

*UMass Amherst  
Environmental Performance & Green Initiatives*

**Energy Conservation**

***Physical Plant Energy Conservation Project:*** The Physical Plant is currently managing a \$43 million energy conservation project for the entire campus. The project includes lighting and lighting controls, new chillers, building mechanical improvements, and water conservation measures including low flow toilets. Steam and electric distribution improvements have also been initiated, including building metering. Because each building has a metering system, the results of the energy conservation project can be tracked and verified. Results to date since 2004 include a 24% reduction in steam, 9% reduction in electricity, and 36% reduction in water consumption 2004.

***New Central Heat Plant:*** The Central Heating Plant will use the latest pollution control technologies, including advanced combustion turbine low NOx burners, advanced Selective Catalytic Reduction and Oxidation Catalyst pollution control technologies, and will feature a combined cycle system comprised of 'topping' and 'bottoming' steam turbines, in addition to its combined heat and power process systems. When placed in service early in 2008, it will utilize technologies not commercially available before its construction. The new Central Heating Plant has some of the most stringent air quality permit requirements for a combustion turbine facility of its kind in the United States. Its combined heat and power applications, together with its advanced co-generation systems, will result in the most efficient thermodynamic cycles possible. Its recycling of municipal wastewater plant effluent for boiler make-up water will reduce the demand for process water on the local public drinking water system (fed by groundwater wells) by 200,000 gallons per day.

The Central Heating Plant will be housed in an aesthetically-pleasing 45,000 square foot building. Its power process systems include a 10 mw combustion gas turbine, a heat recovery steam generator, package boilers, various administrative spaces, and auxiliary equipment. The new CHP will produce up to 14.5 million watts of electricity at 13.8 kilovolts for on-campus consumption. A heat recovery steam generator will use the exhaust heat from the gas turbine to produce steam for campus heating year-round. Three package boilers, each rated up to 125,000 pounds per hour steam, will provide additional steam capacity to meet campus demand in the spring, fall, and winter months. Environmental controls include selective catalytic reduction to control the emissions of nitrous oxide, and oxidation catalysts to control carbon monoxide emissions. Two 20-inch main steam transmission lines will connect the plant to the existing campus distribution system near the west end of the campus parking garage.

Two steam turbine generators will further improve the heat rate and energy performance of this facility. The steam turbines will total 4.5 mw and be fed off of 600 psig and 200 psig plant steam headers, exhausting to the campus distribution system at 15 psig.

**Greenhouse Gas Reductions:** The reduction in steam consumption reduces fossil fuel use in the heating plant. Technology designed into the new Central Heating Plant will reduce greenhouse gas emissions further. By 2008, the campus will reduce its emissions of greenhouse gases by 100,000 tons per year compared with 2004. Finally, the ability to generate electricity close to the point of use eliminates carbon emissions associated with power line losses from purchased electricity, reducing emissions from regional power producers.

**UMass Computerized Energy Management System:** Microprocessor Control systems have been set up so that each building on campus is monitored for its minute-by-minute usage of electricity, water, and steam through centralized controls and timers. Using this system, the campus won a Demand Response Management award from ISO New England for reducing its power requirements by 1.5 megawatts in response to a heat wave in the summer of 2006.

**Steam Line System:** UMASS has replaced a significant percentage of steam lines displaying a high infrared heat signature during the past two years. Leaks and inefficiencies of the old steam lines resulted in major economic losses to the campus. The improvements have cut roughly a third off of steam distribution losses, leading to big cost savings as well as more efficient heating systems.

**Energy Conservation Measures:** More than forty individual energy conservation measures have been developed by the campus; some of which are far along in the implementation process. Baseline numbers generated by the building meters (Computerized Energy Management System) help determine the effectiveness and efficiency of the ECMs.

## **Water Conservation**

**Reclaimed Water Treatment Plant (RWTP)** – The RWTP takes the final treated wastewater from the City of Amherst’s wastewater treatment plant, treats the water for use in the boilers, then feeds process water to the University’s Steam Plant. This alternative to using potable town water has resulted in big savings.

The plant was installed at a cost of \$1.8 million and has a rated output of 250 gallons/minute. To commence the disinfected treatment water process, a chlorinated effluent is sent to a sand filter bank then to several final cartridge filters. These cartridge filters remove fine particles. The central feature of the plant, a bank of reverse osmosis (RO) membranes, filters the effluent. Lastly, the treated water is stored in an outside tank until the steam plant can use it. Typically, the steam plant uses the reclaimed water that very same day.

The effluent from the wastewater treatment plant is of better quality than the town water for industrial purposes, which results in the reduction of boiler “blowdowns” by about 10%. This reduction in boiler blow has resulted in roughly a 2% fuel reduction at the steam plant. This water conservation effort is expected to reclaim approximately 9,000,000 cubic feet of water with cost savings of approximately \$300,000 for water and \$100,000 for fuel.

**Low Flow Water Fixtures** - The retrofit of campus toilets, urinals, and faucets targeted both academic buildings and residence halls. Some 3,400 toilets, 771 urinals, and 4,200 faucets have undergone retrofitting. Piping was also modified to comply with standard trade practices. The flush valves on urinals were replaced with flushometer valves, reducing water consumption from 1.5 to 1.0 gallons of water per flush. Lastly, the faucets include tamper resistant flow restrictors and adapters. The total water savings for all retrofits, including toilets, urinals, showers, faucets, and water heating, will average about 10.5 million cubic feet of water annually, with associated cost savings of about \$400,000.

**Replacing or Re-engineering “one time water pass through equipment”** - Walk-in coolers, distillers, sterilizers, and Food Services equipment were re-designed so that reductions in water use would be achieved from process cooling, scientific equipment, and kitchen services. The major changes will be in the steam sterilizer (autoclave) condensate tempering, the replacement of laboratory stills with new reverse osmosis systems, Food Services’ dish machines, garbage disposals, and pass-through water cooled equipment. These alterations will approximately result in about five million cubic feet of water savings as well as 180,875 kWh in energy savings.

**Summary of Savings** - Due to the advanced water treatment product line at the RWTP and the additional water conservation efforts, the University estimated a reduction of potable water consumption of 25 million cubic feet or 187,250,000 gallons. Using fiscal year FY04 as the baseline, the university consumed 59,935,800 cubic feet of water. Potable water consumption in FY 2006 was 38,284,470 cubic feet. The campus realized close to a 36% reduction in potable water consumption, 21 million cubic feet, from FY 04. UMass anticipates it will reach the projected savings as all three projects will be fully operational for FY 2007.

## Renewable Energy

**Knowles Engineering Building - Photo Voltaic Cells:** UMASS’ first Utility Interactive Photovoltaic System is complete. Situated on the roof of the Knowles Engineering Building, the 7.5 kW array uses all Massachusetts-made products: Schott Solar Modules and the PVII3 Inverter made by Solectria Renewables of Lawrence. Twenty-five 300 watt modules have been placed on the western section of the building’s roof.

**Mullins Center Parking (Lot 25) – Photo Voltaic Cell Lighting:** 23 photovoltaic parking lot lamps were installed in Lot 25 to replace 11 existing 250 watt lights. Installation of these lights removed about 14,000 KWHs from the ISO New England grid, saving the University about \$2,400 in energy costs.

## Bio-Fuel

**Fleet Services Bio Diesel** - UMass Fleet Services has used a B20 bio-diesel blend since 2001. It purchases about 44,000 gallons annually (about 9,000 gallons bio-diesel and 35,000 gallons diesel). The B20 blend consists of 20% bio-diesel and 80% regular diesel. Use of B20 can reduce total hydrocarbon content by nearly 20%, carbon monoxide content by 12%, and total particulate matter by up to 12%.

**Utilities Bio Heat Initiative** - The campus is currently participating in a bio-heat pilot program funded by the MA Executive Office of Environmental Affairs. The B3 blend (3% bio-diesel and 97% regular diesel) is being used in all small boilers on the UMass campus, including those at the Belchertown Apple Orchard Complex. Reduced emissions and more efficient combustion are anticipated as benefits. The initiative focused on the 2006-2007 heating season and should consume around 20,000 gallons of B3.

## Recycling and Solid Waste Management

In fiscal year 2006, 4,627 tons of material was removed from the waste stream and recycled or processed for energy recovery, resulting in a 56% recycling rate. Due to the success of the Office of Waste Management’s programs the University avoided \$275,000 in disposal charges.

	2004	2005	2006
Solid Waste and Recycling (Tons)			
Solid Waste Total	3,379	3,486	3577
Recycling Total*	4,016	4,281	4572

\* *Specifics on recycling data can be provided*

In addition, the campus’ Print Services estimates that 60% of the paper it uses is recycled.

## Dining Services

**Seafood Watch** - Dining Services is a partner of Seafood Watch, a program of California’s Monterey Bay Aquarium, which is designed to raise consumer awareness about the importance of buying seafood from sustainable sources. The program recommends which seafood to buy and/or avoid, helping consumers become advocates for environmentally friendly seafood. In September 2006, Dining Services eliminated Atlantic cod from its menu and instead served Pacific cod, haddock, and tilapia. Dining Services reduced the offering of farmed Atlantic salmon, and instead periodically serves wild Alaskan salmon. UMass is the first public university to participate in this program. In addition to switching to more environmentally friendly seafood, Dining Services will also make available guidance material in order to educate the student population about seafood sustainability.

**“Be A Local Hero, Buy Locally Grown” agriculture program** – The Be A Local Hero, Buy Locally Grown program is operated by the non-profit Community Involved in Sustaining Agriculture (CISA). Dining Services has dedicated about \$150,000, or 15%, of its annual produce budget to this effort. The goal of “Be A Local Hero” campaign is to sustain farming by helping consumers find and purchase locally grown products, critical in western Massachusetts as farming has deep historical roots in this region.

## Green Building and Design

***Integrated Science Building*** - UMass Amherst recently broke ground on an Integrated Science Building (ISB) designed to forge a new model for science teaching and research on campus, focusing on the integration of the life, chemical, and physical sciences. The facility is also expected to play a vital role in advancing the work of the Pioneer Valley Life Sciences Institute (PVLISI), a partnership between UMass Amherst and Baystate Medical Center in Springfield. The ISB will provide 155,000 gross square feet of new space.

The design of this facility incorporates many green design concepts and features, including but not limited to the following:

- An enthalpy heat recovery wheel will be installed in each of the four air handling units serving the lab areas. The enthalpy wheel will remove latent heat in the summer and add moisture and sensible heat during the winter. The wheel recovers 50% more heat and moisture than a glycol loop.
- Rain water from the roof area and from the underground foundation drainage system will be piped to an underground 20,000 gallon storage tank. The collected water will be pumped to the chiller plant cooling towers and will be used to supplement the make-up water that is lost to evaporation. The water collected from the roof will reduce the amount of storm water discharged to the campus storm water sewer system.
- Install an “intensive roof garden” over the chiller plant and an “extensive roof garden” over the loading dock. The intensive roof garden will consist of soil depths greater than 6” and less than 42” with a variety of plants including small trees and shrubs. A roof garden can help keep a building cool in the summer and warm in the winter.
- Install low flow fume hoods in the teaching labs, 60 CFM instead of the standard 100 CFM, which will reduce heating, cooling, and fan energy consumption.

For a complete list of green design elements associated with the ISB, contact Jeff Quackenbush at [jquacken@facil.umass.edu](mailto:jquacken@facil.umass.edu).

***Studio Arts Building*** - The Studio Arts Building will bring together a variety of programs and support units currently scattered around the UMass Amherst campus. This new facility will foster a multidisciplinary approach to art, a trend that has been embraced by the Art Department through the development of its curriculum.

The design of this facility incorporates many green design concepts and features including but not limited to the following:

- South facing windows are equipped with louvered sun-shading devices that allow winter sun energy to be brought in to the building, but shade the building from summer heat.
- The contractor will reuse existing pavers located in front of Hills College. Recycling the old pavers will result in reduced costs and minimize the amount of material disposed of at a landfill.
- Landscaping will feature low-maintenance, drought-resistant plant materials.

- The building will employ occupancy sensors and CO<sup>2</sup> sensors to regulate the amount of ventilation air sent to specific spaces, and to turn lights off automatically when rooms are unoccupied.
- Toilet room fixtures will feature hands-free faucets and flush valves, and utilize low gallon per flush toilets and urinals.

For a complete list of green design elements associated with the Studio Arts Building contact Burt Ewart at [bewart@facil.umass.edu](mailto:bewart@facil.umass.edu).

***North Residential Area Apartments*** - In September, 2006, the first new housing on campus since 1971 opened. This housing represents apartment style living and has 859 beds.

Architectural:

- Building Envelope designed to provide a very tight envelope, with insulation on the exterior of the wall and a highly reduced thermal transmittance on the exterior walls. Also, the glazing was all low E, with high SHGC for clear glazing.
- A large portion of the steel framing was recycled material.
- Low emitting materials utilized on project to greatly reduce volatile organic compounds (VOCs) within the building. These included low VOC paints and water-based stains, low emitting carpets with backing that prevents mold and mildew growth.
- Building design includes trash separation and recycling stations throughout the complex.
- Bike racks provided throughout complex to encourage use in lieu of automobile travel.

Mechanical and Electrical:

- Complex energy usage will be 20% to 25% less than a code minimum designed building. This is due to the above very tight envelope, high efficiency lighting and high efficient motors and mechanical equipment and design.
- Air conditioning chiller system uses CFC free refrigerant for less ozone depletion of the earth's atmosphere.
- High energy recovery wheels (30% more efficient than code) used on the 100% outside air ventilation systems for the apartments.
- Variable speed drives for variable flow pumping provides only the amount of heating or cooling water to provide thermal comfort for the complex.
- Ventilation air treated and dehumidified independent of other HVAC systems. This eliminates overcooling and reheat required on the main HVAC systems.
- All HVAC equipment located within mechanical penthouses with ample room of proper maintenance. This greatly increases the equipments average service life.
- Each apartment has two zones of temperature control of its space. One zone in the living room areas and one zone for the bedrooms. This minimizes overheating or overcooling of dissimilar spaces.
- Building Automation System lets occupants know when it is advantageous to ventilate their apartments with natural ventilation via opening windows. This is accomplished via indicator lights at the lobby entrance vestibules of the buildings.

## Transportation

**Hybrid Vehicles** – Currently UMass EHS owns three hybrid vehicles - two Toyota Priuses and one Ford Escape. Each Prius averages about 55 MPG, while the Escape SUV averages 32 MPG.

**Rideshare** - UMass Amherst was recognized by the US EPA for its efforts in reducing single-occupancy commuting. The campus has reduced SOV commuting numbers by 13% since 1999. For its efforts, the campus was the recipient of the Best Workplace for Commuters award from US EPA. The Rideshare program has also initiated an award winning program (recognized by the Association for Commuter Transportation Patriot Chapter/New England) called the Clean Vehicle Permit, which is half price parking for “clean vehicles”.

**University of Massachusetts Transit Services** - University of Massachusetts Transit Services (UMTS) continues to provide superior mass transit to students through on-campus shuttles and through various routes beginning and terminating at the University campus and serving the greater Pioneer Valley. The UMTS teams up with Pioneer Valley Transport Authority to offer mass transit to many corners of this rural area. Last year alone 2.5 million visitors, students, faculty and staff of the University utilized this service. This service helps the University in reducing emissions, directly offsetting emissions from a similar number of vehicle trips had these commuters used their own private vehicles.

UMTS also aids the commuter by maintaining the online **Regional Transportation Information Center**. This informational center allows the commuter to review their route prior to leaving for their commute. The site offers visual access to traffic points and patterns in high traffic areas. These normal choke points can be avoided by choosing alternate routes or choosing to use mass transit on any given day. This site also allows the University commuters and other residents within the Valley to avoid delays and reduces emissions associated with traffic jams and delays.

## Chemical Inventory

UMass Amherst implemented a campus-wide chemical inventory management program in 2005. All chemicals used for research have been inventoried and entered into an online database. This effort realizes the following benefits:

- An on-line real-time chemical inventory system eliminates the need for faculty to conduct an annual manual inventory.
- Maintaining a current inventory reduces the likelihood that an unknown compound may be found in the lab thus reducing the expensive disposal costs for unknown chemicals
- 28% of our waste stream is unused commercial compounds. EHS has cleaned out refrigerators in the past that have multiple partially filled containers (i.e., 6 half filled containers of butyl lithium in one refrigerator). Better management of compounds can eliminate redundant purchases, thereby reducing the amount of chemical in the waste stream.
- Enhances the Chemical Reuse and Exchange program reducing disposal costs and unnecessary purchases.

## **Mercury Reduction**

Under a 2005 grant from the Executive Office of Environmental Affairs, UMass Amherst performed a mercury reduction program. The Mercury Reduction Project had two major accomplishments: (1) it provided education to the campus community regarding mercury and mercury alternatives, and (2) it greatly reduced the presence of mercury in many of our more vulnerable locations such as teaching laboratories. As a result of this project, the University disposed of approximately 1,480 thermometers. Ranging in size, it is estimated that UMA removed approximately 12 pounds of mercury as a result of this project. Approximately 750 thermometers were removed from one large organic chemistry teaching lab alone.

Working with Fisher Scientific and Ertco, the manufacturer of non-mercury thermometers, UMA developed a specialized non-mercury replacement thermometer used in our organic chemistry teaching lab for micro-scale experiments. The thermometer application required a specific temperature range and incremental scale, as well as identical length and circumference to the mercury original. Developed specifically for this project, this new thermometer should be usable in Chemistry teaching labs throughout the country. The availability of a suitable non-mercury alternative should help to drastically reduce the number of mercury thermometers necessary in these types of teaching labs.

The campus is currently undertaking a second mercury reduction initiative through state funding.

## **Environmental Management System**

The Utilities Department and Fleet Services operations both utilize an Environmental Management System (EMS). An EMS is a management tool that provides a framework for how both units address and manage the environmental impacts associated with their respective operations. Roles and responsibilities, training, documentation, records, and auditing among other elements are defined through the EMS process to ensure environmental issues are addressed in a systematic fashion. In addition it provides a mechanism to ensure environmental considerations are incorporated into the day to day decision making process.

## **Green Cleaning**

UMass Amherst uses green products for general cleaning including floors, walls, carpets, doors, desktops, etc. Currently there are no disinfectants that are green approved, so bathrooms cannot be totally green cleaned at this point.

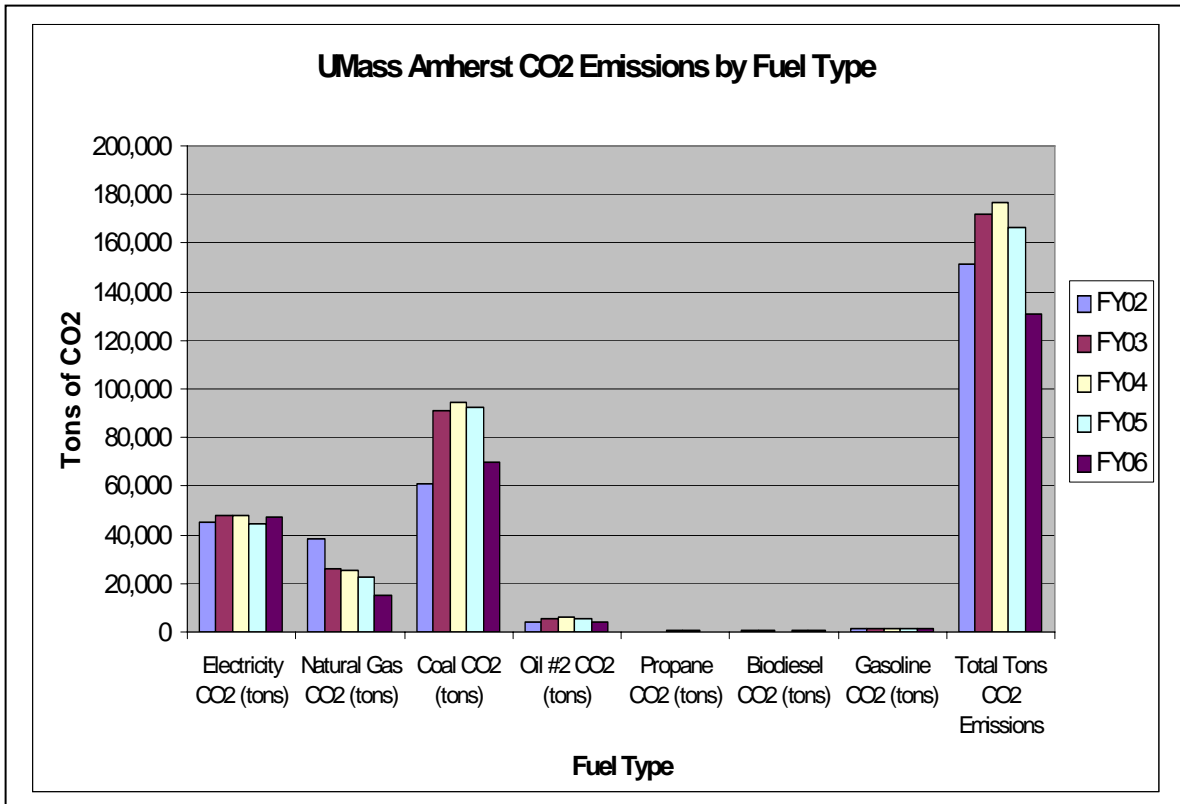
One UMass department, Auxiliary Services, received the OS1 Green Certification for its cleaning program. The certification recognizes organizations that are dedicated to cleaning for health and reducing environmental harm. The achievement of this certification means that Auxiliary Services is actively reducing hazardous chemicals and waste, reusing cleaning materials rather than sending them to the landfill, cleaning safely, and effectively recycling. Auxiliary Services is the first cleaning operation in the State of Massachusetts to achieve this certification.

## Carbon Dioxide (CO<sup>2</sup>) Emissions

The University is required to track fuel consumption and CO<sub>2</sub> emissions as part of the Massachusetts State Sustainability Program which was established in July 2002 by Executive Order No. 438. In cooperation with the Utilities Department EHS compiles data from the various and many emission sources on campus and submits the information to the MA Executive Office of Environmental Affairs on an annual basis.

**CO<sub>2</sub> Data**

FY	Electricity CO <sub>2</sub> (tons)	Natural Gas CO <sub>2</sub> (tons)	Coal CO <sub>2</sub> (tons)	Oil #2 CO <sub>2</sub> (tons)	Propane CO <sub>2</sub> (tons)	Biodiesel CO <sub>2</sub> (tons)	Gasoline CO <sub>2</sub> (tons)	Total Tons CO <sub>2</sub> Emissions	CO <sub>2</sub> Emissions Annual Percent Change	CO <sub>2</sub> Emissions Percent Change from 2002 Baseline
FY02	45,376	38,365	61,042	3,991	296	586	1,359	151,066		
FY03	47,839	25,865	90,952	5,168	227	344	1,381	171,806	13.73%	
FY04	47,939	25,509	94,843	6,355	346	337	1,432	176,762	2.88%	17.01%
FY05	44,437	22,405	92,186	5,360	382	378	1,445	166,594	-5.75%	10.28%
FY06	47,084	15,393	69,839	4,212	324	361	1,358	130,561	-21.60%	-13.60%



**Please note that MA EOE has not verified our emission numbers for FY 06.**