas.

There are a number of ways to reduce emissions from vehicle transportation: driving hybrid and more efficient vehicles, carpooling, and using public transit are all viable options. Biodiesel, an alternative to traditional fossil fuels, may also reduce overall carbon emissions. Made from a variety of feedstocks (such as virgin or used vegetable oils, animal fats or algae), biodiesel blended with petroleum diesel burns cleaner than regular diesel (although there is conflicting data on NOx benefits).

Massachusetts is putting a significant amount of effort into developing the future for biofuel use. In November 2007, Governor Patrick created the Advanced Biofuels Task Force. The goals of the Task Force are to promote the use of biofuels that have less overall carbon emissions. The Task Force summarized its findings and recommendations in a report released in 2008. As a result, the Commonwealth committed to use a B5 biodiesel blend made from waste oils for its state fleet.

The state fleet incorporates alternative-fuel vehicles (AFVs) to support its government operations and infrastructure. These vehicles account for approximately 30% of all light duty government vehicles in use. Along with the environmental benefits, long-term financial savings can be obtained from AFVs as traditional fuel prices continue to rise. The state consumed just over 9.9 million gallons of gasoline and 2.7 million gallons of diesel fuel in 2006, and the use of AFVs can help to reduce fuel spending in the future.

As of May, 2008, Massachusetts had 984 AFVs in its state-wide fleet and this number is growing as new transportation orders are being fulfilled. These AFVs consists of:

- 324 Dedicated Natural Gas Vehicles
- 150 Bi-Fuel Vehicles(Natural Gas or gasoline)
- 265 Flex Fuel Vehicles (E-85 or gasoline)
- 206 Hybrid Vehicles
- 39 Electric (off-road) vehicles mostly for use in prisons and parks

Alternative Fuel Vehicles

Agency/Institution	Project Description	Environmental Benefits	Financials ⁵
Bunker Hill Community College	Replaced a Ford Taurus with a hybrid in FY2007	Reduces GHG emissions by up to 50% Lowers dependence on fossil fuels	N/A
Cape Cod Community College	Began using electric utility vehicles for campus maintenance efforts in FY 2006	100% decrease in vehicle tailpipe emissions Annual CO ₂ reduction of 30 tons	Acquisition cost: \$10,000 (obtained through a grant)
Department of Conservation and Recreation	Ordered 36 hybrid vehicles in FY 2006	Reduces GHG emissions by up to 50% Lowers dependence on fossil fuels	N/A
Department of Environmental Protection	Purchased AFVs in 2007, increasing the number of AFVs to 28, which is 33% of its fleet vehicles	Reduces GHG emissions AFVs get an average of 36 miles per gallon compared to 26 miles per gallon for the non-AFV vehicles	N/A
Fitchburg State College	Acquired 12 GEM cars for campus travel in FY 2006 <i>*See Case Study</i>	100% decrease in vehicle tailpipe emissions	Annual cost for electricity: \$2,999 Savings: \$28,537
Mass Highway Department	Operates automobiles and trucks that run on compressed natural gas and electric/gasoline hybrid	Reduces air pollution and reliance on gasoline/diesel fuel	N/A

⁵ "Cost" represents the total cost of the project, unless otherwise stated. "Savings" represents the total savings of the project, unless otherwise stated.

Agency/Institution	Project Description	Environmental Benefits	Financials ⁵
Mass Highway Department	Funded construction of fueling stations to support Commonwealth fleet CNG/Bi-fuel vehicles installed	Allows for the practical use of the cleaner burning CNG vehicles in the fleet and will be open to all CNG vehicles operated by the Commonwealth, as well as the public during normal facility operating hours	N/A
Massport	Utilizes over 100 AFVs in its fleet, including all 33 shuttles at Logan Airport	Reduces GHG and other emissions	N/A
MBTA	Began delivery of 43 Ford Escape hybrid vehicles for system-wide operations in FY 2007	Reduces GHG emissions by up to 50% Lowers the dependence on fossil fuels	Cost: \$1,216,000
MBTA	Submitted an application for the procurement of five diesel/hybrid electric buses in FY 2007	Reduces GHG emissions by up to 50% Lowers the dependence on fossil fuels	N/A
Mass Water Resources Authority	Purchased 26 hybrids in FY 2006, 23 of which replaced gasoline powered vehicles The MWRA fleet now includes 30 hybrids, 133 biodiesel, and 12 flex fuel vehicles	Reduces GHG emissions by up to 50% Lowers the dependence on fossil fuels	N/A
North Shore Community College	Purchased a hybrid pick-up, a GEM electric grounds vehicle, and a Hybrid Highlander for the college President	Reduces GHG emissions and gas consumption	N/A

Agency/Institution	Project Description	Environmental Benefits	Financials ⁵
Salem State College	Purchased 2 Ford Hybrid Escapes in June 2007 for Campus Police and the Maintenance Department	Reduces GHG emissions by up to 50% Lowers the dependence on fossil fuels	Cost: \$60,000
UMass Amherst	In FY07, UMass Amherst purchased a hybrid Toyota Camry '08 and a hybrid Ford Escape '08 to bring the total number of hybrids in its fleet to five	Reduces emissions, lowers dependence on fossil fuels	N/A
UMass Boston	The campus has incorporated alternative transportation options, including diesel-electric hybrid buses, carpool, vanpool, Zipcars, electric vehicles, and a green boat	Almost 50% of this commuter campus uses public transit and shuttle buses to campus, thus contributing to cleaner air and reduced pollution	
UMass Dartmouth	<p>Improved alternative transportation methods by: collaborating with the South Regional Planning and Development District (SRPEDD) on a bike and walking path project to connect the campus with nearby towns;</p> <p>Adding new routes and additional times for on-campus vans; and</p> <p>Establishing, in partnership with the City of New Bedford, a new free public bus route connecting the campus and downtown New Bedford</p>	Reduces emissions, lowers dependence on fossil fuels	N/A

Case Study 13: Alternative Fuel at the Massachusetts Bay Transportation Authority



The MBTA is the largest alternative fuel user in Massachusetts.

The Massachusetts Bay Transportation Authority (MBTA) is working to reduce their environmental footprint by reducing the emissions on many of their public transportation and maintenance vehicles. A wide variety of energy-efficient vehicles are currently in use with further improvements being made on a yearly basis.

In September 2007, the MBTA received an award for being the “Largest Alternative Fuel User in Massachusetts” at the AltWheels festival in Boston, mainly due to its fleet of 360 buses that run on natural gas. The MBTA bus fleet consists of Compressed Natural Gas (CNG), Emission Control Diesel (ECD), and all electric buses. Additionally, the authority possesses an ECD bus fleet that is currently comprised of 303 vehicles, with two hundred more in production, and an all electric fleet of twenty-seven vehicles that run on overhead electric catenary wires, resulting in zero tailpipe emissions.

The MBTA is working to improve Boston’s air quality even further. Vehicles in their operations/maintenance fleet are being converted to all hybrid vehicles, with the delivery of twenty-eight 2007 Ford Escape hybrids. They are also looking into the procurement of diesel electric hybrid buses and have purchased 28 “Tier 2 Compliant” locomotives. The new locomotives are the most environmentally friendly locomotives currently available.

MBTA Alternative Fuel Vehicles	
AFV Category	Number Owned
Compressed Natural Gas Buses	360
Emission Control Diesel Buses	303
Electric Buses	27
Dual Mode Articulated Buses	32
Gas Electric Hybrid Support Vehicles	28
Tier 0 Compliant Locomotives	12
Tier 2 Compliant Locomotives	28
Tier 2 Compliant Ferries	2

Case Study 14: GEM Car Fleets on College Campuses

Across Massachusetts, state colleges and universities are using electric vehicles for campus travel and maintenance. Cape Cod Community College, Fitchburg State College and Mount Wachusett Community College have all obtained vehicles that run entirely on electricity. These “Neighborhood Electric Vehicles,” or NEVs, provide more than enough versatility for campus-wide activities.

GEMs, or Global Electric Motorcars, have zero tailpipe emissions and are nearly silent in operation. Reaching top speeds of 25 miles-per-hour, the vehicles can usually travel between 30 to 40 miles before needing to be recharged. Smaller models take between eight to ten hours to charge, while larger models require ten to fourteen. All the vehicles are equipped with an in-board charger that plugs into a standard 110-volt outlet. Base models range in price between \$6,800-\$12,500 depending on size and desired features.

Cape Cod Community College was the first state school to experiment with the vehicles back in 1996. Since then, they have stopped using regular compact pick-up trucks in favor of the more environmentally friendly electric trucks. The school estimates that they have reduced emissions by over thirty tons of carbon dioxide per year.

In 2007, Fitchburg State College purchased twelve GEM vehicles for campus travel. With an electricity cost of \$0.13/kWh and an average projected mileage of 40 miles per day, the college anticipates spending only \$2,999 per year to charge its fleet. The cost of running the vehicles is significantly less than running traditional pick-up trucks. With gasoline close to three dollars per gallon and the trucks running on an average of twelve miles per gallon, fuel costs would run well above \$40,000 for the same travel distance, resulting in significant savings.



*Cape Cod Community College,
Fitchburg State College and Mount
Wachusett Community College are using
“Neighborhood Electric Vehicles.”*

Biodiesel

Agency/Institution	Project Description	Environmental Benefits	Financials
Department of Conservation and Recreation	Switched all diesel fuel tanks to biodiesel in FY2006	Reduces emissions depending on concentration of biodiesel	N/A
Department of Conservation and Recreation	Built a rubbish packer that runs on biodegradable hydraulic fluid and B5 biodiesel in FY2006	Reduces harmful emissions Hydraulic fluid is safer for disposal	Cost: \$13,000 Savings: \$98,000 Payback: Less than two months
Mass Highway Department	Currently using B-5 biodiesel in entire vehicle fleet	4% reduction in carbon dioxide emissions 5% reduction in sulfur emissions	N/A
Mass Water Resources Authority	Currently using B-5 biodiesel in appropriate vehicles	4% reduction in carbon dioxide emissions 5% reduction in sulfur emissions	N/A
MBTA	Installed Enviro-Switchers at Readville and Boston Engine Terminal Yards	Dramatically reduces NOx and particulate emissions	
North Shore Community College	Waste cooking oil is collected from the College's cafeteria operations at its Danvers and Lynn campuses and is taken off site by Smart Fuels and used in the production of biodiesel	Reduces waste and aids in the production of alternative fuels	Cost savings: College was previously paying \$3000 per year for oil collection; now Smart Fuels pays the College \$12.50 for every 250 gallons of oil removed

<p>Worcester State College</p>	<p>Currently using 5% biodiesel blend in snow removal/lawn care equipment</p> <p>Expect to increase to 20% for summer months</p>	<p>4% reduction in carbon dioxide emissions</p> <p>5% reduction in sulfur emissions</p>	<p>N/A</p>
<p>UMass Amherst</p>	<p>Currently using B-20 biodiesel in entire non-transit vehicle fleet</p>	<p>Reduction in carbon emissions</p> <p>25% reduction in sulfur emissions</p>	<p>N/A</p>

Case Study 15: Massachusetts Diesel Retrofit Programs

For nearly a decade, the Commonwealth has worked to reduce emissions from its diesel vehicles. State programs to promote diesel retrofits, where pollution control devices are installed along side or in place of a muffler, first began in 1998 with the creation of the Massachusetts Diesel Retrofit Program (MDRP).

Through the MDRP, the Massachusetts Department of Environmental Protection (MassDEP), the Northeast States for Coordinated Air Use Management (NESCAUM), the Massachusetts Highway Department (MHD), and the Executive Office of Energy and Environmental Affairs (EEA), joined with several private contractors (J.F. White, Jay Cashman, and Modern Continental) to retrofit 200 pieces of construction equipment used in the Central Artery/Third Harbor Tunnel Project. A variety of engines, including bulldozers, excavators and cranes, were retrofitted with diesel oxidation catalysts (DOCs), which reduce fine particulate matter by 20 to 30%.



Diesel Oxidation Catalyst

As a result, the MDRP worked with state agencies to require the use of diesel retrofits on equipment used by contractors working on state-funded construction projects administered by the Division of Capital Asset Management, the Department of Conservation and Recreation, MassDEP (the drinking water and wastewater infrastructure program), the Massachusetts Highway Department, and the Massachusetts Bay Transportation Authority (MBTA).

In addition, state agencies have operated grant programs to promote the installation of retrofit equipment on on-road and off-road engines. Using \$16 million in federal funds from the Executive Office of Transportation and Public Works, MassDEP is implementing a program to retrofit state's school buses under the *MassCleanDiesel Program* to reduce tailpipe and in-cabin emissions. In another grant program funded by the U.S. Environmental Protection Agency (EPA), MassDEP is retrofitting almost 30 off-road construction engines owned by municipalities. EEA is dedicating \$120,000 in funding from EPA to reduce emissions from off-road engines used in street paving projects.

On a local level, municipal governments have also joined the effort to retrofit school buses. In 2003, the City of Medford received nearly \$500,000 from EPA to retrofit 71 of the school buses servicing its student population.

Retrofits have also occurred through the use of Supplemental Environmental Projects (SEPs). Developed in lieu of or in addition to penalties for noncompliance with environmental regulations, SEPs have often been established to promote retrofit installations in the community where the environmental noncompliance occurred. As part of a SEP with MassDEP, Mirant Canal LLC, owner and operator of the Sandwich power plant, worked with Sandwich officials and First Student, the town's school bus contractor, to install DOCs on 28 school buses in December 2007. A 2002 SEP between EPA and Waste Management of Massachusetts, Inc., a national waste hauling company, also led to the retrofits of 564 of Boston's school buses.

Section 7 – Environmentally Preferable Products

Background

Environmentally Preferable Products (EPPs) are high performance products or services that have a lesser or reduced effect on human health and the environment when compared with competing products or services. EPPs encompass a broad range of products, such as reduced-toxicity cleaners, recycled-content paper, energy-efficient equipment, and alternative fuel vehicles.

Environmentally preferable products can:

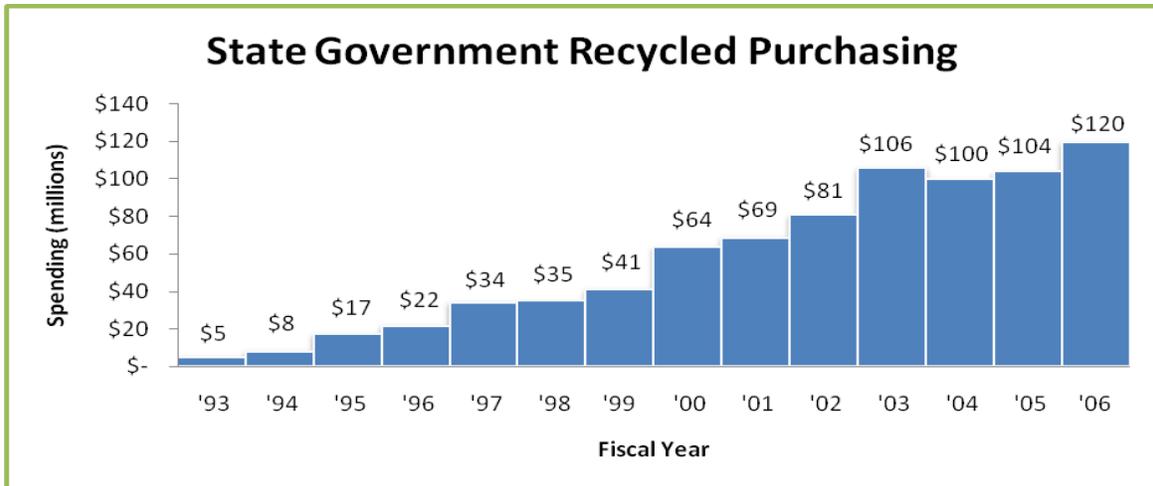
- Contain recycled materials, and thus create markets for recyclable materials.
- Conserve energy, water, and other natural resources.
- Contain fewer toxic ingredients.
- Reduce air and water pollution.
- Cut waste sent for disposal.
- Lessen the impact to public health.

The Massachusetts Environmentally Preferable Products Procurement Program (EPP Program) is coordinated by the Operational Services Division, and consults regularly with the Executive Office of Energy and Environmental Affairs (EEA), and the Massachusetts Department of Environmental Protection (MassDEP). The EPP Program's efforts to establish access to products and services are vital to the achievement of all statewide sustainability goals: climate change, energy efficiency, transportation, recycling, toxics reduction, natural resource conservation, and water conservation.

The program's efforts are concentrated in the following key areas:

1. Expand access to EPPs for state agencies by working with OSD's procurement managers and their teams to research new products and technologies, draft specifications for quality and performance, and include them on state contracts.
2. Conduct a comprehensive program of education and marketing efforts through the annual EPP Vendor Fair as well as through workshops, conference presentations, newsletters, and a website.
3. Track EPP purchases and report on the cost saving and environmental benefits of procuring such goods and services.
4. Work with interested manufacturers and suppliers to "green" their operations.
5. Promote EPP procurement efforts regionally and nationally.

Now in its 5th year, the program has increased the purchase of recycled-content products from just over \$5 million to more than \$120 million a year; when considering the entire range of EPPs purchased by the Commonwealth, that number is closer to \$180 million. Hundreds of EPPs are now available on over three dozen statewide contracts, facilitating their purchase by all public agencies.



EPP Program Awards

The Massachusetts EPP Program is recognized as a nationwide leader in promoting the purchase of EPPs among government organizations, winning a number of awards, including:

- 2007 - Outstanding Program Award, National Association of State Chief Administrators (NASCA)
- 2005 - The Cronin Club Innovation Award, GOLD, National Association of State Procurement Officials (NASPO)
- 2003 - Environmental Merit Award, U.S. Environmental Protection Agency New England
- 2002 - The Cronin Club Innovation Award, Bronze, National Association of State Procurement Officials (NASPO)
- 2001 - Best Government Buy Recycled Program Award, U.S. Conference of Mayors
- 2000 - Best Business or Government Buy Recycled Program, National Recycling Coalition (NRC)

EPPs and Statewide Sustainability Goals

In the Commonwealth of Massachusetts, most products and services needed by state agencies on a daily basis are procured using statewide contracts established by the central procurement department, the Operational Services Division. While all executive-branch agencies are required to use OSD’s contracts, eligible users include municipalities, schools, and higher education; in total accounting for an estimated \$600 million in purchases every year. By making environmentally responsible contracting decisions, OSD is in a position to have a dramatic impact on the environmental impact associated with state’s operations.

Examples of EPPs available on Massachusetts statewide contracts:

Sustainable Goals	Product Examples	Statewide Contract
Climate Change and Air Quality	Low Sulfur Diesel and Biofuels	Biodiesel and Ultra-low Sulfur Diesel (ENE23)
Energy Efficiency	Compact fluorescent light bulbs ENERGY STAR printers, copiers and fax machines Power management activated office equipment	Electrical And Lighting Supplies And Equipment (FAC22) Photocopiers, Printers, Facsimile/Multifunctional Equipment, Supplies and Services (OFF16) IT Hardware, Computers, more (ITC16A)- EPEAT Requirement
Transportation	Hybrid vehicles Alternative fuel vehicles Emission Control Technologies Recycled rubber and plastic products	Furnish and Delivery of Hybrid Vehicles (Gas and Electric) (VEH58) Various Passenger and Light Duty Vehicles Gas, CNG and Bi-Fuel (CNG/Gas) (VEH73) Diesel Emission Control (VEH71) Retread Tires (VEH21) Traffic cones (VEH80)
Recycling	Recycling services for paper, plastics, electronics and other materials	Solid Waste and Recycling Services (FAC33) Electronics Recycling (FAC26) Recycling containers and compost bins (FAC31)
Toxics Use Reduction	EPP cleaning and floor maintenance products Mercury-free alternatives for building products Pest Control Water treatment	Cleaning Products, Environmentally Preferable (GRO16) Building Materials and Supplies (FAC27) Integrated Pest Management (FAC50) Pool ionization & Ozonation; Salt Water Chlorination (FAC46)

Sustainable Goals	Product Examples	Statewide Contract
Natural Resource Conservation	Recycled content carpet Plastic lumber products Recycled Paper/envelopes Biodegradable/compostable food service ware	Carpet / Flooring Products (FAC25) Plastic Lumber (FAC20) Office Supplies (OFF19) Printing Services (OFF15) Grocer Contract (GRO20) Landscaping Applications (FAC24)
Water Conservation	Low-flow and waterless plumbing fixtures	Commercial and Industrial Supplies (FAC28) Composting Toilets (FAC39) Waterless urinals (FAC29)

Environmental Benefits of Green Procurement

In order to estimate the environmental benefits of the Commonwealth’s purchases of EPPs, the program designed a spreadsheet-based tool, EnviroCalc. Unlike other tools available via the web, EnviroCalc is designed specifically to fulfill the needs of purchasing departments and covers a wide range of products. Combining the best available methodologies and models for assessing the environmental impacts of purchasing, EnviroCalc allows the purchaser to simply input some basic purchasing information obtained from the organization’s suppliers and receive an instantaneous estimate of the environmental impact of the purchases. The EPP Program won a national award from both NASPO and NASCA for the creation of the tool and a number of organizations across the nation are using it today. The Program plans to add products to the tool over the next fiscal year as resources are available and conduct further outreach and guidance to agencies and others on the benefits of quantifying and reporting this information.

EPP benefits seen by the Commonwealth of Massachusetts for FY 2006, calculated by EnviroCalc:

	Environmental Benefit Estimate	Equivalent to...
Energy savings	9,690,412 kWh	Annual energy needs of 855 households
CO2 emissions	21,709 tons	Annual tailpipe emissions of 4,263 cars
Landfill space	16,582	829 loaded garbage trucks
Number of trees saved	52,911	529 acres of wood plantation
Weight of materials recycled (tons)	4,519	Annual solid waste generation of 2,123 households

Cost Savings as a result of energy efficient procurements obtained by the Commonwealth for FY 2006, calculated by EnviroCalc:

	Energy Savings Estimate	Annual Cost Saving Estimate
Energy savings	9,690,412 kWh	\$1.1 million

Education and Outreach to Buyers and Businesses

Over the years, the EPP Program has focused on expanding the comprehensive education and outreach of the program goals to all agencies and municipalities as well as the business community. Activities in this area include newsletters, the publication of EPP Purchasing Guides, maintenance of a comprehensive website, and working with local and national manufacturers and suppliers to “green” their product offerings as well as their operations. To showcase this effort, the EPP Program annually coordinates a one day event known as the EPP Vendor Fair and Conference that features over 150 exhibitors of EPPs, ten educational workshops and various opportunities to hear directly from vendors and purchasing peers on the benefits of green procurement. Now in its 14th year, the conference has grown nearly tenfold, attracting an estimated 1,300 purchasing and environmental staff from Massachusetts as well as surrounding New England states and representatives from far away as California, Nevada, North Carolina, Minnesota, Florida, Texas, Washington, Canada, and Mexico.

Leadership in National Efforts

Utilizing the purchasing power of multiple state governments to target large manufacturers to green their product lines results in economies of scale, leading to better, more cost-effective goods in the marketplace. To this end, the EPP Program staff have maintained a leadership role in the national arena to work collaboratively with other states across the country. Such efforts include:

- Green Cleaning Products – Working in concert with several other states and the Center for a New American Dream, Massachusetts was the first state to establish a statewide contract for cleaning products using the third-party Green Seal Certification as a minimum standard (www.greenseal.org). Within two years of making the award, manufacturers across the board worked to certify over 200 product lines using the Green Seal standard. Today that number has doubled and green cleaning products are high performing, cost competitive, and regularly available.
- Over the past three years, the EPP program has played an integral role on the steering committee tasked with developing a national membership-based non-profit for the purpose of assisting government purchasers nationwide in easily accessing information on EPPs. Officially launched in November 2006, the Responsible Purchasing Network (RPN) (www.responsiblepurchasing.org) has already met its initial membership goals, published eight product purchasing guides and conducted several webinars on EPP procurements. National organizations are already recognizing it as a valuable resource for EPP procurement.
- In addition, the EPP Program has accepted a leadership position in working with the National Association of State Procurement Officers and other procurement associations in developing a “green” purchasing guide for use by state and local government procurement officials. Released in 2008, the NASPO green purchasing guide is now available at: http://www.naspo.org/content.cfm/id/green_guide.

Case Study 16: Non-Toxic Cleaning Chemicals

The Massachusetts State House on Beacon Hill, operated and maintained by the Bureau of State Office Buildings, has converted to using environmentally safe cleaning products, produced by the Woburn-based Electolyzer Corporation. The solutions are used to clean and sanitize the restrooms, offices, and floors of the state house eliminating all other chemicals previously used for these tasks.

The environment-friendly cleaning products are made from ordinary tap water, which is run



The Massachusetts State House uses safe, non-toxic alternatives to traditional cleaning chemicals

through an Electolyzer's ElectroCide System. The device electrochemically converts sodium ions to sodium hydroxide that serves as a grease cutter and detergent; it is completely non-toxic. Hypochlorous acid, a powerful and non-toxic disinfectant made from electrically converted chloride ions, is stored in a separate container.

The most exciting part of these new "green" products is their effectiveness. Two independent laboratory tests determined that the cleaners eliminate virtually every trace of E.Coli and salmonella pathogens. The solution works just as well as soaps and detergents, but without the harmful additives.

John Billera, Deputy Superintendent for Operations for the Bureau of State Office Buildings, proclaimed, "We have noticed no difference in the sanitization and cleanliness of our offices and restrooms and our floors are as clean or cleaner than ever."

Case Study 17: UMass Boston and Environmentally-Preferable Products

UMass Boston (UMB) is a signatory to the Talloires Declaration as well as the American College and University Presidents' Climate Commitment (ACUPCC). The campus has a comprehensive sustainability program that works with numerous campus departments to include sustainable practices. In recent years, UMB has been proactive in environmentally-preferable purchasing throughout its departments, and in 2004 won the Commonwealth of Massachusetts University Sustainability and Environmental Purchasing Award from the OSD, EEA and MassDEP.



Some highlights include:

- All of UMB purchased copy- paper is 30% post consumer, to 100% process-chlorine free, recycled paper.
- All computers and self-help copiers on campus are Energy-Star compliant and enabled to save energy.
- The campus underwent a gas to electric, energy-efficiency and water conservation retrofit so as to replace all of its lighting, showerheads, taps etc with energy efficient lighting and low-flow bathroom fixtures.
- The UMB Campus Center, opened in 2004, uses numerous LEED criteria in its building as well as continuing in its green operations – features include building on former landfill space, use of eco-friendly building materials and furniture, sensor-controlled, low VOC and latex paints, aesthetic yet high durability finishes such as stainless steel, built-in multiple recycling kiosks, daylighting and more.
- Campus-dining offers Styrofoam-free, compostable dining dishes as well as Fair Trade coffees and other organic, earth-friendly and healthier food options. Campus uses state-of-the-art 100% biodegradable bags.
- Campus bookstore offers eco-friendly, fair-trade and cruelty-free personal care products and gifts.

Section 8 – Recycling & Waste

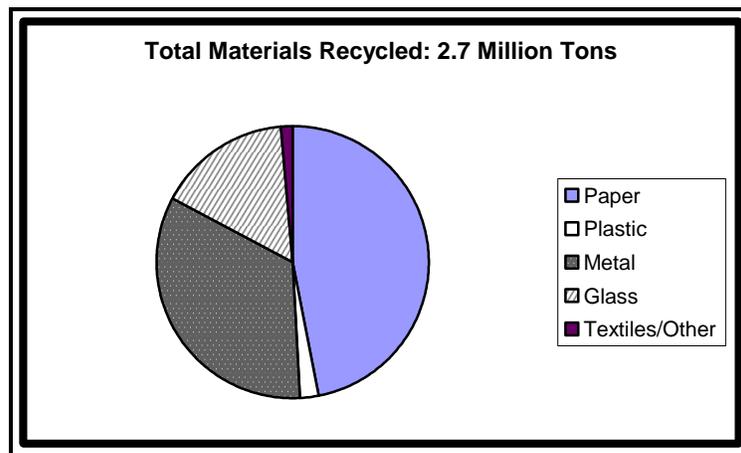
Background

With reductions in landfill capacity and the growing costs for solid waste management and the environmental impacts of trash incineration, using alternative methods for managing waste materials has become critical. Reducing and recycling waste has many environmental and economic benefits: it conserves natural resources through avoided production and raw material extraction, saves money through avoiding disposal costs and reduced expenditures, and saves energy, which helps reduce greenhouse gas emissions and other pollutants. In addition, proper waste management improves human health, while diversion bolsters the economy as recycling, reuse, and remanufacturing directly support employment.

Some of the most commonly recycled materials are cans, bottles, paper, cardboard, plastics and metals. Emerging methods of recycling include composting and single stream recycling. Due to its ease of use, single stream recycling is growing in popularity as it requires only one collection container for all paper, glass, metal, and plastic recyclables; the materials are later separated and processed at a materials recovery facility.

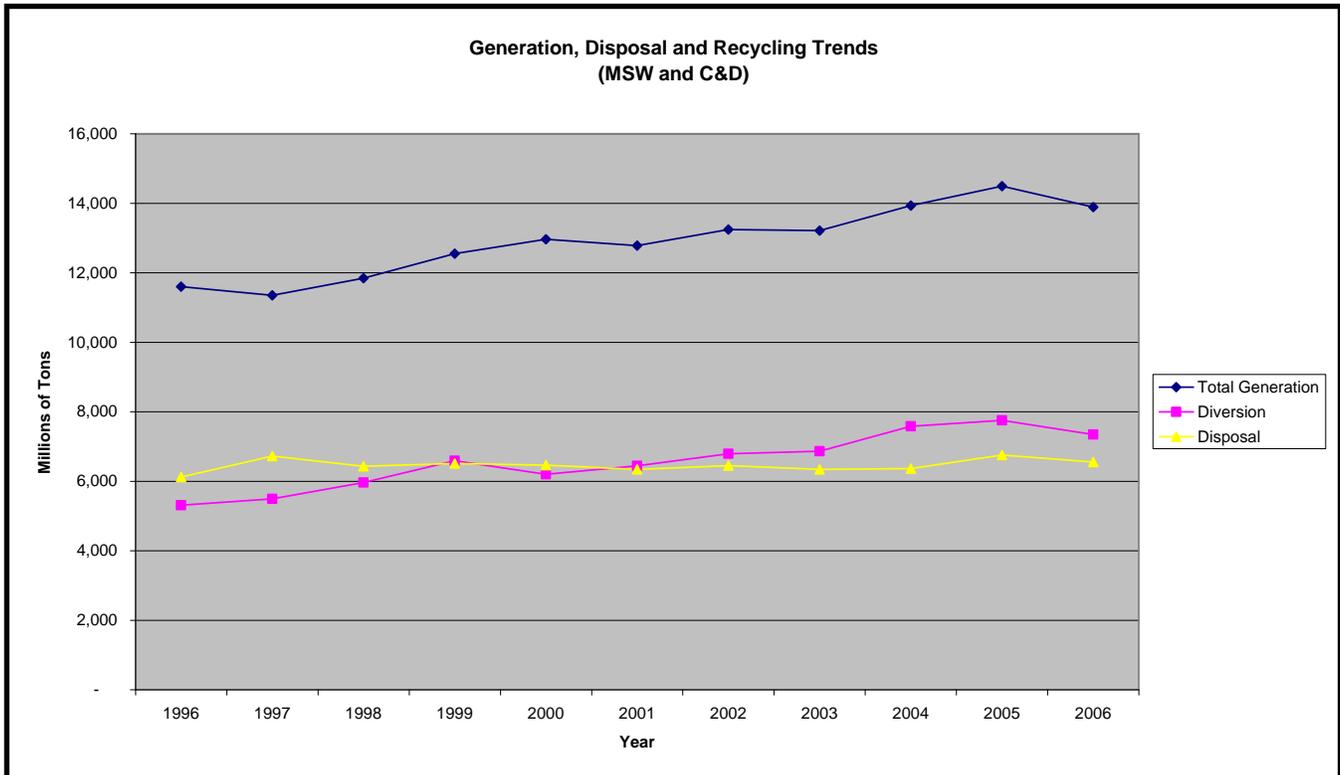
The Massachusetts Department of Environmental Protection (MassDEP) regulates the state's waste and recycling efforts. The *Solid Waste Master Plan: 2006 Revision* provides an updated policy framework for solid waste management in Massachusetts and calls for a 70% waste reduction goal by 2010, which includes a 56% recycling goal (the 2006 recycling rate was 47%). The Department is currently looking at developing strategies to meet a zero waste goal.

To track progress in meeting these goals and to evaluate solid waste management capacity needs, MassDEP annually publishes solid waste management data. Total solid waste generation was 13.9 million tons in 2006, a decrease of 600,000 tons from 2005 data. Both diversion and disposal also decreased in 2006 compared to 2005.



Breakdown of MSW (municipal solid waste) Materials Recycled in 2006 (excluding compost)

To achieve the statewide waste reduction goals, agencies and higher education campuses across the Commonwealth have been increasing and expanding on their waste and recycling projects; from composting initiatives in dining halls, to mixed paper and cardboard recycling programs in offices, to the recycling of demolition waste.



Recycling & Waste Projects

Agency/Institution	Project Description	Environmental Benefits	Financials ⁶
Berkshire Community College	Recycles cardboard, paper, metal, glass, computer monitors, computer processing units, light bulbs, and mercury Soon to include waste food	Results are tracked based on reports and information received from the Center for Ecological Technology	Cost per semester: \$1,015
Bunker Hill Community College	Began building-wide recycling of all bottles and cans	Less waste added to landfills	Cost: \$0
Bureau of State Office Buildings	Mixed paper recycling program in the State House and McCormack, Hurley, and Lindemann Buildings	In FY07, the program recycled 824 tons or (52.39%) of the buildings' trash, otherwise sent to landfills	Cost savings: In FY07, the program saved \$73,852 in waste removal costs
Department of Conservation and Recreation	Place paper receptacles at each printer and desk Cans, bottles, and batteries are collected and redeemed as needed	Less waste added to landfills	N/A
Department of Conservation and Recreation	Fixed 10 fishing line recycling canisters around the Wachusett Reservoir Placed 3 canisters around the Quabbin Reservoir	6 miles of fishing line have been collected	N/A
Department of Conservation and Recreation	Brochure on the recycling program	Prevents littering in state parks	N/A

⁶ "Cost" represents the total cost of the project, unless otherwise stated. "Savings" represents the total savings of the project, unless otherwise stated.

Agency/Institution	Project Description	Environmental Benefits	Financials ⁶
Department of Correction	Recycle cardboard and mixed papers in addition to organic diversion <i>*See case study</i>	Recycled 2,622 tons of materials in FY2006 (36% of total waste)	Savings over 2 years: \$200,000
Department of Education	Recycle soda bottles and cans, cardboard, and wooden pallets	Less waste and conservation of natural resources	Proceeds donated to local school districts
Department of Environmental Protection	Donated 297 computers to the Boston Public Schools in 2007 Those not reused are recycled with keyboards and monitors	Less waste and conservation of natural resources	N/A
Department of Environmental Protection	Implemented paperless employee payroll system in FY2006	Reduces energy and paper consumption	Cost: \$57,460 Savings: \$5,774
Department of Environmental Protection	Implemented E-DEP Filing for submitting permits, transmittals and reports electronically to MassDEP.	Reduces energy and paper consumption as well as space required for files	N/A
Department of Industrial Accidents	Recycle mixed paper, cans and bottles, toner cartridges and cell phones, and cardboard about twice per month	3.25 tons of paper recycled over a 3 month time period	N/A
Department of Youth Services	Break-down cardboard and recycle mixed paper	10 totes of 60 gallons removed twice a month	Annual cost: \$960
Fitchburg State College	Recycle mixed paper, soda bottles and cans, cell phones, and ink toner	Recycle 15% of waste produced	Cost per year for soda bottle recycling: \$3,884 Cost per year for paper recycling: \$2,600

Agency/Institution	Project Description	Environmental Benefits	Financials ⁶
Framingham State College	Recycles mixed paper, cardboard, cans and bottles, and ink and toner cartridges	35 tons of mixed paper and cardboard 0.25 tons of bottles and cans	N/A
Holyoke Community College	Recycles mixed paper, cardboard, scrap metal, and broken equipment	Recycles approximately 90 tons of cardboard and mixed paper	N/A
Lemuel Shattuck Hospital	Recycling of cardboard, electronics, mixed paper, metal, wood, and organic material <i>*See case study</i>	Less waste and conserves natural resources	N/A
Massachusetts Bay Transportation Authority	Hundreds of recycling receptacles, more advertisements and PA announcements throughout the transportation system	1,400 tons of paper since 2006	N/A
Mass College of Art and Design	Recycles mixed paper, cardboard, electronics, plastic, glass, cartridges, metals, and concrete	Reduced solid waste removal by 15% in FY2007	N/A
Mass College of Liberal Arts	Recycles all paper and plastics	Less waste and conserves natural resources	N/A

Agency/Institution	Project Description	Environmental Benefits	Financials ⁶
Mass Highway Department	Implemented a glass and plastic bottle recycling program	Over 7.5 tons of cans and bottles recycled in FY2007	Cost: \$237 for receptacles \$35 per ton tip rate (\$0 for District 4 headquarters)
	Initiated paper and cardboard recycling	Over 150 tons of paper and cardboard recycled in FY2007	N/A
Mass Highway Department	Recycles electronics, computer, and batteries, the majority of which is the result of illegal roadside dumping	Over 8.2 tons of electronics and 15.5 tons of batteries recycled statewide	Cost: Approximately \$4000 for electronics and \$400 for batteries
	Recycles fluorescent bulbs, scrap tires, brick and concrete, wood waste, street sweepings, and construction and demolition waste	Less waste and conserves natural resources	N/A
Mass Maritime Academy	Recycle white paper from offices and dormitories	Less waste and conserves natural resources	N/A
Mass Water Resources Authority	Eight 60 gallon totes collect cardboard and mixed papers from the facility	Less waste added to landfills	Savings per ton: \$80

Agency/Institution	Project Description	Environmental Benefits	Financials ⁶
Mass Water Resources Authority	Since FY04, the MWRA has generated revenue from the following: 201.14 tons/paper, 951.61 tons/scrap metal, 35,565 gls/waste oil, 70,676 lbs/computer hardware, 336 telephones and 15,985 lbs/PotassiumP	Conserves natural resources, reduce energy consumption and landfill space	Revenue: \$83,129 since FY04 in addition to avoiding the cost of dumpsters and disposal fees
Massasoit Community College	Recycles mixed paper and cardboard Student Senate introduced bottle and can receptacles in the cafeteria	30 totes removed weekly holding 60 gallons of the paper and cardboard	Annual cost : \$500 for rental Savings: \$2,200
MassBay Community College: Ashland and Framingham	Developing a program for paper, cardboard and other recyclables (150 new recycling bins purchased) Student Government will help create awareness Working with local municipalities for material removal	Results and amounts of recycled materials will be tracked by the town and submitted to the college	Startup cost : \$15,000
MassBay Community College: Wellesley	Mixed paper and bottle recycling Town of Wellesley removes mixed papers and CMARC Industries removes plastic and aluminum cans	Recycled 8 tons of paper and cardboard in 3 month period Recycled 1,972 cans in the same period	Cost : \$11,688 for 3 months Savings : \$219 in 3 months
Massport	Recycling program adopted at Logan Airport Terminals	Less waste	N/A

Agency/Institution	Project Description	Environmental Benefits	Financials ⁶
Middlesex Community College	Recycles white paper Assessing expansion into mixed paper and cardboard	Less waste	N/A
Mount Wachusett Community College	Recycle mixed paper, cardboard, plastics, metal, and electronics	1,100 tons of paper, cardboard and plastic and 24.5 tons of metal and electronics recycled	N/A
North Shore Community College	Paper and cardboard recycled by private company Ink and toner cartridges recycled as well	Recycle 18.6 tons of paper and 18 tons of cardboard per year	Cost: \$0
Quinsigamond Community College	Recycles lamps, and ballasts, paper, cardboard, bottles, and cans	Recycle 1,600 pounds of paper	Cost : \$3,192 (\$0.67 per foot) Annual savings : \$13,860
Registry of Motor Vehicles	Recycle paper, ink and toner cartridges, and computer supplies	Less waste and conserves natural resources	N/A
Roxbury Community College	Recycle mixed paper and cardboard	Recycled 11 tons of waste paper in 2004	N/A
Springfield Tech. Community College	Recycle mixed paper and aluminum	Recycled 35.19 tons of paper	Cost per semester: \$5,347
UMass Amherst	Recycles solid waste and other recyclable materials	For FY07, UMass Amherst had a recycling rate of 52%, recycling 3,700 tons of solid waste and 3.995 tons of other recyclable materials	N/A

Agency/Institution	Project Description	Environmental Benefits	Financials ⁶
UMass Boston	UMB recycles all paper, bottles and cans, cardboard, wooden pallets as well as organic food waste (both pre and post consumer) and has introduced bulk recycling for construction and demolition waste and bulk furniture recycling. Additionally, they recycle both large and small electronic waste.	More than 500,000 lbs of material are recycled every year. Recycling rates have risen from less than 10% in late 1990s to 35% currently, over \$90,000 saved in trash expenses.	Cost savings due to return on commodities such as paper, cardboard, metals etc.
UMass Dartmouth	Cardboard and paper recycling	Reduced solid waste removal by 550 tons in 2007	Trash removal costs are \$23,000 below previous year; projected yearly savings are \$41,000.
UMass Dartmouth	Pilot single-stream recycling program in four dorms. Plans to expand the program to all 14 dorms in the Fall 2008.	Redirected 17, 230 pounds from solid waste in Fall 2007	Cost savings of roughly \$1376 for the semester
UMass Medical School	Collects bottles and cans throughout the campus	Less waste and conserves natural resources	N/A
Worcester State College	Purchased various office supplies with recycled content ranging from 15% to 100% beginning in FY 2005	Recycled materials reduce waste by up to 50%	N/A

Agency/Institution	Project Description	Environmental Benefits	Financials ⁶
Worcester State College	Recycles paper, cardboard, plastic, aluminum cans, glass, fluorescent lamps, electronics, laser and copier toner cartridges, ballasts, and batteries	Recycled 66 tons of material in FY2007	N/A

Case Study 18: Resource Management Program at Shattuck Hospital

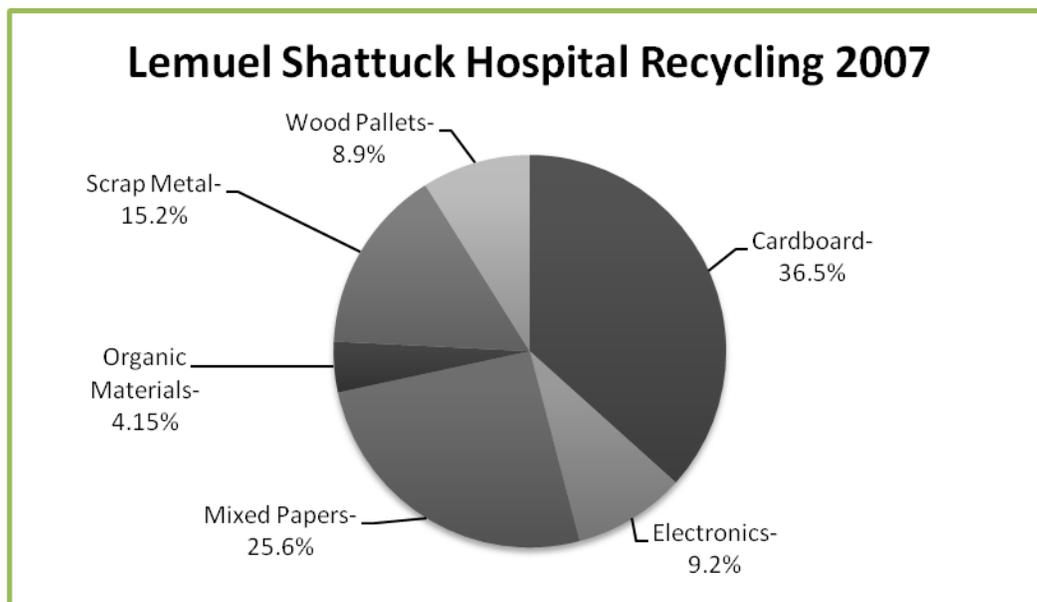


Lemuel Shattuck Hospital has a new cardboard baler.

The 278-bed Lemuel Shattuck Hospital is a primary provider of inpatient and out-patient services for the metropolitan Boston area. In fiscal year 2003, the state hospital produced 807 tons of waste from its facility. The following year, the hospital implemented a waste management program, reducing total waste 11.3% to 717 tons.

By reducing the overall amount of waste, the number of refuse pick-ups decreased from three to two times per week, resulting in an annual savings of nearly \$12,000. The hospital's single waste removal firm allows for more transparent billing, increased efficiency in managing equipment and pick-ups, and cost savings analysis to determine the resources for various recycling programs.

From fiscal years 2004 through 2006, recycling within the facility has increased by approximately 115%, from 60 to 130 tons. In these same years, the amount recycled totaled over 250 tons. The chart below shows the breakdown of recycled materials for 2007.



Case Study 19: Single Stream Recycling at Worcester State College

Until October 2006, Worcester State College utilized a traditional recycling program; separating materials by type, collecting, and bringing them to a recycling plant. This process changed when the college instituted a single stream recycling program that focuses on collecting plastic, glass, metal, paper, and cardboard for future sorting. To carry out the recycling plan, small collection bins were placed in classrooms, hallways, and high traffic areas. Maintenance personnel empty these smaller receptacles into a single, recycling compactor.



In 2005, before the single stream recycle program began, the college recovered 42 tons of recyclable materials. During the first year of the new program, October 2006 through October 2007, Worcester State College increased its recycling rate more than 100%, capturing 86 tons of material. The new program substantially exceeded the 30% increase goal initially set by the college. The program was well received by the campus community and continues to be very successful.

This program was expanded to include the residence halls during the 2007/2008 timeframe and the college expects to capture an additional 10% over the previous year, increasing its recycling rate to over 90 tons.

Single Stream Materials Accepted:

Aluminum Cans	Manila Folders	Computer Paper
Cardboard	Phone Books	Glass Bottles and Jars
Card Stock	Plastics #1 to #7	Magazines
Paper	Tin Cans	

Reuse

Agency/Institution	Project Description	Environmental Benefits	Financials
Department of Environmental Protection	Donated 297 computers to the Boston Public Schools	Less waste added to landfills Computers get a second life	N/A
Department of Youth Services	Donated furniture to international and domestic relief efforts	Diverted 27.1 tons of materials	N/A
Framingham State College	The Institutional Recycling Network transported various equipment and furnishings	Saved usable furniture from ending up in state landfills	One time cost: \$7,000
Mass Highway Department	Collects metal debris from roadways that is then sold for scrap metal	Approximately 580 tons of scrap metal recycled	N/A
Mass Highway Department	Recycles/reclaims bituminous concrete grindings to reuse in new mix (up to 40%) or as fill around guardrail or in base material	35,000 tons of grindings recycled into the new mix each year	Cost: \$150 per square yard
Salem State College	Institutional Recycling Network helped organize the first annual college clean out in Spring 2007	Recycled 6 tons of paper, 12 tons of mixed debris, 6 tons of electronics, and 30 tons of furniture	One time cost: \$20,000
UMass Lowell	Donates unopened cleaning solutions and chemicals to faculty instead of disposing of them	Produces and disposes of fewer chemicals	One time cost: \$5,926 One time savings: \$9,695

Organics

Agency/Institution	Project Description	Environmental Benefits	Financials
Department of Youth Services	Recycles the grease used in fryolators and stove	Recycles 750 gallons of kitchen grease annually	Annual Cost: \$1,525
Mass Highway Department	Mulch storm debris using a high powered grinder for landscaping or fill material	Environmentally friendly use of storm debris	N/A
Massasoit Community College	Recycles grass clippings to fertilize grounds	Reduction in artificial chemicals used	Annual savings: \$5,000
Mass Water Resources Authority	Solids are collected throughout Deer Island Wastewater Treatment Plant and are processed and digested on-site	Methane gas for meeting heat demand Digested sludge is converted to fertilizer pellets	Methane from digestion process provides heat value equivalent to 5 MG of fuel oil annually
Quinsigamond Community College	Began composting program in August 2007 Collect kitchen waste scraps daily and place them in two Earth Machine composting bins	Removes garbage from the waste stream Reuses natural topsoil for use in flowerbeds and small landscaping projects	Cost: \$25 per unit
UMass Dartmouth	Collects and crushes fallen leaves and then bring them to the Dartmouth compost pile	Saves organic material from going to the dump	Cost : \$200
UMass Lowell	Planning to build a compositing facility on campus for the removal of leaves, grass clippings, and other biodegradables	Will use clippings to fertilize two fields on a trial basis	Annual savings: \$30,000 - \$50,000

Agency/Institution	Project Description	Environmental Benefits	Financials
UMass Lowell	Recycles grass clippings and other organic waste to fertilize grounds	Reduction in artificial chemicals used	N/A

Case Study 20: Recycling Program at the Department of Correction

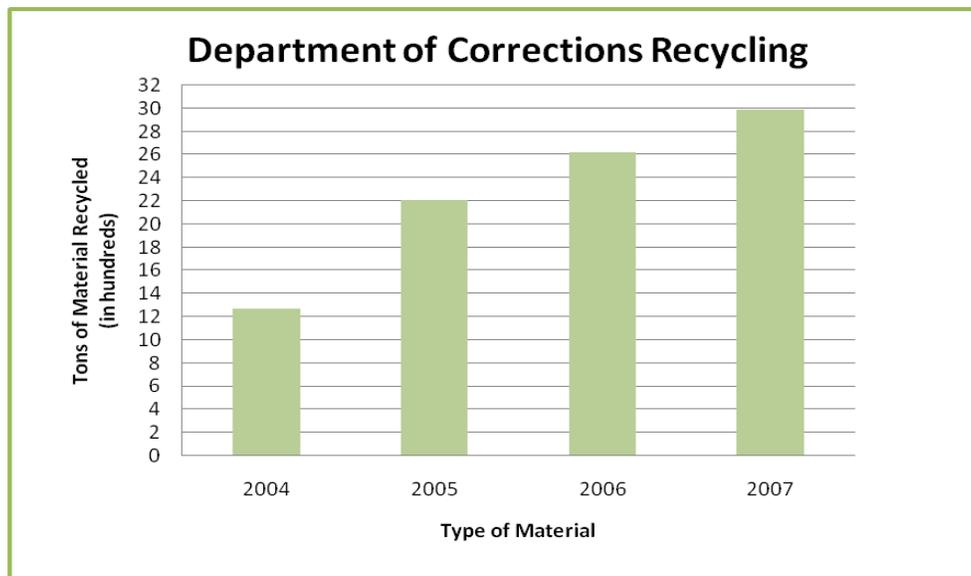
The Department of Correction (DOC) has one of the most comprehensive recycling programs in the executive branch of state government. Over the past few years, DOC has seen a dramatic increase in recycling rates. The department employs inmates who facilitate the recycling process by sorting recyclable materials, collecting a regional transfer station, and packaging materials for shipment.

The DOC's recycling program initially included metals, paper, corrugated cardboard, a plastics, and printer cartridges. DOC was one of the first agencies to include organic materials; separate contracts with local pig farmers are utilized for the removal of organic waste.

DOC Recycled Materials

- Metals
- Paper
- Corrugated cardboard
- Plastics
- Printer cartridges
- Organic materials

The Department set a goal of reducing waste in its seventeen facilities by 50% in 2010, using 2004 as a base year. In 2004, the DOC recycled 25% of its waste. By 2007, it had increased its recycling rate to 43%, amassing a total of 9,000 tons of recycled waste since 2004. Nearly 6,000 tons of the recycled materials have been organic materials. So far, reductions have led to a reduction of over \$200,000 in waste disposal costs.



Case Study 21: State Surplus Program

As with many state governments, Massachusetts has a formal system to dispose of surplus property. State agencies have the first chance to claim the donated goods, followed by schools and nonprofits. Finally, unclaimed property is either recycled or discarded.

In 2005, the Institution Recycling Network (IRN) was awarded the contract to handle Massachusetts's surplus assets. Before the contract with IRN, a small portion of the property was recycled for its metal content, while the rest was thrown out. The state believed that more of the unused assets should be diverted to recycling. This decision resulted in usable surplus directed to disaster relief agencies. In 2007, more than 180 containers filled with relief materials were collected from Massachusetts agencies.

Steadily, more and more agencies have started to use the new alternative method to dispose of excess assets that did not get picked up through the state system. By linking agency pickups into larger routes and by collecting several different materials at the same time, IRN is able to guarantee pick up of property within two days.

In 2007, IRN collected 248 tons of surplus furniture from fifteen Massachusetts state agencies. The beds, chairs, desks and other furniture collected was sent to impoverished schools and villages in El Salvador, Nicaragua, Guatemala, the Ukraine, Haiti, Guyana, Jamaica, and the United States.

Donation Process

Surplus collected and taken to warehouses in Everett or Holyoke

Combined with material from other IRN clients to make up container-loads for our charitable relief partners

Containers filled with surplus property shipped from the two warehouses to cooperating organizations



*Mattresses collected at state schools were sent
to an orphanage in El Salvador*

Section 9 – Toxics Reduction

Background

Toxic substances are chemicals or chemical compounds that are harmful to the human body. The Environmental Protection Agency (EPA) has identified over 640 substances that are considered toxic. Mercury, lead, and asbestos are a few of the most well-known toxic substances. Mercury is commonly used in batteries and some thermometers. Exposure to mercury can cause learning disabilities in children, personality changes, and dementia. Lead, found in older paints, affects the kidneys, the central nervous system, and the heart. Asbestos, commonly used for its insulation properties, may cause breathing problems. These chemicals have been significantly monitored for their use and applications and are only permitted under very specific cases.

Since the creation of the Toxic Use Reduction Act (TURA) in 1989, Massachusetts has been one of the foremost states in the country in dealing with toxic substances. The Act led to the development of the Toxic Use Reduction Institute at University of Massachusetts Lowell (TURI) and the Office of Technical Assistance (OTA). The Massachusetts Department of Environmental Protection (Mass DEP) also committed to handling the administration of toxics within the state. The initial goal of this Act was to reduce toxics by 50% from 1989 to 2004 – the state achieved this goal in 1998. MassDEP, in conjunction with TURI and OTA, has been carefully analyzing the production and use of chemicals with the balance of economic growth in the state. A committee was formed to develop the next series of goals, which is expected to be released by late summer of 2008.

TURA requires companies using noxious chemicals to seek alternative compounds that are less toxic. Every two years companies are required to file with OTA; they outline a toxic materials reduction plan, allowing OTA to review the chemicals being used and compare it to other, less toxic chemicals that may perform the same function.

While aggregate goals are being determined for the reduction of toxics, some chemicals have received special attention. In particular, mercury is of great concern and state agencies have established a reduction goal of 75% from 1998 to 2010. By 2003, the state had achieved a reduction rate of nearly 60%.

Toxics Reduction

Agency/Institution	Project Description	Environmental Benefits	Financials ⁷
Department of Correction	Replaced 50-year old, highly toxic kiln-dried ink license plate manufacturing system <i>* See case study</i>	Less toxic paint used on license plates Process is more efficient	N/A
Department of Environmental Protection	Negotiated for EPP cleaning products and materials in all current and future lease negotiations and janitorial contracts in FY 2005	Improves air quality and reduces water contamination	N/A
Mass College of Art and Design	Switched over all its cleaning products to more environmentally-friendly alternatives.	Reduces the use of toxic materials, reduces waste, and improves air quality	N/A
North Shore Community College	NSCC continually removes instruments containing mercury from their facilities	Mercury instruments are being phased out	Costs are reimbursed by a private firm
Roxbury Community College	Green cleaners at Reggie Lewis Center	Reduces the use of more toxic cleaners	N/A
UMass Dartmouth	Converted from traditional cleaning products to Envirox dispensing systems	Reduces waste and improves indoor air quality	N/A
UMass Dartmouth	Replaced oil based polyurethane floor polish with "oil modified" water based polyurethane	Improved indoor air quality	N/A

⁷ "Cost" represents the total cost of the project, unless otherwise stated. "Savings" represents the total savings of the project, unless otherwise stated.

UMass Lowell	Purchased non-toxic cleaners for custodian services in FY 2005	Improved indoor air quality	N/A
Various	Invited public to exchange mercury thermometers for digital thermometers	Exchanged 546 mercury thermometers	N/A
Worcester State College	Switched to an environmentally friendly ice melt, Magic Salt, for use on walkways during winter conditions	Lower freezing point allows less usage Less vegetation irritation and storm water run-off issues	Same price as conventional de-icing products

Case Study 22: License Plate Production at the Mass Correctional Institution

The Massachusetts Correctional Institution (MCI) at Cedar Junction produces all the license plates for the Commonwealth of Massachusetts. Approximately fifty inmates work to produce 2.6 million license plates per year. Until March 2007, the Cedar Junction used a production process dating back to the 1920s.

In the former method, paints were applied to the license plate number after the aluminum was pressed. A recent innovation by 3M enhanced the process. Before the plates are imprinted with the number, a polyester based sheet is adhered to the aluminum. As the plate is being imprinted, the color of the polyester changes from white to red – a change caused by the immense increase in temperature.

While paint is still used to touch up some of errors, the volume has decreased to only a quart per year. The new process also allows for more colorful and unique license plate designs.



Section 10 – Natural Resources

Background

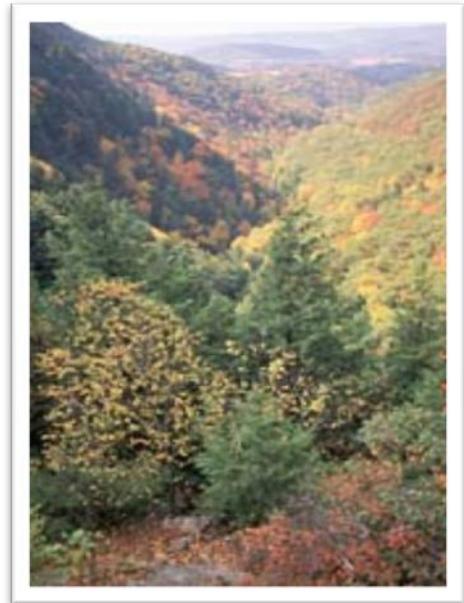
Preserving our natural resources, including water and land resources and the species they support, provides the foundation for our quality of life. Healthy ecosystems provide clean water and clean air, as well as flourishing and diverse fish and wildlife population.

Some of the greatest threats to biodiversity are habitat loss, invasive species, pollution, development, and over harvesting. According to a study by the Massachusetts Audubon Society, the state is losing approximately 44 acres of land per day due to development.

Land conservation and protection of the state's natural resources are also important economic issues, as some of the state's largest industries rely on these resources. Tourism provides more than \$21 billion per year in revenue for the state. Farmland makes up 10% of the total acreage in the state and provides the seventh highest direct sales of agricultural products in the country. Preserving open space not only helps to maintain a healthy environment, but it also increases the value of surrounding properties. In addition to the current economic benefits, actions taken now to preserve the Commonwealth's natural resources will decrease the future costs of restoration and treatment.

State agencies own about 12.5% of all of the land in Massachusetts, which includes parks, reservations, wildlife management area, beaches, and reservoirs and developed properties such as prisons, schools, and hospitals. As a result, state agencies play a leading role in protecting our natural resources and preserving land from development.

Massachusetts state agencies, led by the Department of Conservation and Recreation (DCR), have made protecting natural resources a priority. DCR has acquired thousands of acres of land across the state and implemented forest resource management plans. The Executive Office of Energy and Environmental Affairs has also worked with a number of state agencies to dedicate land to conservation, forestry, and agricultural resources through legislation.



State agencies own approximately 12.5% of the land in Massachusetts.

Natural Resources

Agency/Institution	Project Description	Environmental Benefits	Financials ⁸
Cape Cod Community College	Planted native species to improve wildlife habitat and control invasive plant species <i>*See case study</i>	Protects an important ecosystem	N/A
Department of Correction Bridgewater	Arranged legal protection of agricultural fields and riparian forest in FY 2007	Protected 425 acres of land from development	Receiving \$200 per acre to be used towards recycling and other environmental projects
Department of Conservation and Recreation	Landscaping in FY 2007 with all native, drought-tolerant plants at Corellus State Forest	Creates a healthier environment for plants	N/A
Department of Conservation and Recreation	Protected rare species in 15 DCR coastal sites and habitats in FY 2007	Decreases chance of extinction	N/A
Department of Conservation and Recreation	Initiatives to protect lakes and ponds at over 20 agency properties	Protects against aquatic invasive species, toxic algae blooms, and bacteria	N/A
Department of Conservation and Recreation	Biodiversity management planning six biologically significant DCR properties in FY 2007	Will analyze information on the biodiversity of these properties	N/A
Department of Conservation and Recreation	Designed a strategic forestry management plan for 42,008 acres in an ecological, economic, and socially sustainable manner in FY 2007	Contains important information on protecting physical and natural resources	N/A

⁸ "Cost" represents the total cost of the project, unless otherwise stated. "Savings" represents the total savings of the project, unless otherwise stated.

Agency/Institution	Project Description	Environmental Benefits	Financials ⁸
Department of Conservation and Recreation	Helped develop 58 Stewardship Plans for 6,355 acres of private forestland in FY 2007	Healthy forest ecosystems and sustainable timber harvesting	Cost : \$76,246 Subsidized by federal cost-share funding
Department of Conservation and Recreation	Installed native plants and reused roof water at the Mt. Wachusett Visitors' Center in FY 2007	Protection against invasive species and water conservation	N/A
Department of Mental Retardation	Arranged legal protection for farm and forest land in FY 2002	Permanently protected 2,225 acres of land	N/A
Department of Public Health- Tewksbury State Hospital	Arranged legal protection of farm and forest land in FY 2004	Permanently protected 625 acres of land in Tewksbury	N/A
Greenfield Community College	Developed management plan for wooded portion of campus in FY 2007	Benefits include long-term forest health, productivity, diversity, quality, and a source of sustainable income to reinvest	N/A
Mass Highway Department	Constructed salt sheds using "plas-crete" blocks made from recycled plastic materials instead of traditional concrete blocks	Waste being utilized instead of added to a landfill	N/A
Mass Highway Department	Uses temperature gauges and weather stations to closely monitor road conditions during snow and ice events, which more accurately determines which de-icing	Reduces amount of potentially hazardous chemicals applied to roads	N/A

Agency/Institution	Project Description	Environmental Benefits	Financials ⁸
	<p>material to apply to the roads and how much to use</p> <p>Purchase of re-refined oil instead of new (virgin) oil for vehicles and equipment. Includes: motor oils, transmission oils, and hydraulic oils</p>	Reusing oil instead of depleting resources	Cost: \$219-299 per drum
UMass Amherst	Arranged legal protection of forest and farm land near campus in FY 2002	Permanently protected 2,400 acres of land in Amherst	Funded by a \$500,000 EEA grant to be used for biodiversity enhancement projects
UMass Boston	Integrated pest management in buildings, no pesticide application on grounds	Protects the lands and reduces toxic runoff into the natural harbor location	N/A

Case Study 24: Natural Meadows at Cape Cod Community College

Cape Cod Community College's Barnstable campus is approximately 110 acres. The land is composed of meadows, wetlands, and forests and includes a run-off collection pond that is home to bull frogs, common water snakes, painted turtles, and a variety of aquatic insect species. On the campus grounds are also undisturbed forests that support many species such as hawks, owls, fox, coyote, deer, woodchucks, squirrels, chipmunks, snakes, and a variety of birds.

The Sustainability Team at the college developed a plan to create a healthier ecosystem for their native plants and animals; mowing was either reduced or eliminated in different areas of the campus to help ensure ecological succession and a variety of habitat. This initiative is an example of the college placing priority on stewardship of its natural resources.



Campus staff also planted native species to improve the wildlife habitat and control invasive plant species. In addition to ensuring the health of their natural resources, the program attempts to limit air emissions from mowers and reduce expenses associated with the fuel and labor of the mowers.

The college's Sustainability Plan states that its long-term goal is "to be an active and environmentally responsible member of the Cape Cod community, not only minimizing our negative impact upon our ecosystem but also simultaneously maximizing our positive impact as educators and role models and team members."

Environmental Benefits

- Healthier ecosystem for plants and animals
- Reduce air emissions from mowers
- Plant native species while protect against invasive species
- Better absorbs and filters rainwater

Section 11 – Water Conservation

Background

Water conservation is the protection of fresh water resources through decreased water consumption. Massachusetts is rich with many water bodies and plentiful rainfall. On average, the state receives 45 inches of rainfall per year. However, the level of rainfall depends on the seasons and regions; some regions experience fluctuations down to 30 inches, resulting in droughts. As demand for water increases with growth and the state's infrastructure ages, some of the streams, lakes, and ground water supplies become stressed resulting in water supply shortages. Using water efficiently is critical for the long-term health and viability of these important resources.

The state has been a leader in protecting its water resources since the development of a successful conservation program created by the Massachusetts Water Resources Authority (MWRA) in the 1980s. New technologies can further assist in reducing water consumption in the future.

Executive Order 484 established the following water conservation targets for all state agencies:

- 10% reduction in water use by 2012
- 15% reduction by 2020

Recommendations set by E.O. 484 and the EEA, along with the Water Resources Commission's Massachusetts Water Conservation Standards report:

- Conduct routine water audits and system assessments to eliminate and prevent leaks.
- Work towards metering all significant water uses.
- Strictly apply plumbing codes, and actively promote waterless plumbing fixtures.
- Replace and retrofit older water consuming equipment (e.g. toilets and faucets) with more efficient devices such as high efficiency toilets (HETs), front load washers, and motion sensor faucets.
- Minimize, and wherever possible eliminate, use of potable water and groundwater for outdoor watering purposes, street cleaning, and building washing.
- Lower watering frequency through moisture sensors and/or drip irrigation systems.
- When procuring services for lawn and landscaping maintenance, encourage contractors to minimize water use.

Over the past few years, many state agencies have implemented these types of projects to reduce overall water consumption and improve efficiency. Plumbing retrofits, along with installation of motion sensor faucets, low-flow toilets, and time-controlled showers, have been the most common projects aimed at reducing water consumption.

Water Conservation

Agency/Institution	Project Description	Environmental Benefits	Financials ⁹
Bridgewater State College	Comprehensive water conservation project in FY2007	Water use reduction	Savings: \$1 million Reduces energy and water costs by 30%
Cape Cod Community College	Retrofitted campus for water conservation in FY2006	Reduces water usage by 50%	N/A
Department of Conservation and Recreation	Installed low-flow toilets at Corellus State Forest in FY2003	Reduces water usage	N/A
Department of Conservation and Recreation	Developed a GIS-based database to assess infrastructure of all drainage structures Cleaned 2,874 catch basins Swept 30 miles of DCR streets targeting areas of increased storm water in FY2007	Enhanced asset management efforts, removed debris in drains, and improved storm water management	N/A
Department of Conservation and Recreation	Upgraded plumbing in Wachusett regional office in FY2007	The Watershed region is now bottled water free	N/A
Department of Conservation and Recreation	Installed greywater system and faucets with timers at Halibut Point State Park in FY2003	Reuses rainwater for irrigation	N/A

⁹ "Cost" represents the total cost of the project, unless otherwise stated. "Savings" represents the total savings of the project, unless otherwise stated.

Agency/Institution	Project Description	Environmental Benefits	Financials ⁹
Department of Conservation and Recreation	Installed pay showers at Horseneck Beach in FY 2003	Reduces wasted water and raises awareness among park guests	N/A
Department of Conservation and Recreation	Installed low-flow faucets and toilets, timed showers, and native plants on Mount Greylock in FY2003	Reduces water consumption	N/A
Department of Environmental Protection	In 2008, MassDEP stopped the purchase of bottled water in its Boston and Regional Offices and installed filtered water dispensers. Timer switches, purchased by the Bureau of Waste Prevention, were added for electrical savings.	Reduces waste, energy consumption, and GHG emissions related to the use and transportation of bottled water	N/A
Framingham State College	Installed rain sensors for underground sprinkler system FY2006	Reduces unnecessary irrigation for property maintenance	Cost: \$1,275
Holyoke Community College	Upgraded cooling tower in FY2005	Reduces water consumption	N/A
Mass College of Art and Design	Installed 120 low-flow plumbing fixtures in 2007	Combined with other projects, MassArt reduced water consumption by 996,303 gallons in FY2006 and FY2007	Cost: \$30,000

Agency/Institution	Project Description	Environmental Benefits	Financials ⁹
Mass College of Art and Design	Installed ten waterless urinals in FY2007	Eliminates water consumption in those fixtures	Cost: \$6,000
Mass Highway Department	Constructed new rest areas (i.e. Lancaster Reset Area Visitors Center), which use a composting toilet system instead of a traditional septic system	Conserves water, protects water resources, and creates usable fertilizer	N/A
Massasoit Community College	Switched from water-cooled air conditioning units to air cooling units	Reduces water consumption	Cost: \$4,000 Savings: \$30,000
Middlesex Community College	Tracks non-sewer water usage in cooling towers beginning in FY2005	Conserves water	Savings: \$7,200
Mount Wachusett Community College	Modified current pool filtration in FY2007	Reduces water consumption by 258,000 gallons per year	Cost: \$60,000
Mount Wachusett Community College	Installed low-flow water closets and aerators in faucets and showerheads in FY2007	Reduced water consumption by 10 million gallons in 4 years	N/A
North Shore Community College	Captured and reused rainwater for campus needs in FY2006	Reuse of rainwater for irrigation	N/A

Agency/Institution	Project Description	Environmental Benefits	Financials ⁹
Quinsigamond Community College	Harvested rainwater for reuse in irrigation system along with installing plumbing retrofits such as no flush urinals in FY 2006	Reuse of rainwater for irrigation and reduced water consumption	N/A
Salem State College	Removed irrigation system and protected surrounding wetlands in FY 2005 <i>*See case study</i>	Saves 250,000 gallons of water per year	Savings: \$2,000
UMass Amherst	Implemented a reverse osmosis system to utilize POTW wastewater in steam generation in FY 2005 <i>*See case study</i>	Reduces water consumption	Costs: \$1.67 million Savings: \$400,000 Payback: 4 years
UMass Boston	New UMB Campus Center has many water conservation features such as low-flow plumbing fixtures, automated shut-off sinks, and water efficient toilets	Reduces energy use and water consumption	N/A
Western Massachusetts Hospital	Purchased and installed 21 infra-red sensor faucets in FY 2006	Reduces fixture water usage by 5%	N/A
Worcester County Jail	Changed showerheads from 2.5 gallons per minute to 1.5 gallons per minute water flow in FY 2006	Reduces daily water usage by inmates	Cost: \$5,450

Case Study 25: Athletic Field Renovations at Salem State College

In autumn 2005, Salem State College replaced its O’Keefe Athletic Center Alumni Field’s natural sod with a synthetic infill turf at a cost of \$2 million. The new synthetic turf does not need to be irrigated and no longer needs to be treated with herbicide and pesticides. The removal of the irrigation system for the field saves 250,000 gallons of water per year.

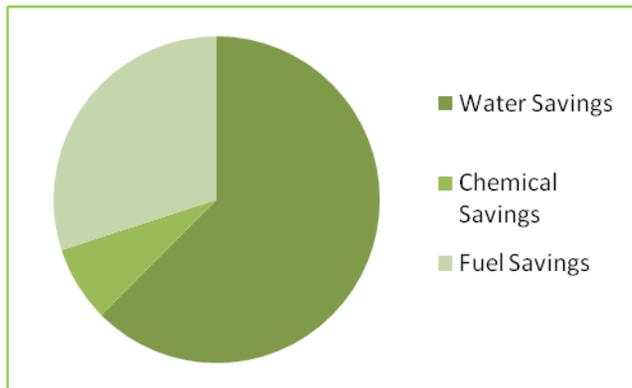


The new synthetic field saves 250,000 gallons of water per year.

Environmental consultants have also protected and improved the wetlands adjacent to the athletic field that accumulate a large amount of storm water.

Case Study 26: Wastewater for Steam Generation at UMass

The University of Massachusetts Amherst installed a reverse osmosis system that uses a Publicly Owned Treatment Works (POTWs) wastewater for steam generation. After it is treated at the POTW, the wastewater is discharged to the university rather than the surrounding river. The water is processed through the reverse osmosis unit and then used at the heating plant to produce steam.



The reuse of wastewater for steam generation saves \$400,000 per year.

At a cost of approximately \$1.67 million, UMass Amherst recognized a number of financial and environmental benefits from the project. The financial savings per year amount to \$400,000 consisting of \$250,000 in water savings, \$30,000 in chemical savings, and \$120,000 in reduced fuel costs.

With about 120,000 gallons of wastewater recovered daily, the total amount of water consumed on campus and the amount of wastewater previously discharged in the adjacent river has decreased significantly.

Section 12 – Education, Training & Outreach

Background

LBE training and outreach programs aim to educate agency employees in topics of environmental sustainability. Additionally, training and outreach urges people to take action and implement new initiatives on both individual and organizational levels.

Institutional Centers

Physical centers headed by sustainability teams can be an effective way to institutionalize training and outreach on college campuses, state agencies and surrounding communities. For example, the Center for Sustainability at Bridgewater State College created a mission to transform the college into a flagship institution for sustainability. Its activities impact educational offerings, student involvement, scholarship and regional outreach.

Curriculum

Courses which provide the education of environmental sustainability practices aim to educate the future leaders of Massachusetts. Mount Wachusett Community College offers renewable energy courses to students, with funding from the National Science Foundation. The University of Massachusetts Dartmouth offers a course entitled “The design of a sustainable solar home;” integrated with the Dartmouth Solar Decathlon Project.

Training Seminars

The Leading by Example Program works to train and educate Massachusetts state agencies and institutions through various workshops. Over the past few years, it has offered training sessions on E.O. 484, biodiesel, green buildings, energy efficiency, climate change issues, and the American College and University President’s Climate Commitment.

Awareness Events

Activities involving the members of state agencies and institutions of higher education help generate widespread interest in sustainability. At Massasoit Community College, National Grid donated 500 organic chocolate bars that were sold to students for a \$1.00 each. Every purchase was accompanied by a free Energy Star light bulb. Additionally, the Environmentally Preferable Products (EPP) Vendor Fair and Conference sponsored by the Commonwealth's central purchasing office is recognized nationally as a premier event for promoting the purchase of EPPs. Now in its 15th year, the Vendor Fair brings together over 1,200 public sector purchasers from Massachusetts, New England and interested states across the country, to meet directly with businesses offering EPPs. It also offers ten educational workshops on EPP procurement issues, "try-before-you-buy" pilot promotional offers from exhibitors as well as other networking opportunities. The event is free to public sector personnel. Event information can be accessed at: www.mass.gov/epp

Informational Brochures

The distribution of pamphlets, fact sheets, and brochures can also be an efficient way to raise awareness. The Massachusetts Water Resources Authority recently produced and distributed a booklet entitled “A Healthy Environment Starts at Home.” Over 20,000 booklets were printed and distributed to state residents.

Education, Training, and Outreach Projects

Agency/ Institution	Project Description	Environmental Benefits
Bridgewater State College	Center for Sustainability has been developed to transform the college into a flagship institution for sustainability <i>*See Case Study</i>	Improved environmental education offerings, student involvement, scholarship and regional outreach
Department of Conservation and Recreation	Published a booklet titled “More Than Just a Yard: Ecological Landscaping Tools for Massachusetts Homeowners”	The guide will help home owners preserve biodiversity, conserve water, and save time and money
Massasoit Community College	Sustainability Team <i>*See Case Study</i>	The team has implemented programs and projects in the areas of recycling, green purchasing and transportation
Mass Highway Department	Annual training for application of snow and ice chemicals, conservation practices, underground fuel tank reconciliation, and environmental awareness	Institutionalization of sustainable practices: conservation, compliance with regulations, improved response time to anticipated leaks
Mass Highway Department	Development of an Environmental Management System (EMS) for construction	System will more fully integrate environmental awareness and responsibility on construction projects by both agency personnel and contractors
Mass Water Resources Authority	MWRA produced and distributed a booklet entitled "A Healthy Environment Starts at Home, Guide to Reducing Our Use of Household Hazardous Products"	20,000 booklets have been printed with 16,000 distributed to schools, community groups, and MWRA member communities

Agency/ Institution	Project Description	Environmental Benefits
Mount Wachusett Community College	With funding from the National Science Foundation, college offers three new courses in renewable energy	Prepares students for careers in the renewable energy technician field
Mount Wachusett Community College	Funded by the U.S. Department of Energy, campus is coordinating efforts of eleven state energy offices to encourage use of bio-based fuels and bio-based products for larger private and public users	Increased use of bio-based products resulting in reduced emissions
North Shore Community College	Green curriculum developed and integrated into courses. A green goal included in the colleges new five-year Strategic Plan, aimed at institutionalizing sustainability	College exhibits greater environmental stewardship through embracing principles of sustainability; students gain greater knowledge of environmental issues
UMass Dartmouth	<p>Offering a new course designed to teach students how to create a sustainable solar home. Course is integrated with the UMASS Dartmouth Solar Decathlon Project</p> <p>Approval of the Sustainability Minor and the Sustainability Online Certificate in Spring 2008</p> <p>Students participate in community service projects, such as teaching local children about recycling</p>	<p>Education to students regarding the creation of a sustainable solar home</p> <p>Incorporation of sustainability into the curriculum</p> <p>Students engage with community members and enrich learning around environmental issues</p>

Agency/ Institution	Project Description	Environmental Benefits
UMass Boston	<p>UMB publishes “Sustainability Times” newsletter and website and campus “Green Corner” for the entire community focused on campus-wide activities and operations engaged in sustainability. Additionally, the UMB campus participates in Earth Day, America Recycles Day, Focus the Nation and other environmental events.</p> <p>UMB’s Sustainability Program: “UMBe Green”</p>	<p>Campus-wide “in-hand” environmental information about awareness, green tips, campus recycling policies, energy savings and more. Campus events allow for events throughout the year that engage the community in sustainability efforts.</p> <p>UMBe Green works with departments within and off-campus to include sustainability efforts and outreach in all aspects of campus operations as well as offers student internships.</p>
Worcester State College	<p>Funding has been appropriated for adding a new full-time permanent employee to assist with all facets of sustainability and environmental compliance</p>	<p>Improved environmental compliance within the college</p>

Case Study 27: Sustainability Team at Massasoit Community College

Massasoit Community College is determined to reduce greenhouse gas emissions through the integration of sustainability into their campus community. This mission is led by a Sustainability Task Force Committee whose goals are to develop ideas, review feasibility and cost savings, and look at environmental measures. Through the creation of the task force, students become better informed about environmental topics and they help to create a prosperous ethical and civil society.



The sustainability team is divided into subcommittees consisting of:

- Recycling
- Green purchasing
- Curriculum
- Community/campus awareness
- Campus watchdogs
- Cafeteria products
- Event planning/public relations
- Earth day program
- Grants/donations
- Future campus initiatives

Accomplishments To-date

Implementing a single stream recycling program

Completing a lighting conservation retrofit

Partnering with *MASSRIDES* to promote commuter programs

The team has made great strides through program and project implementation in the areas of recycling, green purchasing and transportation. Along with being responsible for creating projects, the team takes the initiative to see that energy conservation measures are continually pursued.

In addition to the task force committee, students of the college have founded a Student Sustainability Club named Emerald E.A.R.T.H. which focuses on classroom recycling and an annual earth day fair.

According to John Caffelle, an active member of the college's sustainability team, everything accomplished at MCC in regards to sustainability is done on a volunteer basis. They do not have a sustainability director, rather all members of the Massasoit CC team strive to achieve the goal of making a difference in the world by following their sustainability slogan, "One World, Many Hands."

Case Study 28: Center for Sustainability at Bridgewater State College

The Center for Sustainability at Bridgewater State College fosters the study and application of sustainable practices on campus and throughout the region. The organization understands that a sustainable society is one that is economically vibrant, environmentally sound, and socially just.

As part of its activities to engage students on campus in environmental causes, a sustainability blog was developed where students can discuss their views on environmental sustainability and connect with each other on how to work together to make a difference.

On October 24, 2007, BSC students, faculty and staff took part in a full day of activities devoted to understanding sustainable principles and how they are being implemented on the campus. The center also developed a faculty and librarian development program to conduct an inventory of sustainability activities at the college. Faculty members and librarians provide information of how issues of sustainability are being integrated within their courses, through intra-departmental programs, scholarship, research and outreach.

During its first year of existence, the center has hosted several events raising the issues of energy, organic food systems, global warming, and environmental and social justice. The center has also organized groups of students and faculty to attend national conferences; these conferences teach them how to apply sustainability principles to the college's coursework and outreach activities.

Case Study 29: The CONNECT Sustainability Task Force

Connect is a partnership of public higher education institutions in southeastern Massachusetts—Bridgewater State College, Bristol Community College, Cape Cod Community College, Mass Maritime Academy, Massasoit Community College, and the University of Massachusetts Dartmouth. Established in January, 2003, Connect has two basic goals: to improve the quality, accessibility, and affordability of higher education; and to advance the economic, educational, and cultural life of southeastern Massachusetts. The Connect Sustainability Task Force was created in the spring of 2007 to foster collaborations related to the American College and University President's Climate Commitment (ACUPCC), of which the Connect member CEOs were early signatories.



Since that time, the Task Force has become a vibrant and collaborative group of over 30 facilities managers, faculty, administrators and sustainability coordinators. Their first major project was the creation of Climate Commitment workshops in the fall of 2007. Attended by over 200 colleagues from the across the state, the workshops featured keynotes by Anthony Cortese and CCCC president Kathleen Schatzberg, and informational sessions chaired by the EOEEA and the EPA on campus carbon-reduction strategies. Task Force meetings and discussions have been built around collective sustainability concerns and endeavors, including recycling, renewables, the Climate Commitment, sustainability curricula, speakers and events, grant possibilities, and future collaborations. Future interests for the task force include encouraging Connect CEOs to speak often and publicly about the Climate Commitment, while serving as both a model and resource for community sustainability endeavors.

Section 13 – Conclusion

As detailed in this report, state agencies have significant strides in moving toward a more sustainable future implementing more than 200 sustainability projects across the state, ranging from lighting retrofits to hybrid vehicle purchases to single-stream recycling. In the future, the number of projects in sustainability areas should continue to increase as technologies and practices become more wide-spread.

The Leading by Example Program has a number of goals and projects planned for the near term:

- Implementing computer power management at all 50,000 computers owned by the state, as well as computers at state institutions of higher education and other public entities.
- Inspecting older facilities to analyze current energy systems and apply newer technologies to reduce energy consumption.
- Increasing the prevalence of biomass facilities that combine heat and power production.
- Evaluating sites for construction of wind turbines.
- Expanding solar installations by conducting surveys to identify roofs that provide the optimal conditions for solar power.
- Improving street light efficiency.
- Purchasing ten plug-in hybrid vehicles during 2008-2009.
- Ensuring new construction and development meets and exceeds MA LEED Plus standards.
- Encouraging low impact development for all new construction.
- Increasing the number of large-scale geothermal projects.
- Installing more low-flow and waterless toilets.
- Purchasing less toxic or non-toxic chemicals in place of traditional water treatment chemicals.
- Focusing recycling initiatives on reduction strategies, such as encouraging double-sided copying and printing.
- Creating a full-scale online database to track energy usage.

The Leading by Example Program serves as a catalyst for the state, facilitating and encouraging state agencies and others to do their part in creating a more sustainable Massachusetts.

Appendix – Coordinating Council, LBE Program

The following agencies are members of the Leading by Example Program’s Coordinating Council:

Agency	Web Page
Department of Conservation and Recreation	http://www.mass.gov/dcr/
Department of Correction	http://www.mass.gov/?pageID=eopsagencylanding&L=3&L0=Home&L1=Public+Safety+Agencies&L2=Massachusetts+Department+of+Correction&sid=Eeops
Department of Environmental Protection	http://www.mass.gov/dep/
Department of Higher Education	http://www.mass.edu/
Department of Public Health	http://www.mass.gov/dph/
Division of Capital Asset Management	http://www.mass.gov/cam/statewide/sw-energyconserv01.html
Department of Energy Resources	http://www.mass.gov/doer/
Executive Office for Administration and Finance	http://www.mass.gov/?pageID=eoafhomepage&L=1&L0=Home&sid=Eoaf
Executive Office of Energy and Environmental Affairs	http://www.mass.gov/eea
Executive Office of Health and Human Services	http://www.mass.gov/?pageID=eohhs2homepage&L=1&sid=Eeohhs2&L0=Home
Executive Office of Public Safety	http://www.mass.gov/?pageID=eopshomepage&L=1&L0=Home&sid=Eeops
Massachusetts Department of Transportation	http://www.massdot.state.ma.us/main/main.aspx
Governor’s Office	http://www.mass.gov/?pageID=gov3homepage&L=1&L0=Home&sid=Agov3
Mass. Bay Transportation Authority	http://www.mbtta.com/
Mass. Highway Department	http://www.mhd.state.ma.us/
Mass. Port Authority	http://www.massport.com/default.aspx
Mass. Turnpike Authority	http://www.masspike.com/
Mass. Water Resources Authority	http://www.mwra.state.ma.us/
Office of Technical Assistance	http://www.mass.gov/envir/ota/
Operational Services Division EPP Program	www.mass.gov/epp
University of Massachusetts	http://www.massachusetts.edu/index.html